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1220 Pacific Highway, Room 135
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**COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY**

**CLEAN II**

# FINAL WORK PLAN
# PHASE II
# REMEDIAL INVESTIGATION/ FEASIBILITY STUDY
# MCAS EL TORO, CALIFORNIA

**CTO-0059**

Prepared by:

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July 1995

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Date: 7/28/95

# SUMMARY

A Phase II Remedial Investigation/Feasibility Study (RI/FS) will be conducted at the Marine Corps Air Station (MCAS) El Toro, located in Orange County, California. This revised draft was prepared in response to regulatory agency comments on the draft Phase II RI/FS Work Plan (Jacobs Engineering 1993a).

The objective of Phase II RI/FS work is to collect sufficient information at 23 sites to support decision making required to determine risks associated with Installation Restoration Program (IRP) sites and appropriate response actions when IRP sites pose unacceptable risks to human health and the environment.

The information from the proposed Phase II RI/FS at MCAS El Toro will support decisions for selecting the appropriate response action. Possible response actions include:

- Early Action,
- Long-Term Action, and
- No Further Response Action Planned (NFRAP).

This Work Plan presents the rationale for conducting and completing the RI/FS for IRP sites at MCAS El Toro. Currently, there are 25 IRP sites at MCAS El Toro; however, this document specifically discusses the rationale for 23 of these sites. One of the 25 sites is being considered under a separate RI/FS (Site 18 - Regional Groundwater Contamination). The other site (Site 23 - Sewer Lines) was recommended for NFRAP based on the results of a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (Jacobs Engineering 1993b). Though the rationale presented in this document was developed for the remaining 23 sites, the procedures presented for sampling and analyses can be applied to any site that may be added to the IRP.

The Work Plan and its associated plans satisfy the Department of the Navy (DON) policies and have been prepared in accordance with the DON IRP and the Federal Facilities Agreement (FFA).

The purpose of the IRP is to identify, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous materials spills from Navy and Marine Corps activities.

The FFA is a cooperative agreement between the DON, United States Environmental Protection Agency (U.S. EPA), California Environmental Protection Agency (Cal/EPA), and California Regional Water Quality Control Board (RWQCB), Santa Ana Region, which:

- assures environmental impacts are investigated and appropriate response actions are taken to protect public health and the environment;
- establishes a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions;
- facilitates cooperation, exchange of information, and participation of the parties; and
- assures adequate assessment, prompt notification, cooperation, and coordination between federal and state agencies.

The implementation of the FFA is included as one of the responsibilities of the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT consists of representatives from the DON, U.S. EPA, Cal/EPA, and RWQCB, Santa Ana Region. It was established to manage and coordinate environmental restoration and compliance programs related to the closure and disposition of MCAS El Toro by July 1999.

## BACKGROUND AND SETTING

The IRP sites to be addressed in the Phase II RI/FS are those which were determined through a series of efforts begun in 1985 by the Navy to locate and remediate sites contaminated from Navy/Marine Corps activities at MCAS El Toro. The Navy Initial Assessment Study (IAS) report identified 17 sites as potential sources of contamination, based on the results of record searches and employee interviews. In June 1988, the U.S. EPA recommended listing MCAS El Toro on the National Priorities List (NPL) of the Superfund Program due to the presence of volatile organic compound (VOC) contamination at the MCAS El Toro (Station) boundary and the detection of VOCs in the agricultural wells to the west. MCAS El Toro was listed on the NPL in February 1990.

By December 1989, the Navy began preparation of the Phase I RI for 22 sites. These sites were grouped into three operable units (OUs). OU-1 comprises the regional VOC groundwater investigation (Site 18), which was conducted both on and off the Station. OU-2 includes the sites considered to be potential source areas for the regional groundwater VOC contamination: the four landfill sites (Sites 2, 3, 5, and 17) and the Petroleum Disposal Area (Site 10). The remaining 16 sites were grouped together as OU-3, potential sources for a variety of contaminants.

The July 1993 Draft Technical Memorandum documented the results of the Phase I RI (Jacobs Engineering 1993c). The Phase I RI reported a variety of contaminants in the groundwater, soil, surface water, and sediment at MCAS El Toro, consisting primarily of low concentrations of semivolatile organic compounds, petroleum hydrocarbons, pesticides, herbicides, and polychlorinated biphenyls. The Phase I RI Technical Memorandum also concluded that the source of contamination to the regional groundwater was in the southwest quadrant of the Station, but no specific contaminant sources were identified. Two sites (Sites 24 and 25) were added to the IRP as part of OU-2.

Concurrent with the Phase I RI, the Navy conducted an RFA at MCAS El Toro. The final RFA report was submitted in July 1993 (Jacobs Engineering 1993b). Two of the 140 solid waste management units/areas of concern were recommended for further action under the Phase II RI/FS Program being conducted at MCAS El Toro.

The IRP for OU-1 is the highest-priority environmental restoration project at MCAS El Toro because planned development of the Irvine Desalter Project by the Orange County Water District is scheduled to begin operation in late 1996, and would extract groundwater from the Irvine Subbasin for drinking water supplies. To address this priority, an RI and Draft Interim-Action Feasibility Study (IAFS) was conducted for OU-1 in 1994. The Draft IAFS evaluated feasible alternatives to treat VOC-contaminated groundwater in the Irvine Subbasin if it is captured by the Desalter groundwater production wells.

The BRAC Cleanup Plan (BCP) lists 3 OUs (Jacobs Engineering 1994a). OU-1 consists of the regional groundwater contamination (Site 18). OU-2 consists of the landfill sites (Sites 2, 3, 5, and 17), the VOC source area (Site 24), and the major drainages (Site 25). The remaining 18 sites are assigned to OU-3.

## INITIAL EVALUATION FOR PHASE II REMEDIAL INVESTIGATION/FEASIBILITY STUDY

The initial evaluation for the Phase II RI/FS identified existing information on a site-specific basis to prepare the Phase II sampling programs using existing information as a foundation. The initial evaluation of the IRP sites was conducted by reviewing the site history, the summary and conclusions of the Phase I RI, the regulatory agency comments, the list of chemicals of potential concern (COPCs), a conceptual site model of site-specific receptors and pathways, and the identification of potential remedial goals and alternatives.

## WORK PLAN RATIONALE

The Work Plan rationale for the Phase II RI/FS was developed by completing the data quality objectives (DQOs) process and specifying data needs of the DQOs. The appendices to the Work Plan are site-specific DQOs formulated on the following U.S. EPA seven-step DQOs process:

- Step 1 – State the Problem
- Step 2 – Identify the Decisions
- Step 3 – Input to the Decisions
- Step 4 – Define the Study Boundaries
- Step 5 – Decision Rules
- Step 6 – Acceptable Limits on Decision Errors
- Step 7 – Optimize the Sampling Design

Data needs for the DQOs include:

- existing site information;
- lists of wastes or COPCs;
- lists of decisions to be made;
- available sampling designs;
- appropriate laboratory analytical methods;
- establishing the values against which analytical results from Phase II RI/FS are compared during the work so appropriate sampling and risk analyses are completed;
- available field sampling methods;
- information on site boundaries;
- logical decision rules to guide the Phase II RI/FS work;

- methods to evaluate decision errors; and
- an optimized sampling strategy for each site.

This information is compiled in the Work Plan to present a resource-effective sampling and analysis program to complete the MCAS El Toro Phase II RI/FS. RI/FS tasks include project planning, community relations, remedial investigation activities, and the feasibility study. Detailed descriptions of the sampling activities are presented in the Phase II RI/FS Field Sampling Plan.

## SCHEDULE AND PROJECT MANAGEMENT

The Work Plan provides an overview of the Phase II RI/FS schedule and project management. The work is scheduled to start in the summer of 1995 and is tentatively scheduled for completion in 1997. Project management describes the relationships between the Navy and BCT and briefly summarizes responsibilities of those personnel.

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Appendix

# ACRONYMS/ABBREVIATIONS

| | |
|---|---|
| AM | Action Memorandum |
| AOC | area of concern |
| ARAR | applicable or relevant and appropriate requirement |
| | |
| BAT | best available technology |
| bgs | below ground surface |
| BCP | BRAC Cleanup Plan |
| BCT | BRAC Cleanup Team |
| BNI | Bechtel National, Inc. |
| BRAC | Base Realignment and Closure |
| | |
| Cal/EPA | California Environmental Protection Agency |
| CARB | California Air Resources Board |
| CDF | California Department of Forestry |
| CDFG | California Department of Fish and Game |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CERFA | Community Environmental Response Facilitation Act |
| CFEST | Coupled Fluid Energy and Solute Transport |
| CFR | *Code of Federal Regulations* |
| CLEAN | Comprehensive Long-Term Environmental Action Navy |
| CLP | (U.S. EPA) Contract Laboratory Program |
| CNDDB | California Natural Diversity Data Base |
| COC | chain of custody |
| COPC | chemical of potential concern |
| COPEC | chemical of potential ecological concern |
| CPT | cone penetrometer test |
| CTO | Contract Task Order |
| CV | coefficient of variation |
| | |
| DCE | dichloroethene |
| DERP | Defense Environmental Restoration Program |
| Desalter | Irvine Desalter Project |
| DMP | Data Management Plan |
| DoD | Department of Defense |
| DON | Department of the Navy |
| DQO | data quality objective |
| DRMO | Defense Reutilization and Marketing Office |
| | |
| EBS | Environmental Baseline Survey |
| ECD | electron capture detector |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EQL | estimated quantitation limit |

## ACRONYMS/ABBREVIATIONS (continued)

| | |
|---|---|
| ET | El Toro (well) |
| °F | degrees Fahrenheit |
| FFA | Federal Facilities Agreement |
| FID | flame ionization detector |
| FS | Feasibility Study |
| FSP | Field Sampling Plan |
| ft/day | feet per day |
| GC/MS | gas chromatograph/mass spectrometer |
| gpm | gallons per minute |
| GPR | ground-penetrating radar |
| GPS | global positioning system |
| HI | hazard index |
| IAFS | Interim-Action Feasibility Study |
| IAS | Initial Assessment Study |
| ICP | inductively coupled argon plasma |
| IDWMP | Investigation-Derived Waste Management Plan |
| IR | infrared |
| IRP | Installation Restoration Program |
| Irvine Subbasin | Irvine Groundwater Subbasin |
| IRWD | Irvine Ranch Water District |
| JMM | James M. Montgomery Engineers, Incorporated |
| LUFT | (California) Leaking Underground Fuel Tanks |
| MCAS | Marine Corps Air Station |
| MDD | minimal detectable difference |
| MDL | method detection limit |
| MDRD | minimum detectable relative difference |
| MeCl | methylene chloride |
| MODFLOW | Modular Three-Dimensional Finite-Difference Groundwater Flow Model |
| MSL | mean sea level |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NEESA | Naval Energy and Environmental Support Activity |
| NFA | no further action |
| NFI | No Further Investigation |
| NFESC | Naval Facilities Engineering Service Center |
| NFRAP | No Further Response Action Planned |

## ACRONYMS/ABBREVIATIONS (continued)

| | |
|---|---|
| NPL | National Priorities List |
| OCWD | Orange County Water District |
| OU | operable unit |
| PAH | polynuclear aromatic hydrocarbons |
| PCB | polychlorinated biphenyl |
| PCE | perchloroethene (tetrachloroethene) |
| PID | photoionization detector |
| PQL | practical quantitation limits |
| PRG | (U.S. EPA Region IX) Preliminary Remediation Goal |
| PSI | Perimeter Study Investigation |
| QA/QC | quality assurance/quality control |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| RA | remedial action |
| RAOs | remedial action objectives |
| RBC | risk-based concentration |
| RCRA | Resource Conservation and Recovery Act |
| RFA | RCRA Facility Assessment |
| RfD | reference dose |
| RGM | ratio of geometric means |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| RPM | Remedial Project Manager |
| RWQCB | (California) Regional Water Quality Control Board |
| SACM | Superfund Accelerated Cleanup Model |
| SARA | Superfund Amendments and Reauthorization Act |
| SCAQMD | South Coast Air Quality Management District |
| SESOIL | Seasonal Soil Compartment Model |
| Station | MCAS El Toro |
| SVOC | semivolatile organic compound |
| SVE | soil vapor extraction |
| SWDIV | Southwest Division Naval Facilities Engineering Command |
| SWMU | solid waste management unit |
| TCE | trichloroethene |
| TDS | total dissolved solids |
| TIC | The Irvine Company |

# ACRONYMS/ABBREVIATIONS (continued)

| | |
|---|---|
| U.S. EPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| UST | underground storage tank |
| VLEACH | Vadose Zone Leaching Model |
| VOC | volatile organic compound |
| WP | Work Plan |

# SECTION 1

## INTRODUCTION

## Section 1
# INTRODUCTION

A Phase II Remedial Investigation and Feasibility Study (RI/FS) will be conducted at the Marine Corps Air Station (MCAS) El Toro located in Orange County, California (Figure 1-1). This Work Plan (WP) for the Phase II RI/FS has been prepared by Bechtel National, Inc. (BNI), on behalf of the U.S. Department of the Navy (DON), Southwest Division Facilities Engineering Command (SWDIV) in accordance with Contract Task Order (CTO)-0059 issued under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II Program, contract No. N68711-92-D-4670. This revised final Phase II RI/FS WP was prepared in response to regulatory agency comments on the draft Phase II RI/FS WP (Jacobs Engineering 1993a) and a series of meetings held since December 1993.

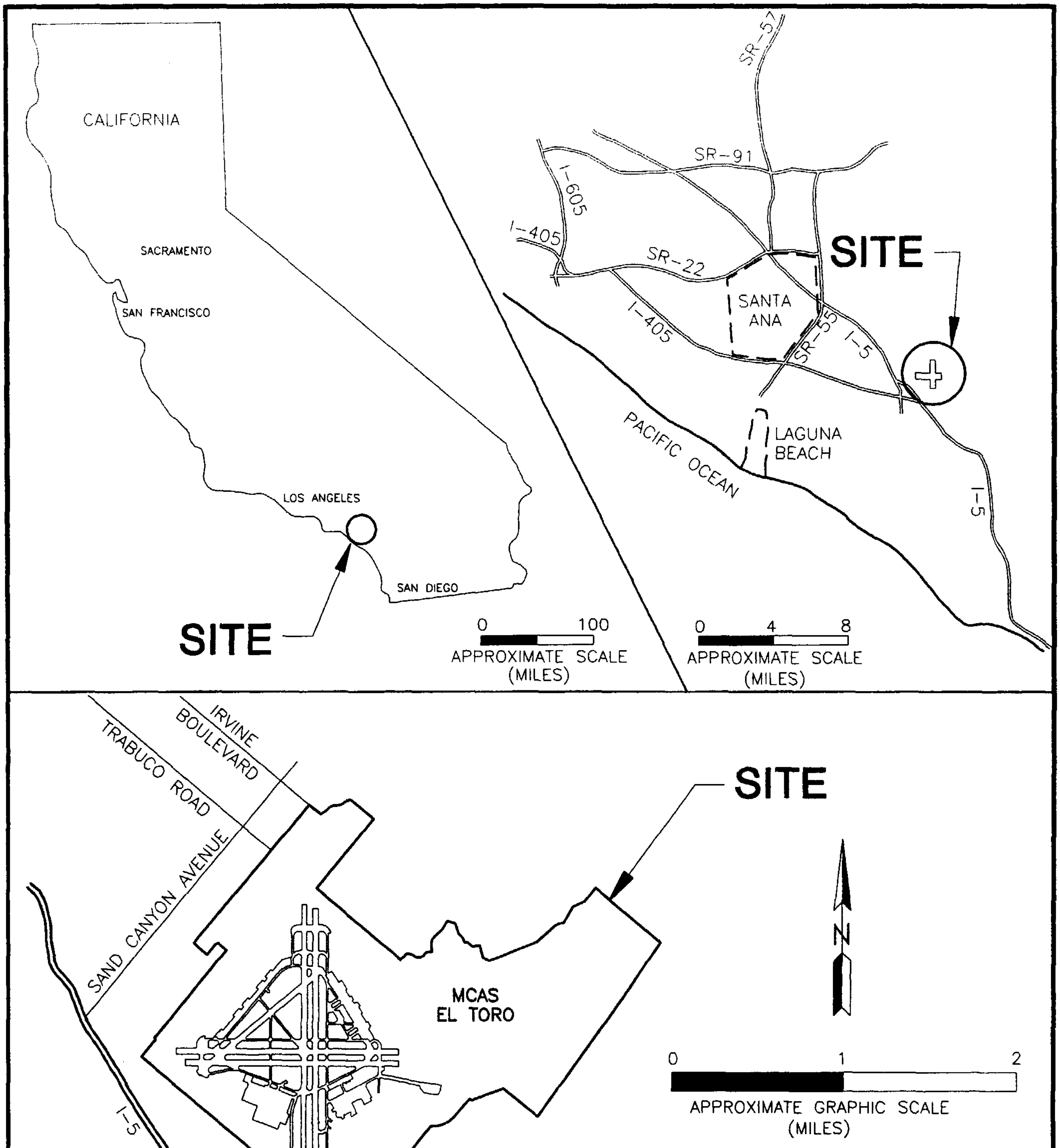
## 1.1 PURPOSE OF PLAN

The purpose of this WP is to present the rationale for activities to be conducted during the Phase II RI/FS at MCAS El Toro. The WP and its associated plans are required to satisfy the DON policies. In particular, this WP is prepared in accordance with the DON Installation Restoration Program (IRP) (DON 1992) and the October 1990 Federal Facilities Agreement (FFA) between the DON, U.S. Environmental Protection Agency (U.S. EPA) – Region IX, California Department of Health Services (now referred to as the California Environmental Protection Agency) (Cal/EPA), and California Regional Water Quality Control Board (RWQCB), Santa Ana Region (FFA 1990).

The purpose of the IRP is to identify, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous materials spills from Navy and Marine Corps activities as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986 (DON 1992). CERCLA and SARA have established a series of programs for the cleanup of hazardous waste disposal and spill sites nationwide. One of these programs, the Defense Environmental Restoration Program (DERP), is codified in SARA Section 211 (10 USC 2701). The IRP is a component of DERP. Guidance to implement the IRP is provided in the IRP Manual (DON 1992), which specifies Navy and Marine Corps personnel responsibilities, a description of the various steps of the IRP, consistency with guidelines, regulations, and criteria associated with CERCLA/SARA, the Navy Environmental and Natural Resources Program Manual (DON 1994), and the Marine Corps Environmental Compliance and Protection Manual (DON 1990).

The FFA is a cooperative agreement between the DON, U.S. EPA, and RWQCB, Santa Ana Region, that:

- assures that environmental impacts are investigated and appropriate response actions are taken to protect public health and the environment;
- establishes a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions;




**Work Plan**

**Figure 1-1**

**Location Map**

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. vicin59r
Job No. 22214-059

- facilitates cooperation, exchange of information, and participation of the parties; and
- assures adequate assessment, prompt notification, cooperation, and coordination between federal and state agencies.

The implementation of the FFA is included as one of the responsibilities of the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT consists of representatives from SWDIV, U.S. EPA, Cal/EPA, and RWQCB. It was established to manage and coordinate environmental restoration and compliance programs related to the closure and disposal of MCAS El Toro by July 1999.

The IRP established a process consisting of several steps to evaluate the conditions of sites where hazardous wastes were known or suspected to be disposed. Figure 1-2 illustrates this process as it applies to sites considered in this WP. This revised draft WP completes the planning process for the RI/FS step of the IRP.

## 1.2 SCOPE OF PHASE II REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK

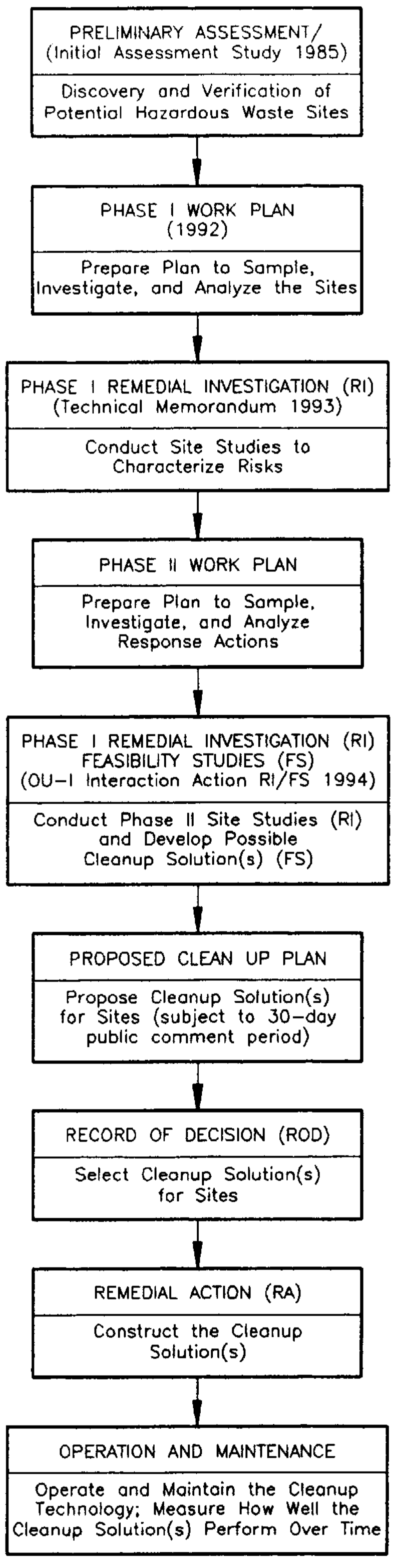
The scope of Phase II RI/FS work is to collect sufficient information to support the required decision-making process to determine risks associated with IRP sites and appropriate response actions when IRP sites pose unacceptable risks to human health and the environment. There are a total of 25 IRP sites that are assigned to three operable units (OUs) at MCAS El Toro. OU-1 encompasses Site 18 (Regional Groundwater). OU-2 is subdivided into OU-2A, OU-28, and OU-2C. OU-2A encompasses Sites 24 and 25. OU-2B encompasses Sites 2 and 17. OU-2C encompasses Sites 3 and 5. Sites in OU-2B and OU-2C are generally referred to as the landfill sites. OU-3 encompasses Sites 1, 4, 6 through 16, and 19 through 23. This WP presents the rationale and procedure for collecting the necessary information at 23 of these IRP sites at MCAS El Toro. Two of the IRP sites (Site 18, Regional Volatile Organic Compound [VOC] Groundwater Contamination and Site 23, Sewer Lines) are not addressed in this WP. Site 18 was evaluated in a separate RI/FS effort (Jacobs Engineering 1994b,c). Site 23 was recommended for no further action (NFA) based on the results of an RFA (Jacobs Engineering 1993b). In addition, Sites 4 and 13 and portions of Sites 7, 8, 11, 15, 19, and 20 have been designated for removal actions. These removal actions will be documented by Engineering Evaluation/Cost Analysis (EE/CA) reports and Action Memorandums (AMs). Table 1-1 presents a summary of the 23 sites, and Figure 1-3 illustrates the locations of these sites on MCAS EL Toro.

Information from the proposed Phase II RI/FS at MCAS El Toro will support decisions for selecting the appropriate response action. Possible response actions include:

- Early Action,
- Long-Term Action, and
- No Further Response Action Planned (NFRAP).

# THE NAVY INSTALLATION RESTORATION (IR) PROGRAM

Each of the following steps have been conducted for each IR site at MCAS El Toro




**Work Plan**

**Figure 1-2**
**IR Program Process**

MCAS El Toro, California

| | |
|---|---|
| CLEAN II Program | Date: 7/11/95<br>File No. inres-wp<br>Job No. 22214-059 |

**Table 1-1**
**Installation Restoration Program Sites**

| Site No. | Site Name | Operable Unit | Planned Action | Site Description |
|---|---|---|---|---|
| 1 | Explosive Ordnance Disposal Range | 3 | RI/FS | This site is normally used for the disposal of small munitions (i.e., flares and small ordnance). Whether undetonated explosives or drums are still present is unknown. Drums containing approximately 2,000 gallons of sulfur trioxide chlorosulfonic acid were disposed in trenches and ruptured with small explosive charges. It is estimated that approximately 75 percent of the compound may have remained after the explosions. |
| 2 | Magazine Road Landfill | 2B | RI/FS | This site was used as a landfill from 1959 until 1991. Reports estimate that approximately 800,000 to 1,000,000 cubic yards of wastes were disposed in the landfill. Wastes consisted of construction debris, municipal waste, batteries, waste oils, hydraulic fluids, paint residues, transformers, and solvents. Methane has been detected within the landfill at levels as high as 45-percent volume according to landfill gas samples. |
| 3 | Original Landfill | 2C | RI/FS | The Original Landfill was used from 1943 to approximately 1965. Estimates of waste burned and buried in the landfill range from 163,500 to 243,000 cubic yards of metals, incinerator ash, solvents, paint residues, hydraulic fluids, engine coolants, construction debris, oily wastes, municipal solid wastes, and various inert solid waste. Chloroform, TCE, and PCE were detected in landfill gas samples. |
| 4 | Ferrocene Spill Area | 3 | Removal Action | Approximately 5 gallons of ferrocene and a hydrocarbon carrier solution were spilled in this area. |
| 5 | Perimeter Road Landfill | 2C | RI/FS | The landfill was in use from 1955 to the late 1960s. Approximately 50,000 to 60,000 cubic yards of wastes were disposed in the landfill, including burnable trash, municipal solid waste, unspecified fuels, oils, solvents, cleaning fluids, scrap metal, paint residues, and other waste materials. |
| 6 | Drop Tank Drainage Area No. 1 | 3 | RI/FS | From 1969 to 1983, aircraft drop tanks were transported to this area, drained of jet fuel, and washed out on the concrete pad. The jet fuel and wash/rinse water drained off the concrete pad onto adjacent area. It is estimated that 1,400 gallons of jet fuel have drained onto the vegetated area. |
| 7 | Drop Tank Drainage Area No. 2 | 3 | Removal Action and RI/FS | Aircraft drop tanks were drained of jet fuel and washed out on the concrete pad from 1969 to 1983. The jet fuel and wash/rinse water drained off the concrete pad onto the adjacent area. Waste lubrication oil from nearby maintenance buildings was also disposed in this area. In addition, portions of this area served as an unpaved parking area. Lubrication oils were applied for dust control. In 1982, 2,000 gallons of jet fuel were accidentally spilled in this area. The fuel and wash water flowed onto soil around the concrete pad. |

(table continues)

Table 1-1 (continued)

| Site No. | Site Name | Operable Unit | Planned Action | Site Description |
|---|---|---|---|---|
| 8 | DRMO Storage Area | 3 | Removal Action and RI/FS | This area has been used since the mid-1970s. The yard is used to store various scrap and salvage materials (i.e., mechanical and electrical components) and containerized liquids of unknown composition. In 1984, PCBs were spilled on soils in the immediate area. Soils were excavated up to 1 foot below grade. |
| 9 | Crash Crew Pit No. 1 | 3 | RI/FS | This area was used from 1965 to 1971. Materials used and ignited during training included jet fuel, aviation gasoline, and other liquid waste. Approximately 123,700 gallons of liquid waste were estimated to have been used during training. |
| 10 | Petroleum Disposal Area | 3 | RI/FS | Approximately 52,000 gallons of waste crankcase oil, antifreeze, hydraulic and transmission fluids, motor oils, and solvents were applied to the ground for dust control. |
| 11 | Transformer Storage Area | 3 | Removal Action and RI/FS | Fifty to 75 electrical transformers were stored in this area from 1965 to 1983. Five transformers leaked, and one spilled an estimated 60 gallons of PCB transformer oil onto the concrete pad. The PCB oil probably ran off the concrete pad into the adjacent ditch and surrounding soils. |
| 12 | Sludge Drying Beds | 3 | RI/FS | From 1943 to 1972, MCAS El Toro operated a secondary wastewater treatment plant. The sludge generated from the wastewater treatment plant was dewatered in this area and subsequently was abandoned in the drying beds and plowed under. Chemicals of potential concern include silver, arsenic, cadmium, copper, mercury, nickel, lead, selenium, and zinc. |
| 13 | Oil Change Area | 3 | Removal Action | It is estimated that about 7,000 gallons of waste crankcase oil were drained directly onto the ground at this site during vehicle maintenance. |
| 14 | Battery Acid Disposal Area | 3 | Removal Action | From 1977 to 1983, an estimated 210 gallons of battery acid were drained onto the soil from vehicles. |
| 15 | Suspended Fuel Tanks | 3 | Removal Action and RI/FS | Between 1979 to 1984, an estimated 500 gallons of diesel fuel leaked from nozzles and hoses of two 500-gallon elevated diesel tanks. |
| 16 | Crash Crew Pit No. 2 | 3 | RI/FS | This area was used from 1972 to 1985. Materials used and ignited during training included jet fuel, leaded aviation gasoline, hydraulic fluid, and crankcase oil. Approximately 275,700 gallons of fluids were estimated to have been used during training. Of this amount, approximately 10 percent (24,700 gallons) may have infiltrated the soil. Small quantities of napalm, white phosphorous, and magnesium phosphate were also burned at the site. |

(table continues)

**Table 1-1** (continued)

| Site No. | Site Name | Operable Unit | Planned Action | Site Description |
|---|---|---|---|---|
| 17 | Communication Station Landfill | 2B | RI/FS | The landfill is reported to have been used from 1981 to 1983; however, there is some evidence that the area may have been used as a landfill as early as 1970 and as late as 1986. Wastes disposed in this landfill include domestic waste and rubble, cooking greases, oils and fuels from sumps, empty drums, and other unknown materials. As much as 36,000 gallons of liquid wastes may have been dumped at this site. |
| 19 | Aircraft Expeditionary Refueling Site | 3 | Removal Action and RI/FS | Six aboveground bladder tanks, each containing 20,000 gallons of jet fuel, were used from 1964 to 1987. In 1986, one tank ruptured, spilling 15,000 gallons of jet fuel. A 300- by 60-foot area was excavated to a depth of 2 feet; the soil is stockpiled at the site. |
| 20 | Hobby Shop | 3 | Removal Action and RI/FS | The area is used by military personnel to service privately owned vehicles. The ground surface around an underground waste oil tank is stained black from oil. A ditch is also stained black by wastewater from the 700-gallon oil/water separators. Until 1976, kerosene was routinely used to wash down the pavement in the area. |
| 21 | Materials Management Group | 3 | RI/FS | The area was used to store drums of contaminated materials. The hazard potential of these contaminated materials was not documented. In 1964, approximately 1,000 drums were stored in the area. By 1986, only 100 to 125 drums were stored in this area. No reported leakages or spills have occurred. |
| 22 | Tactical Air Fuel Dispensing System | 3 | RI/FS | This site has a history of undocumented spills and leakages of jet fuel and other fuels. |
| 24 | Potential Volatile Organic Compound Source Area | 2A | RI/FS | This new site has been established for an expanded groundwater source investigation in the proximity of IR Sites 7, 8, 9, 10, and 22. Phase I RI indicated that one or more sources may exist for the VOCs in groundwater in the vicinity of these sites. |
| 25 | Major Drainages | 2A | RI/FS | Site 25 includes the soil, subsurface soil, and surface water in Agua Chinon Wash, Bee Canyon Wash, Borrego Canyon Wash, and Marshburn Channel. These media and washes were formerly part of Site 18 Regional Groundwater Investigation. |

The WP was prepared in accordance with U.S. EPA guidance (U.S. EPA 1987) and consists of the following sections:

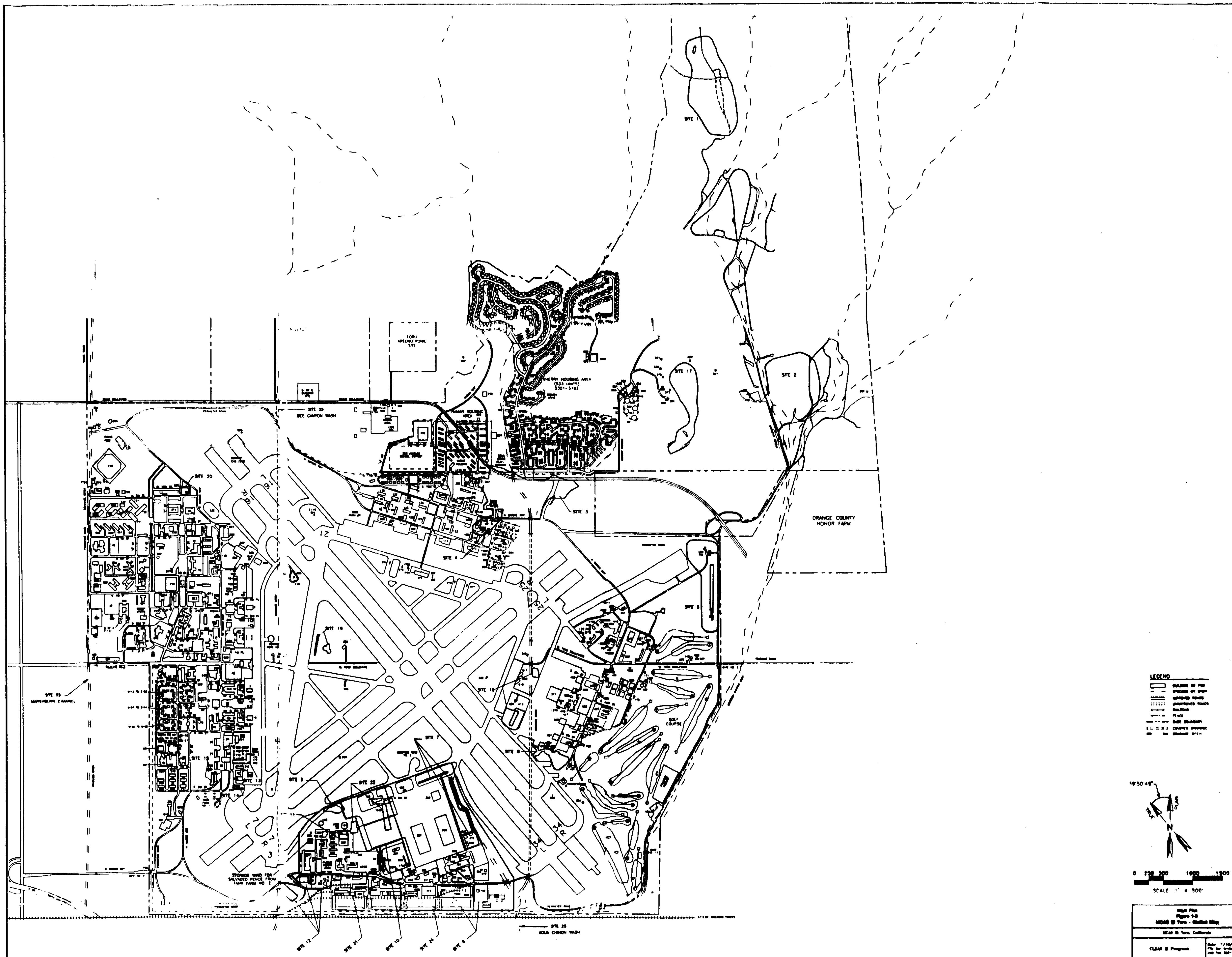
## 1.3 WORK PLAN CONTENTS

The principal sections within the WP and Field Sampling Plan (FSP) present basewide information; the appendices and associated WP documents present site-specific information. Between all plans, there is substantial cross-referencing.

- Section 1 – introduction to the WP;
- Section 2 – background and setting of MCAS El Toro;
- Section 3 – initial evaluation of sites, including previous results, chemicals of potential concern (COPCs), and preliminary remedial alternatives;
- Section 4 – rationale for the Phase II RI/FS efforts;
- Section 5 – description of the Phase II RI/FS tasks;
- Section 6 – schedule;
- Section 7 – description of the Phase II RI/FS project management; and
- Appendices – DQOs for each IRP site.

This WP focuses on the general background and setting of the IRP sites at MCAS El Toro and how the rationale was developed for the Phase II RI/FS activities. The complete WP comprises a set of seven associated documents:

- WP – summarizes general background and presents rationale for Phase II RI/FS efforts;
- FSP – summarizes field methods and analytical techniques to be applied for the Phase II RI/FS (BNI 1995a);
- Quality Assurance Project Plan (QAPP) – summarizes data measurement objectives, sample collection procedures, and data quality management procedures (BNI 1995b);
- Data Management Plan (DMP) – summarizes the procedures for managing data collected during the Phase II RI/FS efforts (BNI 1995c);
- Risk Assessment WP – presents the procedures for assessing risks to human health and the environment (BNI 1995d);
- Investigation-Derived Waste Management Plan – summarizes procedures for handling, storing, and disposing of waste materials generated during the Phase II RI/FS (BNI 1995e); and
- Site-Specific Health and Safety Plan (SHSP) Supplement – summarizes measures to protect site workers health and safety (BNI 1995f).



ORANGE COUNTY HONOR FARM
GOLF COURSE
SITE 2
SITE 3
SITE 4
SITE 7
SITE 8
SITE 9
SITE 12
SITE 13
SITE 16
SITE 17
SITE 18
SITE 19
SITE 20
SITE 21
SITE 22
SITE 24
SITE 25 BEE CANYON WASH
SITE 25 AGUA CHINON WASH
SITE 25 MARSHBURN CHANNEL
STORAGE YARD FOR SALVAGED FENCE FROM TANK FARM NO. 2
LEGEND
0 250 500 1000 1500
SCALE 1" = 500'
CLEAN II Program

# SECTION 2

## BACKGROUND AND SETTING

# Section 2
# BACKGROUND AND SETTING

This section provides general information on MCAS El Toro, including the scope of the Phase II RI/FS activities. The following subsections describe the location, history, and setting of MCAS El Toro.

## 2.1 LOCATION

MCAS El Toro is situated in a semiurban agricultural area in southern California, approximately 8 miles southeast of the city of Santa Ana and 12 miles northeast of the city of Laguna Beach (Figure 1-1). Northwest of MCAS El Toro, the land is used for agricultural purposes. The land to the south and northeast is used mainly for commercial, light industrial, and residential purposes. The closest residential areas are the cities of Lake Forest, Irvine, and Laguna Hills (MCAS El Toro 1991).

## 2.2 HISTORY

The following sections provide a summary of the history, recent Station operations, and previous investigations of MCAS El Toro. This history section was used to develop the scope of work for the Phase II RI/FS.

### 2.2.1 History of MCAS El Toro

In March 1943, MCAS El Toro was commissioned as a Marine Corps pilot fleet operation training facility. In 1950, MCAS El Toro was selected for development as a master jet station and permanent center for Marine Corps aviation on the west coast to support the operations and combat readiness of Pacific Fleet Marine Forces. Since commissioning, MCAS El Toro has been utilized for aviation activities. Other historic Station activities include plating, sewage treatment, and incineration of trash. These activities have generated waste oils, paint residues, hydraulic fluid, used batteries, and other wastes (MCAS El Toro 1991). Since 1985, MCAS El Toro (Station) has taken actions to assess effects of its activities on the surrounding environment and to remediate areas adversely affected by these activities.

### 2.2.2 Recent Station Operations

MCAS El Toro continues to provide materials and support for aviation activities of the U.S. Marine Corps. The Station comprises runways, aircraft maintenance, training facilities, housing, shopping facilities, and other support facilities totaling 4,471 acres. The Station provides housing for 5,250 Marines and 2,000 dependents (as of 1991). Both military personnel and civilians live off-Station but work at MCAS El Toro. The Station is currently undergoing the BRAC process. Some operations have closed, and various parts of the Station are no longer in use. Squadrons have been transferred to other Marine Corps and Naval Air Stations.

Currently, hazardous materials wastes are managed under Resource Conservation and Recovery Act (RCRA) requirements. Hazardous wastes are stored in containers at generator accumulation areas and are held for less than 90 days. The on-Station RCRA Interim-Status Storage Facility holds these wastes until they are released for disposal. MCAS El Toro contracts with waste transporters and treatment, storage, and disposal facilities to transport, recycle, treat, or dispose hazardous wastes. The contracts are established through either the Defense Reutilization and Marketing Office (DRMO) (established in 1973) or through the Environmental Office at MCAS El Toro.

## 2.2.3 Previous Investigations

In 1985, the Navy began work on an Initial Assessment Study (IAS) to locate potentially contaminated sites on the Station. This work was conducted for the Naval Facilities Engineering Command under the Navy Assessment and Control of Installation Pollutants Program, which was the Navy version of the Department of Defense (DoD) IRP at that time. The IAS report identified 17 sites as potential sources of contamination (Brown and Caldwell 1986). The identification of potentially contaminated sites was Based on the results of record searches and employee interviews. The report recommended sampling locations and analytical parameters to confirm the suspected contamination at the 17 sites.

In June 1985, while the IAS was underway, the Orange County Water District (OCWD) discovered trichloroethene (TCE) in an agricultural well (TIC 47) belonging to The Irvine Company (TIC) approximately 3,000 feet west of MCAS El Toro. OCWD subsequently launched an investigation to determine the source and extent of the TCE contamination in this well (TIC 47). After installing a network of monitoring wells and soil vapor probes and reviewing the results of independent investigations, OCWD concluded that MCAS El Toro was the source of the contamination. These OCWD investigations continue to the present (Herndon and Reilly 1989; Herndon 1990).

In 1987, the Marine Corps contracted for a review of the IAS to produce a Site Inspection Plan of Action (SIPOA) (JMM 1988). In July 1987, while the SIPOA study was underway, the RWQCB, Santa Ana Region, issued a cleanup and abatement order to the Marine Corps requiring the Station to initiate a perimeter groundwater VOC investigation and to submit a draft report. The SIPOA released in August 1988 included a recommendation of 19 sites for study and amended the site sampling plans proposed in the IAS report. One site (Site 18) was intended to address the off-Station contaminant plume of VOCs. This SIPOA report served as the basis for the Sampling Analysis Plan for the RI/FS sites.

In 1988, the Marine Corps conducted a Perimeter Study Investigation (PSI) of VOC contamination along the southwestern boundary of the Station (JMM 1989). This study addressed the RWQCB, Santa Ana Region, concerns that the Station was a potential source of the VOC groundwater contamination, which extended approximately 4 miles off-Station. The PSI results also indicated that VOCs were present at the groundwater table near the Station boundary.

As a consequence, an interim groundwater pump-and-treat system was installed near the Station boundary. This system, which began operation in June 1989, could pump and treat approximately 30 gallons per minute (gpm) of groundwater from three extraction wells. VOC-contaminated water is sent to an on-site granular-activated carbon unit for treatment, and the effluent is used to irrigate the Station golf course. TCE and tetrachloroethene (PCE) concentrations in the influent to the treatment system were in the range of 10 to 160 and 25 to 100 parts per billion , respectively.

In May 1988, the Marine Corps submitted Air Solid Waste Assessment Test (SWAT) proposals for the four Station landfills to the South Coast Air Quality Management District (SCAQMD). These four landfills were listed as IR Program sites in 1986. Following SCAQMD approval, the fieldwork was conducted (meteorological and geophysical surveys; and landfill gas, ambient air, and surface gas sampling). Reports were issued in 1991 (Strata 1991). The geophysical surveys using ground-penetrating radar (GRP) were partially successful at defining the landfill perimeters. TCE, PCE, chloroform, and benzene were detected in landfill gas samples in concentrations above the minimum detection limits determined by the California Air Resources Board (CARB). Methylene chloride (MeCl) was also detected in the landfill gases at the Station; the presence of MeCl may be due to inadequate decontamination procedures because the field system blanks were also contaminated with MeCl (Strata 1991, pp. 3-9, 4-7, and 8-6). The ambient air samples collected at the Station landfills contained concentrations of MeCl, trichloroethane (TCA), and PCE near the CARB detection limits. These concentrations, based on upwind and downwind measurements, were not necessarily attributable to emissions from the landfills.

In June 1988, the U.S. EPA recommended listing MCAS El Toro on the National Priorities List (NPL) of the Superfund Program because of the presence of VOC contamination at the Station boundary and the detection of VOCs in the agricultural wells to the west. MCAS El Toro was listed on the NPL in February 1990. An FFA between the U.S. EPA, RWQCB (Santa Ana Region), Cal/EPA, and DON was signed in October 1990 (FFA 1990).

In December 1989, the Navy began to prepare of the Phase I RI WP and associated documents for MCAS El Toro. The Navy reviewed the available reports and other documents pertinent to past disposal practices at the Station. The Navy concluded that 22 sites would be investigated (Jacobs Engineering 1993c). These sites were grouped into three operable units (OUs). OU-1 comprised the regional VOC groundwater investigation (Site 18), which was conducted both on and off the Station. OU-2 includes the sites considered to be potential source areas for the regional groundwater VOC contamination: the four landfill sites (Sites 2, 3, 5, and 17) and the Petroleum Disposal Area (Site 10). The remaining 16 sites were grouped together as OU-3. These sites were considered to be potential sources for a variety of contaminants.

In March 1993, MCAS El Toro was placed on the BRAC III list of military facilities considered for closure. Under the terms of the FFA, Station closure would not affect the

Navy's obligation to conduct the RI/FS and to comply with the other requirements of the FFA (FFA 1990, Section 37, Base Closure).

In July 1993, a Draft Technical Memorandum was submitted that documented the results of the Phase I RI (Jacobs Engineering 1993c). The principal objectives of the Phase I RI were to make an initial determination regarding the existence and risks of contamination at sites in OU-1 (regional groundwater contamination), OU-2 (landfill sites 2, 3, 5, and 17, and the Petroleum Disposal Area, Site 10), and OU-3 (the remaining 16 sites). Three additional sites were added during the Phase I RI.

The Phase I RI detected a variety of contaminants in the groundwater, soil, surface water, and sediment at MCAS El Toro. Contaminants in the soil and sediment consisted primarily of low concentrations of semivolatile organic compounds (SVOCs), petroleum hydrocarbons, pesticides, herbicides, and polychlorinated biphenyls (PCBs) (Jacobs Engineering 1993c). The Phase I RI also concluded that the source of contamination for regional groundwater is in the southwest quadrant of the Station, but no specific sources were identified. The sampling events yielded sufficient information to conduct a preliminary risk assessment of contaminants at the sites for both groundwater and soil contamination. The results of the Phase I RI provided the primary data for the Phase II RI/FS.

Concurrent with the Phase I RI, the Navy conducted a RCRA Facility Assessment (RFA) at MCAS El Toro. The final RFA report was submitted in July 1993 (Jacobs Engineering 1993b). The purpose of the RFA was to evaluate whether an additional 140 sites at MCAS El Toro would require further investigation under the Phase II RI/FS program. Based on an evaluation of the Sampling Visit results, 25 solid waste management units (SWMUs)/areas of concern (AOCs) were recommended for further action. This action included additional subsurface investigation or other activities such as inspection of underground storage tanks (USTs), repair of cracks in concrete-paved areas, and excavation of contaminated soil. Of these 25 SWMUs/AOCs, two were recommended for further action under the Phase II RI/FS Program being conducted at MCAS El Toro.

The first area recommended for further action was SWMU/AOC 194, the Former Incinerator Site, where PCE concentrations exceeded the U.S. EPA Preliminary Remediation Goals (PRGs). This site was included in the Phase II RI/FS by expanding the boundaries at Site 3 (Original Landfill). The second area was SWMU/AOC 300, a spill area. Although SWMUs/AOCs with only petroleum hydrocarbon contamination are generally not considered for inclusion in a CERCLA program, this site was recommended for further action based on the unknown extent of the petroleum contamination. This SWMU/AOC was also included in the Phase II RI/FS by expanding the boundaries of Site 3.

SWMU/AOC 90 is the former sewage treatment plant at the Station. Although it was not recommended for further action in the RFA report, the Phase II RI/FS Program incorporated it into Site 12 (Sludge Drying Beds) because of its relationship to that site (i.e., the sludge came from the sewage treatment plant).

A UST investigation in the Tank 398 area was also conducted at MCAS El Toro. Investigations to assess the extent of subsurface JP-5 jet fuel contamination and to evaluate potential remediation methods have been completed (Stollar and Associates, Inc. 1991; Jacobs Engineering 1992, 1993d,e,f). The project is currently in the preparation phase for the free-product recovery system. Construction is tentatively scheduled for early 1995.

In November 1993, a draft work plan for the Phase II RI/FS was issued (Jacobs Engineering 1993a). This draft work plan presented an approach to conduct the Phase II RI at 23 sites at MCAS El Toro, including additions. The basis for the plan was the results of the Phase I RI and development of DQOs with the BCT. The objectives of the draft Phase II plan was to present a statistically based sampling strategy to numerically establish confidence that inferences made from the data are correct, establish background concentrations of metals in soils and groundwater and, ultimately, collect sufficient information to support decisions on risk management. This work plan for the Phase II RI/FS incorporates into the DQOs several issues that have evolved since the draft work plan was issued, as well as comments from the BCT, including:

- formal recognition of the Superfund Accelerated Cleanup Model (SACM) and Removal Actions;
- acceptance of judgmental samples rather than exclusively statistically collected samples;
- recognition of No Further Investigation (NFI) designation for portions of sites;
- use of the seven-step DQO process;
- use of pilot testing with air sparging, soil vapor extraction, and aquifer testing;
- use of soil gas to evaluate relation of near-surface soil gas hot spots and groundwater contamination;
- use of soil gas to evaluate alternatives at landfills;
- application of DTSC ecological risk assessment guidelines and, in particular, use of predictive modeling to assess ecological risks; and
- emphasis on field analytical methods including immunoassays, mobile laboratories, and portable gas chromatographs , and a confirmation procedure of these field methods by fixed-base laboratories.

The regional VOC groundwater contamination (Site 18) was investigated during the Phase I RI process; however, the source of the contamination was not identified. Based on the Phase I RI, two sites were added to the IR Program as part of OU-2: Sites 24 and 25. A soil gas survey was performed at these sites in June 1994 during which soil gas samples were collected from depths between 5 and 30 feet (Jacobs Engineering 1994d). Fourteen of the 18 VOC soil gas plumes identified in this survey were recommended for further investigation became soil gas concentrations increased with depth. One principal soil gas source area and 12 other possible shallow VOC source areas were identified.

Interviews with active and retired personnel from the Fuel Operations Division and Facility Management Department (currently, the Installations Department) were held in July 1994 at MCAS El Toro (Jacobs Engineering 1994e). The objectives of the meeting were to supplement and confirm information obtained from past interviews and field investigations, to obtain a better understanding of current and historical operations at MCAS El Toro, and to possibly identify new areas of potential environmental concern at MCAS El Toro. Those interviewed had knowledge of operations and procedures for storage and disposal of hazardous materials and waste at MCAS El Toro. The interview panel consisted of regulatory agency personnel, Navy and MCAS El Toro personnel, and CLEAN I personnel.

The subjects covered during the interviews included USTs, aboveground storage tanks, RI/FS investigation sites, tank farms, disposal procedures, disposal areas, and any accidental or unintentional spills or leaks that may have occurred. Much of the information gathered from previous interviews and field investigations was confirmed. The interview panel discussed the types of wastes deposited in each of the landfills, the depth and the boundaries of the landfills, and how the wastes were handled. Other subjects discussed included the types of operations that occurred on the Station and the types of chemicals used in these operations. The interviews revealed that liquids were often poured down storm drains or emptied onto unpaved areas to control dust. Sodium dichromate was also reportedly used in boiler systems as corrosion inhibitors.

The Navy has conducted an RI and Draft Interim-Action Feasibility Study (IAFS) for the regional groundwater contamination designated as OU-1 (Jacobs Engineering 1994b,c). This response action to the VOC contamination in the regional groundwater was addressed by the DON because planned development of the Irvine Desalter Project (Desalter) by the OCWD. This facility is scheduled to begin operation in late 1996, and will extract groundwater at a rate of 5,700 gpm (approximately 8,000 acre-feet of groundwater per year) from the Irvine Groundwater Subbasin (Irvine Subbasin) and treat it to provide potable water to the area. The capture zone of the Desalter wells partially coincides with the area of contamination for OU-1. Also, groundwater modeling indicates that the Desalter well field, in addition to having a major impact on the Irvine Subbasin, will influence groundwater flows at the Station. Based on the detailed analysis presented in the IAFS, several alternatives were considered. The key criteria in alternative selection were:

- on-Station containment of the higher-concentration VOCs detected,
- reduction of VOC concentrations in the principal and shallow aquifers downgradient of the source areas,
- containment of TCE at the downgradient edge of the existing plume,
- safeguarding the proposed local potable water supply provided by on-Station pretreatment to reduce VOCs prior to treatment at the Desalter treatment facility, and
- potential cost savings from treatment capacity for groundwater to be extracted under OU-2.

The interim-action alternative had not been selected as of February 1995.

## 2.3 SETTING

The subsections below contain the following information relating to the setting of MCAS El Toro:

- weather and climate,
- topography and geography,
- land use and demographics,
- biological setting,
- geology,
- hydrogeology, and
- hydrology.

### 2.3.1 Weather and Climate

MCAS El Toro has a Mediterranean climate, characterized by cool, moist winters and warm, dry summers. Early morning fogs are typical in late spring and early summer. Annual precipitation averages 12.2 inches, and most of the rainfall occurs from November through April. Winter temperatures seldom drop below freezing. The mean low temperature is 37 degrees Fahrenheit (°F). Summer temperatures rarely exceed 100°F. Night temperatures are generally cool throughout the year. From March through October, the prevailing wind is from the west and averages 6 knots. From November through February, the prevailing wind is from the east and averages 4 knots. During the late fall and early winter, strong dry gusty offshore winds (known locally as "Santa Ana" winds) are common. Table 2-1 provides average temperatures, precipitation, and wind speeds for MCAS El Toro by month.

### 2.3.2 Topography and Geography

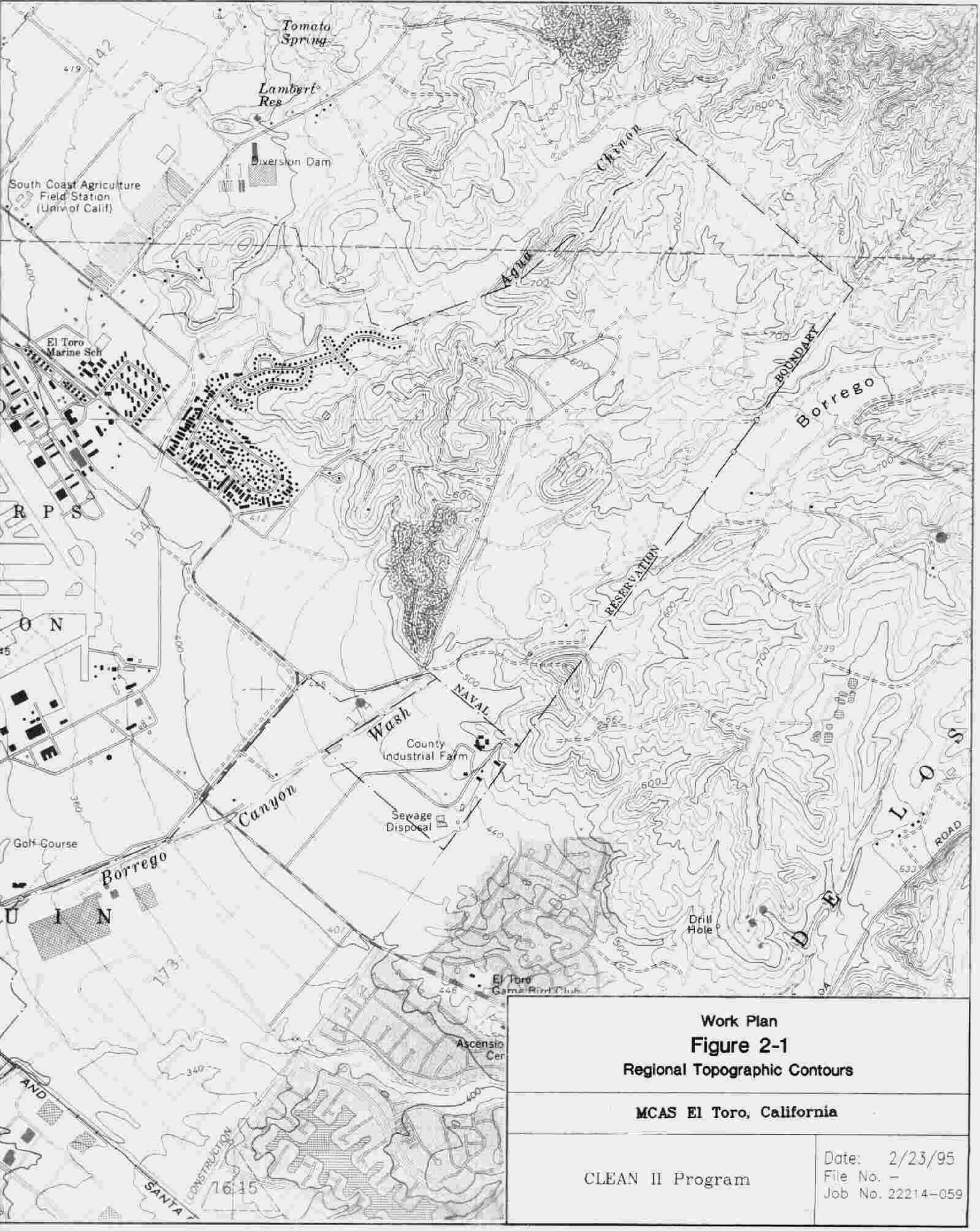
Sloping gently downward to the west-southwest, MCAS El Toro property extends across a broad alluvial valley (Tustin Plain) and into the Santa Ana Mountains. At the west corner of the facility, elevations begin at approximately 215 feet mean sea level (MSL) and rise to approximately 800 feet MSL at the east corner of the Station in the foothills of the Santa Ana Mountains (Figure 2-1). Rising steeply north and east of the Station are the Santa Ana Mountains, whose highest peak (6,698 feet) is approximately 10 miles east of the Station. Ten miles south of the Station is the highest peak of the San Joaquin Hills, which gradually rise to the south. The land northwest of MCAS El Toro is relatively level (Jacobs Engineering 1993b).

**Table 2-1**
**Climate at MCAS El Toro**

| | TEMPERATURE | | | | SURFACE WIND | |
|---|---|---|---|---|---|---|
| **Period** | **Average Low** (°F) | **Average** (°F) | **Average High** (°F) | **Average Precipitation** (inches) | **Most Frequent Direction** | **Average Speed** (knots) |
| January | 45 | 55 | 65 | 2.4 | E | 4 |
| February | 46 | 56 | 66 | 2.1 | E | 4 |
| March | 47 | 57 | 67 | 2.3 | W | 5 |
| April | 49 | 60 | 70 | 1.1 | W | 7 |
| May | 53 | 63 | 72 | 0.2 | W | 6 |
| June | 57 | 67 | 77 | 0.1 | W | 6 |
| July | 61 | 67 | 82 | 0.1 | W | 6 |
| August | 62 | 72 | 83 | trace | W | 6 |
| September | 60 | 71 | 82 | 0.3 | W | 6 |
| October | 56 | 67 | 77 | 0.3 | W | 6 |
| November | 50 | 61 | 71 | 1.5 | E | 4 |
| December | 46 | 56 | 66 | 1.8 | E | 4 |
| Annual Average | 53 | 63 | 73 | | | 5 |
| Annual Total | | | | 12.2 | | |

Source: Jacobs Engineering 1993c


East Irvine
EL TO
MARINE C
AIR STA
SAN JOAQ
JEFFREY
SANTA ANA FREEWAY
IRVINE CORP BDY
SANTA FE
MARINE WAY
SAND CANYON AVE
TRABUCO ROAD
LAGUNA FREEWAY
LAGUNA CANYON
SAN DIEGO
ATCHISON
TOPEKA
AQUEDUCT
Irvine Sch
Trailer Park
Substation
International Raceway
Bee Canyon Wash
Agua Chinon Wash
Laguna Creek
BM 138
BM 195
BM 208
BM 239
BM 188
BM 258
BM 270
BM 161
0
2000
4000
APPROXIMATE GRAPHIC SCALE
(FEET)
SOURCE: U.S.G.S. 7.5 Quadrangle Map (photo revised 1982)




Work Plan

**Figure 2-1**

**Regional Topographic Contours**

**MCAS El Toro, California**

| | |
|---|---|
| CLEAN II Program | Date: 2/23/95<br>File No. –<br>Job No. 22214-059 |

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MCAS El Toro is situated on the southeastern edge of the Tustin Plain, a gently sloping surface of alluvial fan deposits derived mainly from the Santa Ana Mountains. The Tustin Plain, bounded on the north and east by the Santa Ana Mountains and on the south by the San Joaquin Hills, is at the southeast end of the Los Angeles Basin, a large sedimentary basin in the Peninsular Ranges Geologic Province. The Plain also lies in the so-called "Central Block" of the Los Angeles Basin, which is bound on the north by the Whittier Fault zone and on the south by the Newport-Inglewood Fault zone (Jacobs Engineering 1993a).

### 2.3.3 Land Use and Demographics

MCAS El Toro is bordered on the south and west by the city of Irvine and on the north and east by unincorporated lands (Figure 2-2). The Station and some of these unincorporated lands fall within the Irvine "sphere of influence." The city of Irvine controls development in surrounding areas that are suitable for urbanization. However, local jurisdictions do not have authority over federal lands (MCAS El Toro 1991).

MCAS El Toro encompasses about 4,738 acres. Approximately 1,000 acres are designated for outleases because airfield safety clearances render them unsuitable for any other use. The outleased lands are at the corners of the Station and are used for agricultural purposes, including landscape nurseries, livestock grazing, and crop production. Crops grown on-Station include strawberries, winter celery, tomatoes, and avocados (MCAS El Toro 1991).

Land use on MCAS El Toro consists of a few general types of land use. General Station land uses are described in the following four quadrants, as defined by the bisecting north-south and east-west runways:

- the northwest quadrant consists of administrative services (including the MCAS El Toro headquarters, family and bachelor housing, and community support services);
- the northeast quadrant consists of Marine Aircraft Group activities (including training, maintenance, supply and storage, and airfield operations), family housing, community services, and ordnance storage for areas isolated by topographic relief and distance from other developments (MCAS El Toro 1991);
- the southeast quadrant consists of administrative services, maintenance facilities, ordnance storage, and the golf course; and
- the southwest quadrant consists of maintenance facilities, supply and storage facilities, and limited administrative services.

The locations of structures, principal roads, and runways are shown on Figure 1-3. A boundary fence surrounds MCAS El Toro and access is limited to four gates. Only two of the gates are open 24 hours: the Main Gate (off Trabuco Road) and Gate No. 2 (off Irvine Boulevard).

Historically, the land use around MCAS El Toro has been largely agricultural. However, the land to the south, southeast, and southwest has been developed recently for commercial, light industrial, and residential uses (Figure 2-2). Currently, expanding commercial areas are located adjacent to MCAS El Toro (MCAS El Toro 1991). Additional residential areas are located to the northwest and west of the Station. Adjacent land to the northeast and northwest is used for agriculture.

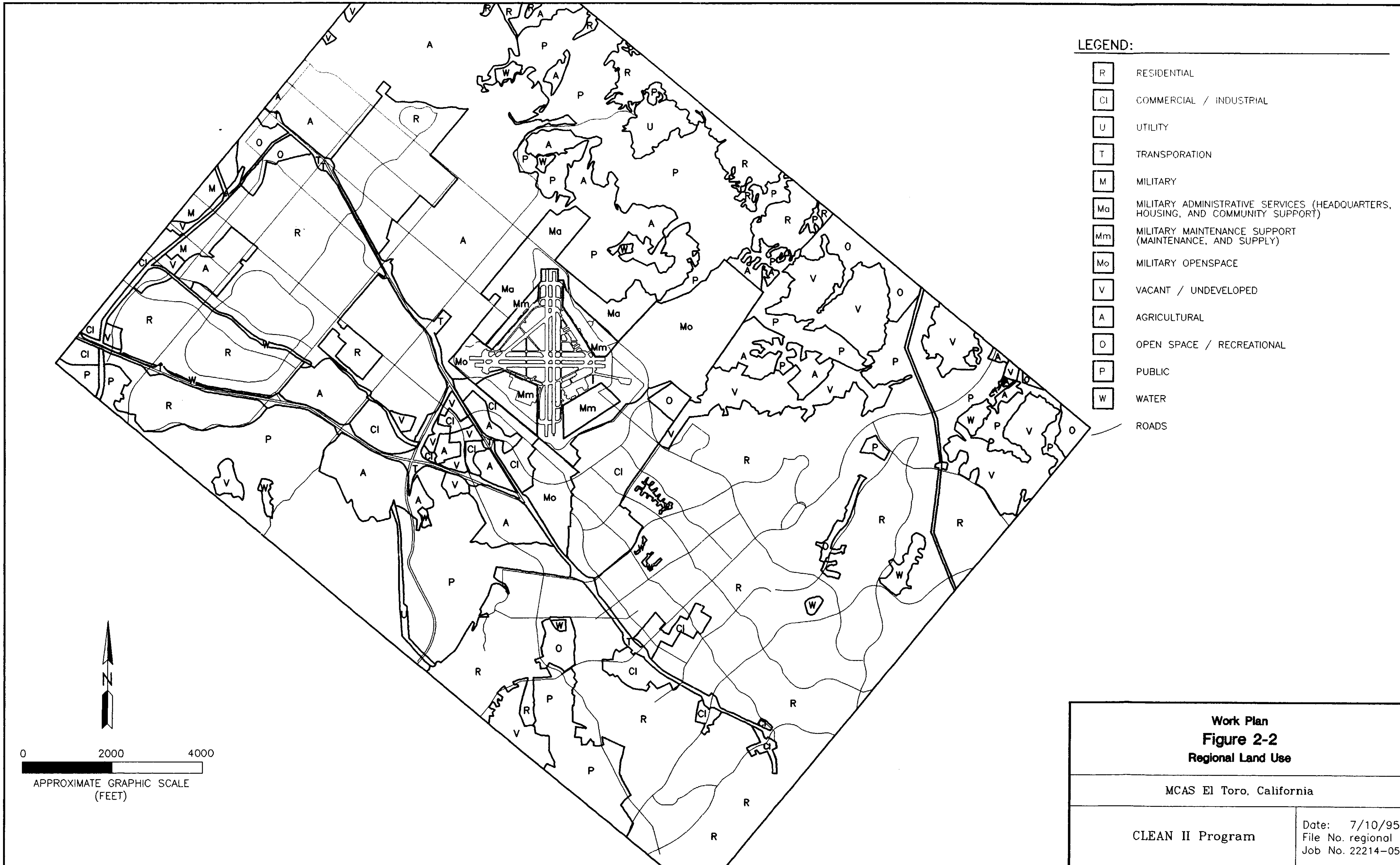
Growth projections through the year 2000 for the area surrounding the Station indicate continued urbanization. The city of Irvine plans to continue both residential and commercial growth, with construction of 8,800 to 13,188 residential units over the next 5 years. Most of the new residences will be constructed in the low-density areas north, northeast, and southwest of MCAS El Toro (City of Irvine 1991).

Housing for military personnel is primarily in the northwest quadrant of the Station near the Main Gate and in the northeast quadrant across from Irvine Boulevard. MCAS El Toro has 1,188 family housing units that serve both officers and enlisted personnel. Bachelor officer and enlisted quarters are in separate complexes within the northwest quadrant, and they house 4,380 personnel. Temporary lodging for newly transferred personnel, also in the northwest quadrant, provides housing for up to 24 families (MCAS El Toro 1991).

The estimated population in the city of Irvine in 1990 was 105,311. Population projections indicate further increases to 118,570 by the year 2000 and 208,220 by the year 2020. Population growth has occurred primarily in the central residential districts within 2 to 3 miles of the Station. The districts with the highest population density are west and northwest of the Station. Medium-density districts are southeast, and low-density districts are north, northeast, and southwest (MCAS El Toro 1991).

## 2.3.4 Ecological Setting

The IAS described the biological features and existing habitats of MCAS El Toro (Brown and Caldwell 1986). Ecological descriptions were based on reconnaissance surveys (May 1992 and September 1993) and a biological inventory conducted by the U.S. Fish and Wildlife Service (USFWS) (Jacobs Engineering 1993c). Ninety percent of the native habitats of MCAS El Toro have been cleared for agriculture, housing, and Station operations. In the remaining 10 percent of the Station, three native habitats predominate: annual grassland (70 percent), coastal sage scrub, and riparian woodland (Brown and Caldwell 1986). Many wildlife species typically include multiple habitat types within their home range. Animal movement between habitat types or between patches of the same habitat type is facilitated by corridors of habitat or cover acceptable to the species. Maintaining corridors of appropriate habitat is a critical factor in enabling animals to find adequate food, water, nesting or denning sites, and breeding opportunities as well as to allow seasonal movement (e.g., between summer and winter ranges).




**Work Plan**

**Figure 2-2**

**Regional Land Use**

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. regional
Job No. 22214-059

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#### 2.3.4.1 ANNUAL GRASSLAND

Several species that have adapted to semidesert conditions are predominant in the annual grassland habitat: bromegrass, wild oat grasses, filaree, and mustards. The species composition is greatly influenced by seasonal and annual fluctuations in weather patterns. Plants found in this habitat may also occur as understory plants in other nearby habitats. Many wildlife species use annual grasslands for foraging, but some species require other special habitat features (e.g., cliffs, ponds, and woody plants) for cover, breeding, and escape. The wildlife typical of this habitat include western toads, Pacific treefrogs, red-tailed hawks, mourning doves, cliff swallows, northern mockingbirds, western meadowlarks, California ground squirrels, southwestern pocket gophers, desert cottontails, and coyotes.

#### 2.3.4.2 COASTAL SAGE SCRUB

Coastal sage scrub habitat is found on dry hillsides and other stable terrain. It is dominated by 3- to 5-foot-tall shrubs with woody bases and shallow roots. Plant species observed in this habitat include California sagebrush, purple sage, black sage, and buckwheat. Common wildlife species are side-blotched lizards, western fence lizards, skunks, turkey vultures, red-tailed hawks, California quail, greater roadrunners, western screech owls, great horned owls, common ravens, rufous-sided towhees, Anna's hummingbirds, house finches, deer mice, cactus mice, Pacific kangaroo rats, California pocket mice, and coyotes.

#### 2.3.4.3 RIPARIAN WOODLAND

Riparian woodland habitat occurs along portions of Borrego Canyon Wash, Bee Canyon Wash, Agua Chinon Wash, and San Diego Creek. This habitat is characterized by willows, cottonwoods, alders, and oaks. The understory includes mostly annual grassland habitat species, wild rose, monkey flowers, hemlock, and (in wetter places) cattail. Common wildlife species are bullfrogs, great blue herons, American coots, American kestrels, black-shouldered kites, ash-throated flycatchers, bushtits, northern flickers, American and lesser goldfinches, orange-crowned warblers, song sparrows, brush rabbits, raccoons, and coyotes.

#### 2.3.4.4 SENSITIVE HABITATS

The following sensitive natural communities were identified by the California Natural Diversity Data Base (CNDDB) as potentially occurring in the Orange County area, including MCAS El Toro (CNDDB 1993):

- southern coast live oak riparian forest,
- southern sycamore alder riparian woodland,
- southern cottonwood willow riparian forest,

- southern riparian scrub, and
- valley needlegrass grassland.

Wetlands are limited to sections of washes on MCAS El Toro and washes and reservoirs in the surrounding areas (Figure 2-3). Identification of these sensitive habitats is currently being conducted in the eastern portion of the Station (Wilson, pers. com. 1994). These habitats are usually associated with one or more special-status wildlife species.

#### 2.3.4.5 SPECIAL-STATUS WILDLIFE

Special-status wildlife species include the following:

- animals listed or proposed for listing as threatened or endangered under the federal Endangered Species Act of 1973;
- animals that are Category 1 or 2 candidates for listing as threatened or endangered under the federal Endangered Species Act. Category 1 candidates are those for which the USFWS has sufficient information to support listing as threatened or endangered. Category 2 candidates are those for which further information is required to determine their appropriate status;
- animals listed or proposed for listing under the California Endangered Species Act;
- animals fully protected in California by the California Department of Fish and Game (CDFG), which prohibits at any time the taking or possession of protected animals or parts thereof;
- animals that meet the definitions of rare or endangered species under the California Environmental Quality Act (CEQA);
- animal "Species of Special Concern" as designated by CDFG; and
- birds protected by the 1972 Migratory Bird Treaty Act.

Table 2-2 contains a list of special-status species known to occur or expected to occur near MCAS El Toro. These species were identified through the Wildlife Habitat Relationships database, the CNDDB, and the biological inventory by USFWS. Table 2-3 identifies the habitat utilization of species known to occur at MCAS El Toro.

### 2.3.5 Geology

This subsection provides a summary of background information on the geology of the MCAS El Toro vicinity and a discussion of the interpreted subsurface geology based on the data derived from the Phase I RI.

#### 2.3.5.1 STRATIGRAPHY

MCAS El Toro is underlain chiefly by Tertiary sedimentary rocks, which are overlain by Quaternary surficial units. Fife (1974) reports that the Cenozoic rocks have a maximum composite exposed thickness of 5,000 feet in the southern half of the El Toro Quadrangle.

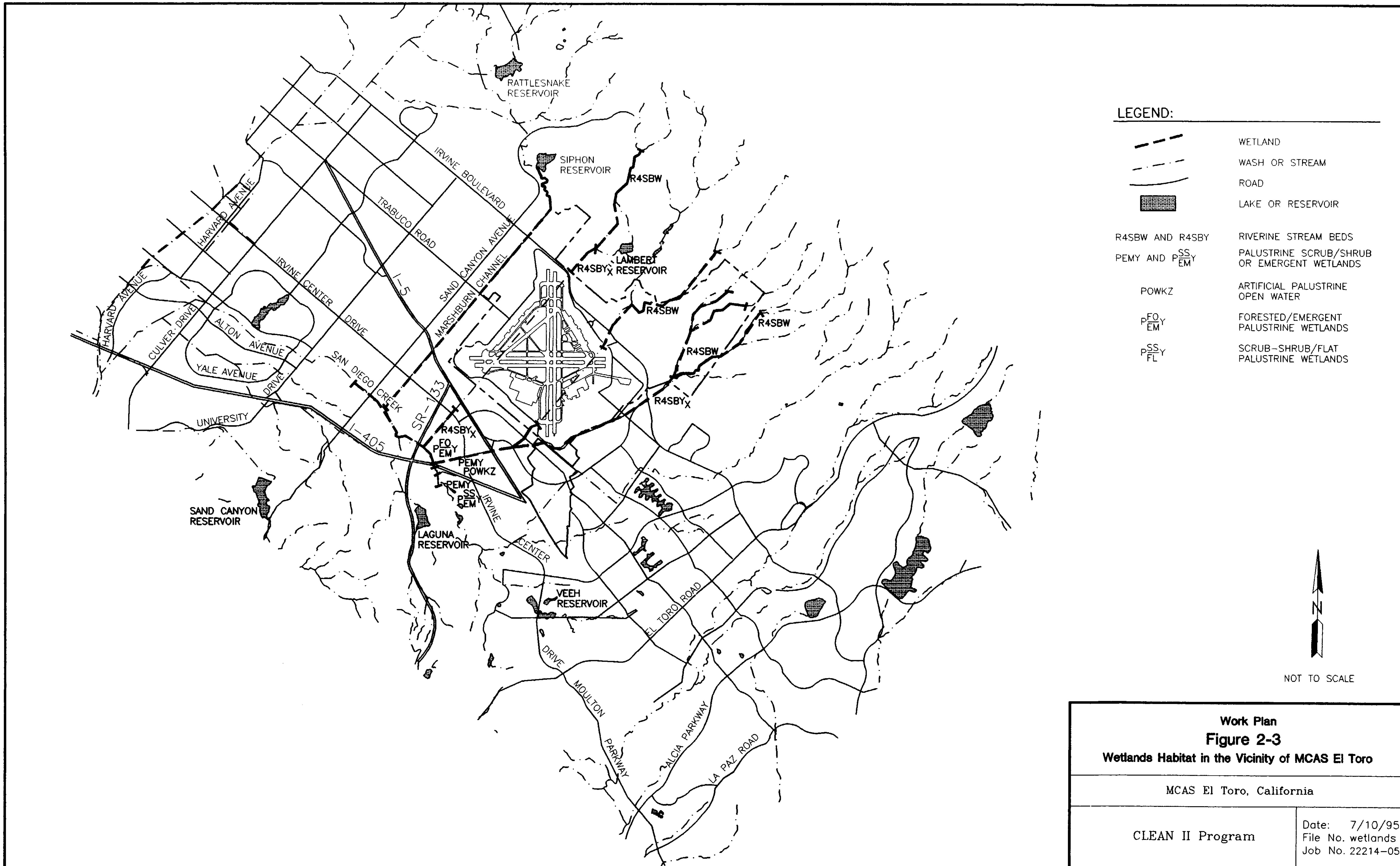
RATTLESNAKE RESERVOIR
SIPHON RESERVOIR
LAMBERT RESERVOIR
R4SBW
R4SBY
IRVINE BOULEVARD
TRABUCO ROAD
SAND CANYON AVENUE
MARSHBURN CHANNEL
I-5
HARVARD AVENUE
CULVER DRIVE
ALTON AVENUE
YALE AVENUE
IRVINE CENTER DRIVE
SAN DIEGO CREEK
SR-133
UNIVERSITY
DRIVE
I-405
PEMY
POWKZ
SAND CANYON RESERVOIR
LAGUNA RESERVOIR
VEEH RESERVOIR
EL TORO ROAD
MOULTON PARKWAY
ALCIA PARKWAY
LA PAZ ROAD
LEGEND:
WETLAND
WASH OR STREAM
ROAD
LAKE OR RESERVOIR
R4SBW AND R4SBY — RIVERINE STREAM BEDS
PEMY AND P SS/EM Y — PALUSTRINE SCRUB/SHRUB OR EMERGENT WETLANDS
POWKZ — ARTIFICIAL PALUSTRINE OPEN WATER
P FO/EM Y — FORESTED/EMERGENT PALUSTRINE WETLANDS
P SS/FL Y — SCRUB-SHRUB/FLAT PALUSTRINE WETLANDS
N
NOT TO SCALE
Work Plan
Figure 2-3
Wetlands Habitat in the Vicinity of MCAS El Toro
MCAS El Toro, California
CLEAN II Program
Date: 7/10/95
File No. wetlands
Job No. 22214-059

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**Table 2-2**
**Special-Status Species Near MCAS El Toro**

| Species | CALIFORNIA Special Concern | CALIFORNIA Fully Protected | FEDERAL Category 1 Candidate | FEDERAL Category 2 Candidate |
|---|---|---|---|---|
| **AMPHIBIANS** | | | | |
| Western Spadefoot | X | | | |
| **REPTILES** | | | | |
| Orange-Throated Whiptail | X | | | X |
| San Diego Horned Lizard | X | | | X |
| **BIRDS** | | | | |
| Belding's Savannah Sparrow* | | X | | X |
| Bell's Sage Sparrow | X | | | X |
| California Black Rail* | X | | X | |
| California Brown Pelican* | | X | X | |
| California Gnatcatcher | X | | | X |
| California Horned Lark | X | | | X |
| California Least Tern* | | X | X | |
| Cooper's Hawk | X | | | |
| Ferruginous Hawk | X | | | X |
| Golden Eagle | X | X | X | |
| Least Bell's Vireo* | | X | X | |
| Light-Footed Clapper Rail* | | X | X | |
| Loggerhead Shrike | X | | | X |
| Northern Harrier | X | | | |
| Prairie Falcon | X | | | |
| San Diego Cactus Wren | X | | | X |
| Sharp-Skinned Hawk | X | | | |
| Tricolored Blackbird | X | | | X |
| **MAMMALS** | | | | |
| Little Pocket Mouse | X | | | X |
| Pallid Bat | X | | | |
| San Diego Black-Tailed Hare | X | | | X |
| San Diego Desert Woodrat | X | | | X |
| San Diego Pocket Mouse | X | | | X |
| Southern Grasshopper Mouse | X | | | X |

* These species are associated with the Upper Newport Bay Ecological Reserve and habitats downstream of MCAS El Toro. They may be affected by drainage from the Borrego Canyon, Bee Canyon, and Agua Chinon Washes.

**Table 2-3**
**Wildlife Known to Occur at MCAS El Toro and Habitat Utilization**

| Species | Special Status | Annual Grassland | Habitat Coastal Sage Scrub | Riparian |
|---|---|---|---|---|
| **AMPHIBIANS** | | | | |
| Bullfrog | | | X | |
| Western Toad | | X | X | |
| **REPTILES** | | | | |
| California Whipsnake | | X | | |
| Coast Horned Lizard | | X | X | |
| Common Kingsnake | | X | X | |
| Gopher Snake | | X | X | |
| Orange-Throated Whiptail | X | | X | |
| Rosy Boa | | | X | |
| San Diego Horned Lizard | X | | X | |
| Side-Blotched Lizard | | X | X | |
| Western Blind Snake | | | X | |
| Western Fence Lizard | | X | X | |
| Western Rattlesnake | | X | X | |
| Western Skink | | | X | |
| **BIRDS** | | | | |
| Anna's Hummingbird | | | X | |
| Ash-Throated Flycatcher | | | X | |
| Bell's Sage Sparrow | X | | X | |
| Black Phoebe | | | | X |
| Black-Chinned Sparrow | | | X | |
| Black-Headed Grosbeak | | | X | |
| Black-Shouldered Kite | | X | | |
| Bushtit | | | | X |
| California Gnatcatcher | X | | X | |
| California Horned Lark | X | X | | |
| California Quail | | X | X | X |
| California Towhee | | | X | |
| Common Barn Owl | | X | X | |
| Common Raven | | | | X |
| Cooper's Hawk | X | X | X | |
| Golden Eagle | X | X | | |
| Grasshopper Sparrow | | X | | |
| Greater Roadrunner | | X | X | |
| Hermit Thrush | | | X | |
| Lark Sparrow | | X | | |

(table continues)

**Table 2-3** (continued)

| Species | Special Status | Annual Grassland | Habitat Coastal Sage Scrub | Riparian |
|---|---|---|---|---|
| **BIRDS (continued)** | | | | |
| Lesser Goldfinch | | | | X |
| Loggerhead Shrike | X | X | X | |
| Mallard | | | X | |
| Mourning Dove | | X | X | |
| Northern Harrier | X | X | | |
| Northern Mockingbird | | X | X | |
| Plain Titmouse | | | | X |
| Red-Shouldered Hawk | | X | | |
| Red-Tailed Hawk | | X | X | X |
| Rufous-Crowned Sparrow | | X | | |
| San Diego Cactus Wren | X | | X | |
| Say's Phoebe | | | X | |
| Turkey Vulture | | X | | |
| Western Meadowlark | | X | X | |
| White-Crowned Sparrow | | | X | |
| **MAMMALS** | | | | |
| Brush Rabbit | | | X | X |
| Cactus Mouse | | | X | |
| California Ground Squirrel | | X | | |
| California Mouse | | | X | |
| California Pocket Mouse | | X | X | |
| California Vole | | X | | |
| Coyote | | X | X | X |
| Deer Mouse | | X | X | |
| Desert Cottontail | | | X | |
| Dusky-Footed Woodrat | | X | | |
| Gray Fox | | | X | |
| Little Pocket Mouse | X | | X | |
| Pacific Kangaroo Rat | | | X | |
| Pallid Bat | X | | X | |
| Raccoon | | | X | |
| San Diego Black-Tailed Hare | X | X | X | |
| San Diego Pocket Mouse | X | | X | |
| Southwestern Pocket Gopher | | | X | X |
| Striped Skunk | | | X | |
| Western Harvest Mouse | | X | | |

Source: Jacobs Engineering 1993c

The rest of the study area consists of Cretaceous sedimentary rocks and slightly metamorphosed Jurassic sedimentary and volcanic rocks. The geologic units are discussed in more detail below, from most recent to older units. Figure 2-4 depicts the outcrop pattern of stratigraphic units described below.

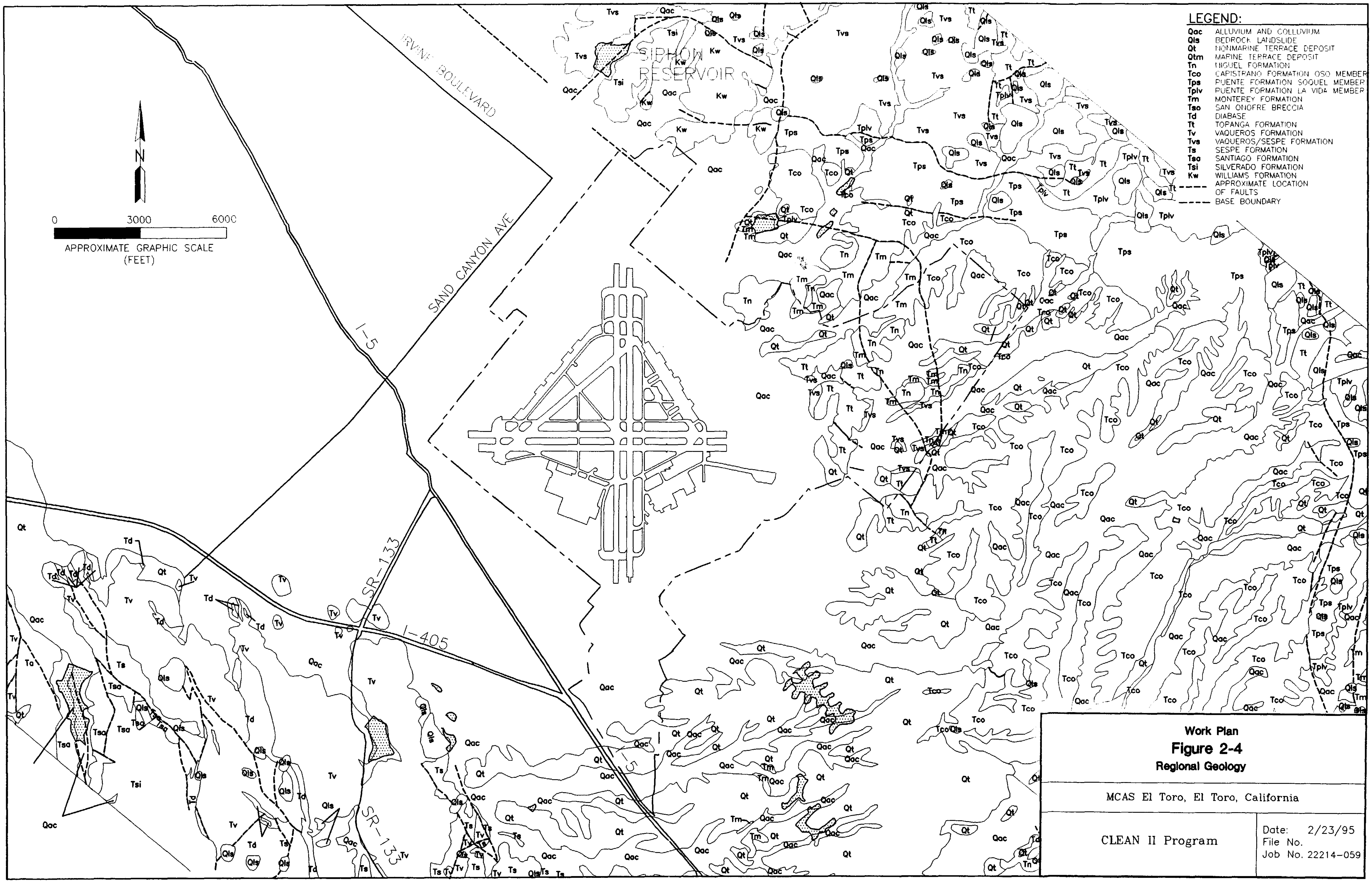
MCAS El Toro lies on alluvial fan deposits derived mainly from the Santa Ana Mountains. These Holocene materials consist of isolated coarse-grained, stream-channel deposits contained within a matrix of fine-grained overbank deposits that range in thickness up to 300 feet (Herndon and Reilly 1989).

The sediments encountered during well drilling for the Phase I RI (on the southeastern portion of Tustin Plain) consist of unconsolidated clays and silts with interbedded sands and gravels. These unconsolidated sediments are typical of alluvial, floodplain, and shallow marine deposits that formed from the poorly consolidated sedimentary formations which underlie the surrounding foothills. Silts and clays predominate in the central and northwestern portion of the Station. Sands are more common near the foothills. The sands are predominantly well graded (poorly sorted), ranging from coarse to fine and commonly containing clay streaks. In a few instances, pelecypods and other shells were brought up with the drill cuttings. Clays exhibit medium plasticity and contain sand.

The Holocene alluvial materials conformably overlie Pleistocene Age sediments predominantly composed of interlayered fine-grained lagoonal and near-shore marine deposits. These materials become increasingly mixed with beach sands, terrace, and stream-channel deposits in the eastern portion of the Tustin Plain and along the plain margins. Thus, the Quaternary deposits form a heterogeneous mixture of silts and clays with interbedded sands and fine gravels that range in thickness up to 500 feet in the western portion of the Tustin Plain (Singer 1973).

The deeper Quaternary sediments may be equivalent to the lower Pleistocene San Pedro Formation, which consists of semiconsolidated silts, clays, and sands with interbedded limestone. These lagoonal and shallow marine deposits are considered to be a major water-bearing unit in the region (Brown and Caldwell 1986).

The Pleistocene deposits unconformably overlie older semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene age; these units make up the Niguel, Fernando, and Capistrano Formations. These semiconsolidated sediments are considered the top of the bedrock near MCAS El Toro. The lower Pliocene Fernando Formation, considered to be the major aquifer in the Irvine area, is the base of the water-bearing units (Herndon and Reilly 1989). This formation probably interfingers with marine clayey and sandy siltstones of the Capistrano and Niguel Formations west of MCAS El Toro. Together these formations range up to 1,500 feet in thickness (JMM 1988).


LEGEND:
Qac ALLUVIUM AND COLLUVIUM
Qls BEDROCK LANDSLIDE
Qt NONMARINE TERRACE DEPOSIT
Qtm MARINE TERRACE DEPOSIT
Tn NIGUEL FORMATION
Tco CAPISTRANO FORMATION OSO MEMBER
Tps PUENTE FORMATION SOQUEL MEMBER
Tplv PUENTE FORMATION LA VIDA MEMBER
Tm MONTEREY FORMATION
Tso SAN ONOFRE BRECCIA
Td DIABASE
Tt TOPANGA FORMATION
Tv VAQUEROS FORMATION
Tvs VAQUEROS/SESPE FORMATION
Ts SESPE FORMATION
Tsa SANTIAGO FORMATION
Tsi SILVERADO FORMATION
Kw WILLIAMS FORMATION
APPROXIMATE LOCATION OF FAULTS
BASE BOUNDARY
N
0
3000
6000
APPROXIMATE GRAPHIC SCALE
(FEET)
SIPHON RESERVOIR
IRVINE BOULEVARD
SAND CANYON AVE
I-5
SR-133
I-405
Work Plan
Figure 2-4
Regional Geology
MCAS El Toro, El Toro, California
CLEAN II Program
Date: 2/23/95
File No.
Job No. 22214-059

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Beneath the semiconsolidated rocks lies a thick sequence of interbedded Paleocene, Eocene, and Miocene marine and nonmarine sedimentary rocks and volcanic rocks of the Puente, Monterey, Topanga, Vaqueros, Sespe, Santiago, and Silverado Formations (Table 2-4). The Vaqueros and Sespe Formations that crop out in the Santa Ana Mountains northeast of MCAS El Toro are not differentiated.

Beneath the Cenozoic rocks are several thousand feet of Cretaceous sandstone, siltstone, and conglomerate of the Williams, Ladd, and Trabuco Formations that are found only in the subsurface (Fife 1974; Yerkes et al. 1965). The Cretaceous units nonconformably overlie a Jurassic basement of crystalline metamorphic and igneous rocks. The Cretaceous units, which crop out in the Santa Ana Mountains, include slightly metamorphosed sedimentary and volcanic rocks of the Bedford Canyon Formation and Santiago Peak Volcanics (Fife 1974).

#### 2.3.5.2 STRUCTURAL GEOLOGY

As discussed earlier, MCAS El Toro is on the Tustin Plain at the southeastern end of the Los Angeles Basin. The Tustin Plain boundaries are discussed in Section 2.3.6. The Los Angeles Basin is characterized by a northwest-trending, doubly plunging synclinal trough, deeper than 30,000 feet. The depression of the Los Angeles Basin began in middle Miocene time.

In the study area, several faults and folds are found on the flanks of the Los Angeles Basin syncline (Table 2-5). Three northwest-trending faults (Shady Canyon, Pelican Hill, and Newport-Inglewood) are less than 10 miles southwest of MCAS El Toro. The Shady Canyon Fault is a normal fault with the west side down.

The Pelican Hill Fault, probably a branch of the Newport-Inglewood Fault, is a right-lateral strike-slip fault (Miller and Tan 1976). Of these faults, only the Newport-Inglewood Fault (also a right-lateral strike-slip fault) is considered active (Holocene movement). The Christianitos Fault, a north-trending high-angle normal fault, is 3 miles east of MCAS El Toro. This fault appears to converge with a system of northwest-trending frontal faults along the southwest side of the Santa Ana Mountains (Fife 1974).

### 2.3.6 Hydrogeology

MCAS El Toro lies within the Irvine Subbasin. The Irvine Subbasin is located southeast and adjacent to the Main Orange County Groundwater Basin (Figure 2-5). The Irvine Subbasin and the main basin underlie the Tustin Plain and Downey Plain (DWR 1967), which are surficial physiographic features. The information on hydrogeology was developed from drilling, installing, and sampling monitoring wells for the IRP and from regional water districts information. The locations of IRP and regional wells are presented on Figure 2-6.

**Table 2-4**
**Stratigraphic Units Near MCAS El Toro**

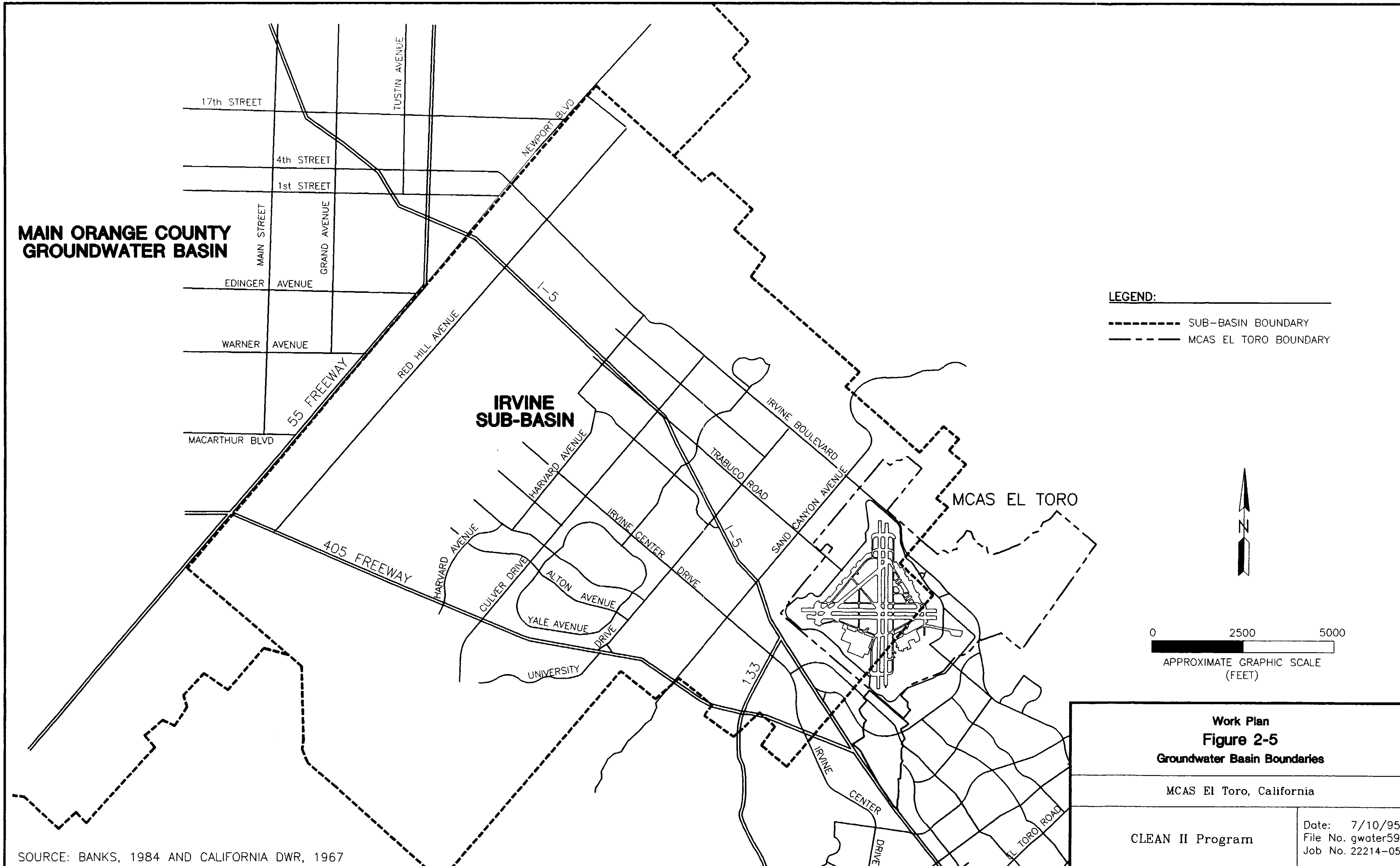
| GEOLOGIC TIME - | | | Formation or Geologic Unit | Approximate Thickness (feet) |
|---|---|---|---|---|
| **Era** | **Period** | **Epoch** | | |
| Cenozoic | Quaternary | Holocene | Alluvial, stream terrace, and beach deposits | Up to 300 |
| | | Pleistocene | Marine terrace deposits and nonmarine fluvial terrace deposits | 0 to 350 |
| | | | San Pedro | Up to 1,000 |
| | Tertiary | Pliocene | Niguel | 350 |
| | | | Fernando | 1,300 |
| | | | Capistrano | 2,400 |
| | | Miocene | Puente | 2,000 |
| | | | Monterey | > 1,500 |
| | | | Topanga | > 1,500 |
| | | | Vaqueros | Up to 3,800 |
| | | Eocene | Sespe | 2,450 |
| | | | Santiago | >775 |
| | | Paleocene | Silverado | 1,875 |
| Mesozoic | Cretaceous | | Williams | 1,500 |
| | | | Ladd | > 1,000 |
| | | | Trabuco | 575 |
| | Jurassic | | Santiago Park Volcanics | 1,500 |
| | | | Bedford Canyon | Unknown |

Source: Jacobs Engineering 1993c

**Table 2-5**
**Faults in the Vicinity of MCAS El Toro**

| Fault | Location (from Station) | Orientation | Type | Movement Direction | Latest Reported Movement |
|---|---|---|---|---|---|
| Shady Canyon | 4 miles SW | NW | Normal | SW down | Pre-Middle Miocene |
| Pelican Hill | 7 miles SW | NW | Strike-Slip | Right-Lateral | Late Pliocene |
| Newport-Inglewood | 10 miles SW | NW | Strike-Slip | Right-Lateral | Holocene |
| Christianitos | 3 miles E | N | Normal | W down | Pliocene |

Source: Jacobs Engineering 1993c




**Work Plan**
**Figure 2-5**
**Groundwater Basin Boundaries**

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. gwater59
Job No. 22214-059

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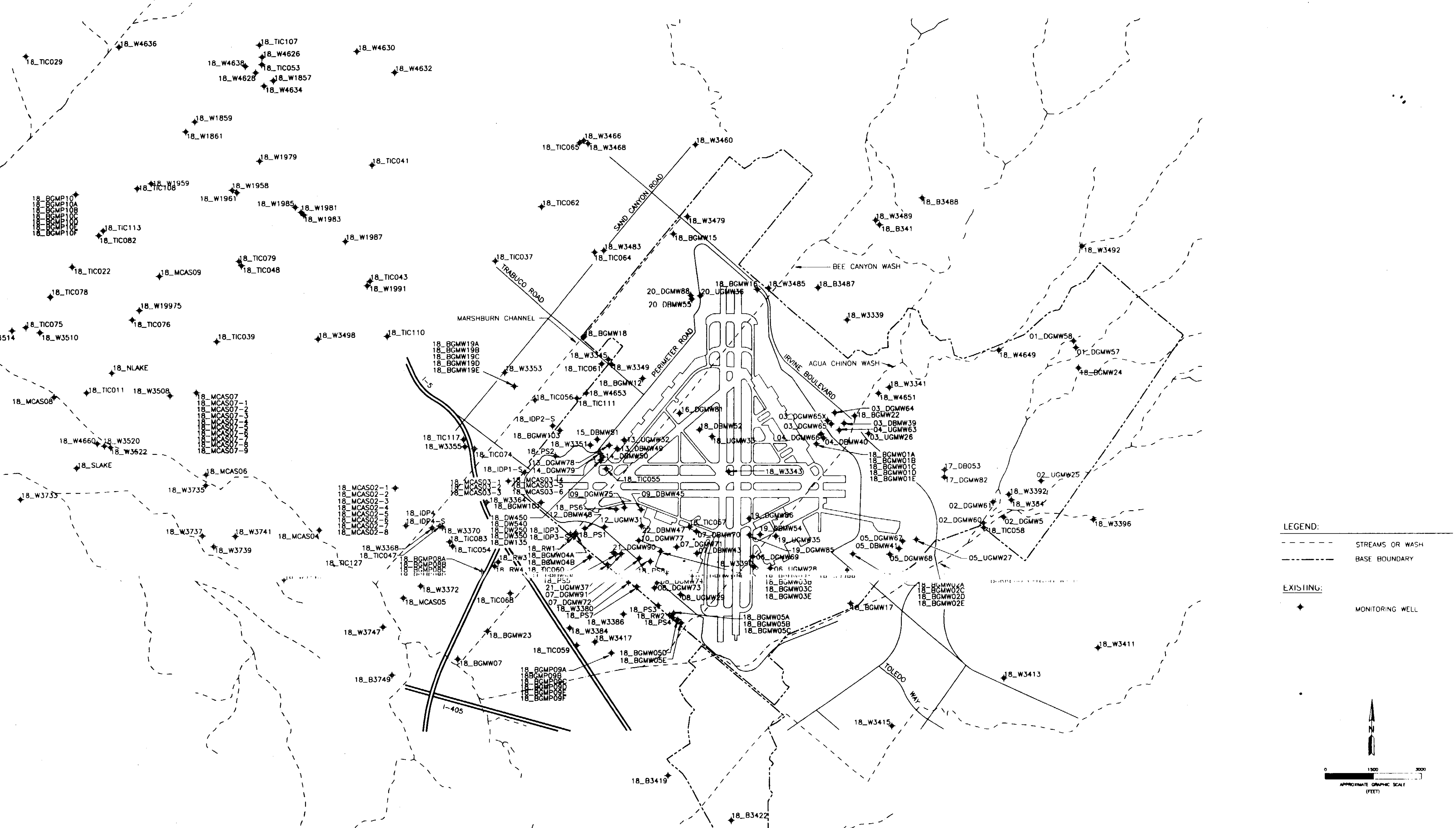


**Work Plan**
**Figure 2-6**
**Location of Wells**

MCAS El Toro, California

CLEAN II Program

Date 7/10/95
File No Wells
Job No 22214 059

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### 2.3.6.1 AQUIFER SYSTEMS

Aquifer zones in the Irvine Subbasin have been described as occasional discontinuous lenses of clayey and silty sands and gravels contained within an assemblage of sandy clays and sandy silts. The sandy lenticular nature of the silts and clays separating the more permeable lenses probably allows groundwater to flow between the aquifer zones. Thus, rather than being separated into identifiable aquifers that may be correlated from place to place, the groundwater has been considered to flow in a single, large-scale heterogeneous system (Herndon and Reilly 1989).

Review of water-level and water-quality data for multiple port monitoring wells and cluster wells suggest hydraulic separation between the shallow, uppermost layer of sediment and the deeper aquifer composed of interbedded fine-grained silts and clays and coarse gravel lenses. An intermediate horizon of finer-grained, lower-permeability material appears to exist between the shallow alluvium and the deeper principal aquifer, causing the hydraulic separation. The degree to which hydrographs of water levels measured in the shallow intervals reflect hydrographs of water levels measured in the deep zone likely depends on two factors: the proximity to the main production center where stresses to piezometric pressure are applied in the deeper portions of the aquifer by production wells, and the characteristics (integrity, composition) of the intermediate unit. In an alluvial setting, the composition and aquifer properties of a particular lithologic unit commonly vary laterally.

Although piezometric pressure profiles of multiple-port monitoring wells indicate hydraulic separation, the presence of TCE in shallow and deep zones downgradient of the source at MCAS El Toro suggests that hydraulic connection occurs. Hydraulic connection between the shallow and deep zone is also indicated by the occurrence of TCE, which may be considered as a tracer for groundwater flow, in both zones. TCE present in groundwater in the Irvine Subbasin may have originated at MCAS El Toro. TCE occurs in groundwater at shallow depths beneath MCAS El Toro. Beyond the southwest boundary, closer to the main pumping area of the basin, TCE is detected at greater depths within the principal aquifer system. Comparison of vertical gradients measured seasonally indicates that this hydraulic communication from the shallow to deeper zones may be enhanced by deep pumping in the central portion of the basin.

For the purposes of this plan, the uppermost sediments, comprising the main hydrogeological units beneath MCAS El Toro, are identified as the shallow zone; the deeper gravel intermediate sediments as the principal aquifer; and the fine-grained intermediate zone that appears to hydraulically separate the two as the horizon of fine-grained materials. Underlying the principal aquifer system are semiconsolidated materials, the contact of which is referred to as the base of the water-bearing zone.

The shallow zone appears to correlate with Holocene alluvial, stream terrace, beach deposits, Pleistocene marine terrace deposits, and nonmarine fluvial terrace deposits. The principal aquifer appears to correlate with the Pleistocene San Pedro Formation. The underlying semiconsolidated materials correlate with the Pliocene Niguel, Fernando, and Capistrano Formations.

The groundwater system beneath 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. Groundwater is thought to occur under unconfined conditions in this area. Recharge to the regional system takes place in the forebay area, primarily along washes that exit the Santa Ana Mountains. The pressure area lies in the central portion of the basin, where sediments are thicker and relatively fine-grained. Productive aquifers in this area are present mainly in deeper zones that become increasingly confined with depth.

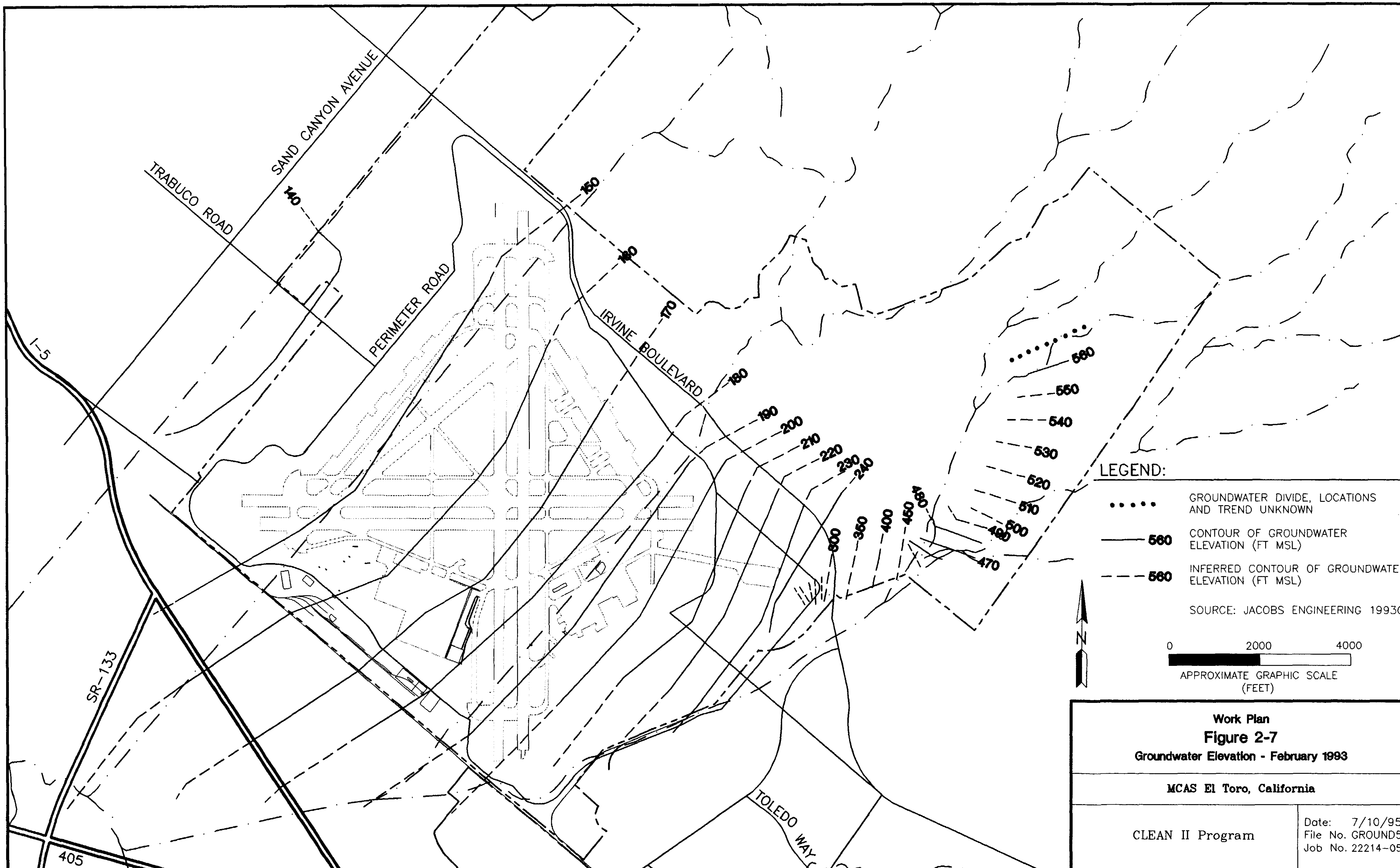
Although the boundary between the forebay and pressure area varies seasonally and yearly according to the amount of groundwater recharge and withdrawal, MCAS El Toro is situated principally in the forebay area (Brown and Caldwell 1986). Thus, geologic materials are relatively coarser than those in the central portion of the basin. Recharge to the regional system may take place as infiltration of surface water along washes and swales and as subsurface inflow along permeable zones. The groundwater discharges through irrigation wells, or it moves westward to the Main Orange County Basin (Banks 1984). During 1989, about 10,000 acre-feet of groundwater were pumped from the Irvine Subbasin, mostly for irrigation during the summer months (Herndon 1990).

### 2.3.6.2 HORIZONTAL FLOW

In 1989, along the southwest perimeter of the facility, the depth to groundwater ranged from 82 to 122 feet below ground surface (bgs) (JMM 1990). Reduced pumping and water imports in the past 20 years have allowed groundwater levels to rise as much as 100 feet. Groundwater within the foothills, where it occurs, is reported to be less than 50 feet bgs (JMM 1988).

Information gathered during Phase I RI drilling shows that depth to groundwater is generally consistent with those given above. Groundwater is shallowest in the foothills, where it is about 45 to 60 feet bgs. In the alluvial basin, groundwater is first encountered at a depth greater than 240 feet bgs on the northeastern portion of MCAS El Toro along Irvine Boulevard (near Sites 3, 4, and 5). The depth decreases to 85 feet bgs along the southwestern boundary (Jacobs Engineering 1993b).

According to 1989 water levels, the direction of flow along the southwest boundary of MCAS El Toro was northwest at a gradient of 0.0066 (JMM 1989). Regional flow has been west and northwest since the 1940s and has been controlled locally by large pumping depressions. In 1988, the regional gradient was calculated to be 0.008 (Herndon and Reilly 1989). From 1969 to 1982, Banks reported an average gradient of 0.0046 to the northwest in the principal aquifer zone in the Irvine area (Banks 1984). Phase I RI data indicate that regional groundwater flow is still toward the northwest with an average groundwater gradient of about 0.008. This is consistent with regional water-level maps prepared by OCWD. Figure 2-7 presents the groundwater elevation contour map for the period of February 1993.




**Work Plan**

**Figure 2-7**

**Groundwater Elevation - February 1993**

**MCAS El Toro, California**

CLEAN II Program

Date: 7/10/95
File No. GROUND59
Job No. 22214-059

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### 2.3.6.3 VERTICAL FLOW

Review of water-level information for multiple-port monitoring wells and cluster wells throughout the Irvine Subbasin suggests some hydraulic separation may exist between the shallower and deeper portions of the regional groundwater aquifer. In general, deep-screened zones in wells located near pumping centers in the main portion of the Irvine Subbasin appear to exhibit seasonal fluctuations in piezometric pressure more strongly than shallow-screened intervals in the same wells. A "step-change" in water levels is observed when hydrographs are compared for shallow-screened intervals and deep-screened intervals. The difference in seasonal behavior of the water levels measured in the shallow versus deep zones suggests an intermediate zone of separation that hydraulically isolates shallow pressures, to a varying extent, from the stresses of pumping from deep-screened production wells.

### 2.3.6.4 AVERAGE LINEAR GROUNDWATER-FLOW VELOCITIES

The average linear groundwater-flow velocities in the uppermost aquifer across MCAS El Toro are in the range of 0.02 to 1.9 feet per day (ft/day) (Table 2-6).

Average linear groundwater-flow velocities in localized areas in the deeper coarse-grained portion of the aquifer that supplies groundwater to production wells are likely to be higher than the average linear groundwater-flow velocity in the uppermost aquifer. An average linear groundwater-flow velocity of 1.5 ft/day was calculated based on the hydraulic conductivity of 56.8 ft/day (estimated from a 24-hour pumping test completed by OCWD), an average hydraulic gradient of 0.008, and an aquifer porosity of 0.3.

Aquifer tests in monitoring wells installed on and near MCAS El Toro generated hydraulic conductivity estimates of 2.2 to 36 ft/day, with an average of 30 ft/day determined in a 72-hour aquifer test (JMM 1990). A 72-hour test performed by OCWD in the basin west of the Station found the hydraulic conductivity to be 21 ft/day. The average linear groundwater-flow velocity was estimated to be 0.7 to 4 ft/day (Herndon and Reilly 1989).

In general, transmissivities of Irvine area aquifers are lower than those of Main Basin aquifers. Aquifer transmissivities range up to 13,000 ft/day in the Irvine Subbasin and from 8,000 to 40,000 ft/day in the Main Basin. Aquifer storage coefficients in the confined area range from 0.0005 to 0.0563. Specific yields of unconfined aquifers in the forebay area range from 0.036 to 0.2 (3.6 to 20 percent) (Jacobs Engineering 1993d).

Pumping tests and slug tests performed during Phase I estimated hydraulic conductivity from 0.3 to 65 ft/day. These values are comparable to, but have a larger range than, the previous tests conducted (OCWD 1993; JMM 1990).

Three storage coefficients were estimated from the Phase I tests: 0.013 for shallow groundwater at Wells 5D and 5E, 0.00078 at Wells 5B and RW-2, and 0.00063 at Wells IDP and 103 for deeper groundwater.

**Table 2-6**
**Calculated Average Linear Groundwater Flow Velocities**

| Site Number | Site Name | Hydraulic Conductivity (feet/day) | Groundwater Gradient (feet/feet) | Average Linear Velocity (feet/day) |
|---|---|---|---|---|
| 1 | Explosive Ordnance Disposal Range | 1.2 | 0.05 | 0.2 |
| 2 | Magazine Road Landfill | 0.38 to 4.7 | 0.01 to 0.04 | 0.1 to 0.6 |
| 3 | Original Landfill | 1.9 to 10.3 | 0.008 | 0.05 to 0.3 |
| 4 | Ferrocene Spill Area | 4.0 to 11.3 | 0.008 | 0.1 to 0.3 |
| 5 | Perimeter Road Landfill | 3.4 to 44.1 | 0.013 | 0.15 to 1.9 |
| 6 | Drop Tank Drainage Area 1 | 1.1 | 0.009 | 0.03 |
| 7 | Drop Tank Drainage Area 2 | 2.0 to 8.1 | 0.007 | 0.05 to 0.2 |
| 8 | DRMO Storage Yard | 0.18 to 23.1 | 0.009 | 0.005 to 0.7 |
| 9 | Crash Crew Pit 1 | 65.1 | 0.007 | 1.5 |
| 10 | Petroleum Disposal Area | 42.4 | 0.007 | 1 |
| 12 | Sludge Drying Beds | 4.3 to 9.7 | 0.007 | 0.1 to 0.2 |
| 13 | Oil Change Area | 1.1 to 21.4 | 0.008 | 0.03 to 0.6 |
| 15 | Suspended Fuel Tanks | 0.52 | 0.008 | 0.01 |
| 16 | Crash Crew Pit 2 | 0.03 to 0.52 | 0.0045 | 0.0005 to 0.008 |
| 19 | Aircraft Expeditionary Refueling Site | 0.37 to 0.86 | 0.009 | 0.02 to 0.04 |
| 20 | Hobby Shop | 0.29 to 19.6 | 0.003 | 0.003 to 0.2 |
| 21 | Materials Management Group | 10.6 | 0.007 | 0.25 |
| 22 | Tactical Air Fuel Dispensing System | 7.1 | 0.007 | 0.02 |

Source: Jacobs Engineering 1993b

Phase I RI test results also suggest that the fine-grained confining units are leaky. Vertical movement of water through units of lower permeability can be a major source of water to wells in aquifers consisting of alternating layers of coarse-grained and fine-grained sediments. A leakage factor of 0.1 was estimated for the only shallow-zone test (Wells 5D/5E), and leakage factors of 0.1 and 0.05 were determined from the two tests of deeper zones (Wells 5B/RW-2 and Wells IDP1/103, respectively).

## 2.3.6.5 WATER QUALITY

In addition to the VOC contamination described earlier, other contaminants have been associated with the historical degradation of shallow groundwater quality in the Irvine area. Increases in the levels of total dissolved solids (TDS), selenium, and nitrates in the groundwater have been related to agricultural activities and incursions of lower-quality water from the margins of the Irvine Subbasin under the influence of pumping wells. The largest area of groundwater not affected by this contamination lies in deeper zones in the central pressure area of the Irvine Subbasin (Banks 1984).

### *Inorganic Chemistry*

Investigations by OCWD northwest of MCAS El Toro have also revealed the presence of three hydrochemical facies in groundwater related to depth in the aquifer. The first facies, characteristic of shallow groundwater no deeper than 200 feet bgs, contains relatively high levels of TDS and nitrate, and it is dominated by calcium and sulfate ions.

The second facies, characteristic of groundwater between 200 and 450 feet bgs, contains lower levels of TDS and nitrate, and it is dominated by sodium, calcium, and bicarbonate ions. This is the zone in which VOC contamination has occurred. The third facies occurs in the lower hydrogeologic system at depths greater than 450 feet bgs, and it contains relatively high levels of TDS and relatively low levels of nitrate. It is dominated by sodium and sulfate ions (Herndon and Reilly 1989). Preliminary work performed at MCAS El Toro has generally confirmed these findings (JMM 1990). Phase I data indicated results consistent with the OCWD hydrochemical facies interpretations.

### *Organic Chemistry*

Phase I RI hydrogeologic data, including piezometric head, water-quality chemistry, and contaminant chemistry data, suggest that the on-Station groundwater VOC contamination occurs predominantly in the shallow groundwater hydrogeologic unit. Figure 2-8 illustrates the primary VOC contaminant (1,1,1-TCE) distribution in regional groundwater. The shallow groundwater unit consists of low-permeability interbedded silts, fine sands, and clays. The underlying principal aquifer unit consists of interbedded silts, sands, gravels, and clays of significantly higher permeability. The principal aquifer unit is the primary source of groundwater pumped by nearby agricultural wells.

Vertical hydraulic gradients from the shallow groundwater unit to the principal aquifer vary in response to extraction from deep production wells located off-Station in the central portion of the Irvine Subbasin. During months of large groundwater extraction from these production wells, downward vertical gradients are enhanced from the shallow zone to the deeper principal aquifer. Existing data suggest the on-Station TCE contamination migrates with advected groundwater into the deeper principal aquifer in response to the downward vertical gradient imposed by deep production wells located off-Station.

The Phase I RI Technical Memorandum presented the concentration contour maps for some important detected VOCs (Jacobs Engineering 1993c). The VOCs listed below are considered as COPCs for OU-1 (Site 18 - Regional Groundwater Contamination) and include TCE, PCE, 1,2-dichloroethene (DCE), 1,1-DCE, carbon tetrachloride, and benzene.

***Current Uses***

Groundwater in the vicinity of the site is used primarily for agriculture. Wells producing irrigation water are TIC-55, TIC-107, TIC-108, TIC-111, and TIC-113 (northwest of MCAS El Toro) and Wells TIC-47, TIC-78, and El Toro (ET)-1 (west of MCAS El Toro) (OCWD 1993).

Potable water is supplied by the Irvine Ranch Water District (IRWD), which receives its water from the Metropolitan Water District. Up to 70 percent of this water is imported from various sources, and the remainder comes from local resources (including groundwater).

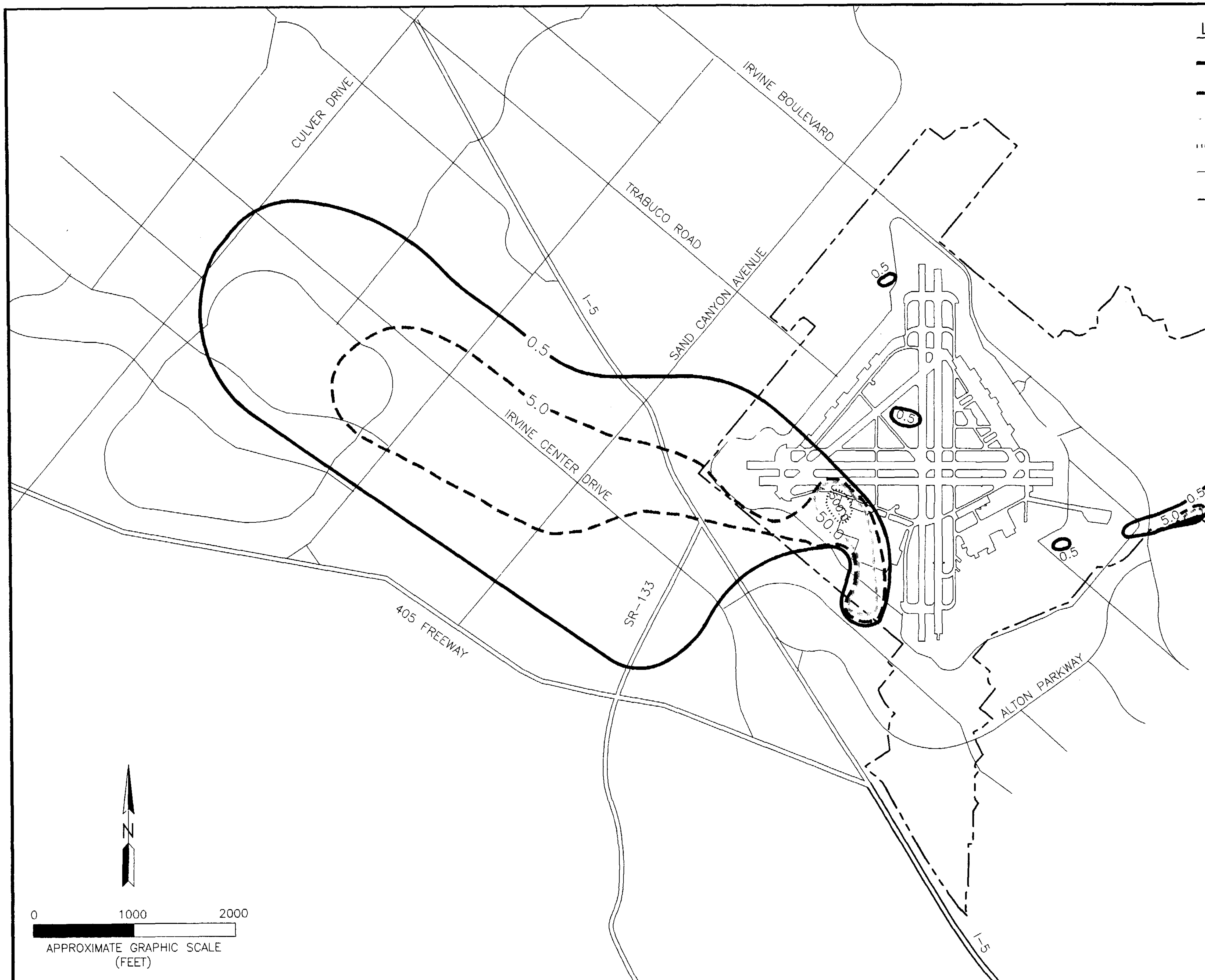
Water supplied to the central portion of Orange County (including the city of Irvine) is supplemented primarily through local groundwater. Other drinking water production wells in the vicinity are a city of Tustin well (Number 77) located near the junction of Walnut Avenue and Red Hill Avenue and a city of Santa Ana well (Number 26) located near the junction of Grant Avenue and Walnut Avenue (OCWD 1993).

The IRWD also supplies nonpotable water to MCAS El Toro to irrigate the outleased agricultural areas. A significant irrigation groundwater well is TIC-55, located at the westernmost end of the east-west runway. Well TIC-55 pumps into the regional irrigation distribution system.

## 2.3.7 Surface Hydrology

Surface drainage near MCAS El Toro generally flows southwest, following the slope of the land perpendicular to the trend of the Santa Ana Mountains. Several washes originate in the hills northeast of MCAS El Toro and flow through or adjacent to the Station en route to San Diego Creek. Off-Station drainage from the hills and upgradient irrigated farmlands combines with Station runoff at MCAS El Toro (generated from the extensive paved surfaces) and flows into four main drainage channels (Figure 2-3).

Three of these drainage channels are continuous with natural washes that originate in the Santa Ana Mountains: Borrego Canyon, Agua Chinon, and Bee Canyon. The fourth drainage is Marshburn Channel.




**Work Plan**

**Figure 2-8**

**Trichloroethylene Concentrations in Groundwater**

MCAS El Toro, California

CLEAN II Program

Date: 7/10/95
File No. TCEPLUME
Job No. 22214-059

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The southernmost wash is Borrego Canyon Wash, which flows along the southeast boundary of MCAS El Toro (Figure 1-3). The wash is unlined in the Santa Ana Mountains; downstream of Irvine Boulevard, it is lined. Borrego Canyon Wash crosses the southern corner of the Station and joins Agua Chinon Wash about 1/4 mile from the Station boundary.

Both the Agua Chinon and the Bee Canyon Washes cross the central portion of MCAS El Toro and receive runoff mainly through storm sewers (Figure 1-3). These washes are contained in culverts through most of their pathways across the Station. Both washes are unlined along several hundred feet at the southwest edge of the Station and are lined again in a culvert beneath the Irvine Spectrum development adjacent to the southwestern boundary of the Station. Surface water may infiltrate through the bottom of the unlined portions of the culverts. The lined culverts may also act as a source of infiltration to groundwater, because the concrete lining is cracked in many places, as shown by vegetation growth. Agua Chinon Wash flows into San Diego Creek just east of the intersection of the San Diego and Laguna Beach Freeways, about 1 mile downstream of its confluence with Borrego Canyon Wash. Bee Canyon Wash flows into San Diego Creek just northeast of the same intersection, about 1,500 feet north of Agua Chinon Wash.

Marshburn Channel is a lined drainage channel that runs along the northwestern boundary of MCAS El Toro. The channel receives runoff from the western part of the Station (Figure 1-3), and it flows into San Diego Creek about 3/4 mile northwest of Bee Canyon Wash.

Southwest of MCAS El Toro, the San Diego Creek flows through commercial and agricultural areas. Approximately 5 miles downstream from the Station, the creek runs through a recreational area that includes hiking and bicycle paths. The creek flows into Upper Newport Bay about 7 miles downstream from its intersection with the Marshburn Channel. Recreational uses of the bay include swimming and fishing. Upper Newport Bay is an ecological preserve used by migratory birds.

## 2.4 MCAS EL TORO ENVIRONMENTAL RESTORATION AND COMPLIANCE PROGRAMS

The coordination of the IRP and several other environmental restoration and compliance programs is managed by the Base Environmental Office, Base Environmental Coordinator (BEC), and the BCT. By coordination of these programs, the addition of sites to the IRP may be streamlined and funding priorities can be established. Environmental restoration and compliance programs that have impacted or currently impact the IRP are implemented through the following regulations:

- BRAC,
- RCRA, and
- CERCLA as amended by SARA and the Community Environmental Response Facilitation Act (CERFA).

The following sections discuss the relationship of these programs to the IRP.

### 2.4.1 Base Realignment and Closure

In March 1993, MCAS El Toro was placed on the proposed BRAC list of military facilities considered for closure. The Station was selected for closure in September 1993. This closure will involve relocating Station tenants to other Stations by mid-1999 and preparing Station property for transfer or disposal.

The DON organized the BCT to manage and coordinate closure activities and to prepare the BCP. The BCP describes the status, management, and response strategies of the environmental restoration and compliance programs (Jacobs Engineering 1994a). The plan then classifies the known sites into seven area types as follows:

- BCP Area Type 1 – areas where no storage, release, or disposal has occurred;
- BCP Area Type 2 – areas where only storage occurred;
- BCP Area Type 3 – areas where storage, release, disposal, and/or migration has occurred, but require no remedial action;
- BCP Area Type 4 – areas where storage, release, disposal, and/or migration has occurred, and all remedial actions have been taken;
- BCP Area Type 5 – areas where storage, release, disposal, and/or migration has occurred, and action is underway, but not final;
- BCP Area Type 6 – areas where storage, release, disposal, and/or migration has occurred, but required response actions have not been taken; and
- BCP Area Type 7 – unevaluated areas or areas requiring additional evaluation.

Currently, all IRP sites are classified as BCP Area Type 7 because further evaluation is required at these sites (Jacobs Engineering 1994a). To reclassify these sites to Area Types 1, 2, 3, 4, 5, and 6, the Navy will investigate the sites further. If the sites do not require cleanup actions, the Navy will request regulatory agency concurrence for reclassification to the appropriate area type. Once these sites are classified as Area Types 1, 2, 3, and 4, the Navy can consider the property as uncontaminated and available for potential property transfer or disposal.

### 2.4.2 Resource Conservation and Recovery Act

An RFA was performed at MCAS El Toro between 1991 and 1993 (Jacobs Engineering 1993b). The RFA focuses on:

- releases or potential releases of hazardous substances at the MCAS El Toro,
- SWMUs/AOCs where the potential exists for releases of hazardous wastes or hazardous waste constituents to the environment,

- the need for further action at SWMUs/AOCs, and
- the potential for a site to be included in the IRP.

Over 300 SWMUs/AOCs were identified; 140 of the 300 were investigated. Based on the RFA results, 25 SWMUs/AOCs were recommended for further action, and three SWMUs/AOCs (194, 204, and 300) were recommended for inclusion in the IRP. IRP Site 3 (Original Landfill) boundaries were revised to include SWMU 194, a former incinerator, and SWMU/AOC 300, a solvent spill area next to SWMU/AOC 194. SWMU/AOC 204 was also included within the boundaries of IR Site 6 (Drop Tank Drainage Area No. 1).

### 2.4.3 Comprehensive Environmental Response, Compensation, and Liability Act as Amended by Superfund Amendments and Reauthorization Act and Community Environmental Response Facilitation Act

CERCLA (1980) and SARA (1986) established a series of programs for the cleanup of hazardous waste disposal and spill sites nationwide. One of these programs, DERP, is codified in SARA Section 211 (10 USC 2701). Under DERP, the IRP specifies Navy and Marine Corps personnel responsibilities and the processes involved with the IRP. Under the IRP, the DON is encouraged to use the Superfund Accelerated Cleanup Model (SACM) to expedite cleanup response actions and to use the CERFA as the mechanism for documenting properties eligible for transfer, disposal, or reuse.

#### 2.4.3.1 INSTALLATION RESTORATION PROGRAM

The goals of the IRP include identifying, investigating, and cleaning up contamination from hazardous substances. The IRP consists of the following steps, as illustrated on Figure 1-2:

- a Preliminary Assessment/Site Inspection, which identifies potentially contaminated sites;
- the RI, which characterizes nature and extent of contaminants usually by a comprehensive sampling program;
- the FS, which evaluates various cleanup options;
- the Record of Decision (ROD) in which the cleanup plan is selected after public review and comment of the RI/FS;
- the remedial action which is the implementation of the cleanup plan; and
- operation and maintenance of the cleanup operations.

The Phase I RI provided data for a preliminary risk assessment of 25 sites at MCAS El Toro (Jacobs Engineering 1993c). Contaminants in the soil and sediment consisted primarily of low concentrations of SVOCs, petroleum hydrocarbons, pesticides, herbicides, and PCBs. The Phase I RI also concluded that the source of the regional groundwater contamination (Site 18) is situated in the southwest quadrant of the Station. The OU-1 RI and Draft IAFS were prepared in 1994 (Jacobs Engineering 1994b,c). Currently, the Navy is negotiating with the OCWD to implement a remedial alternative for Site 18.

#### 2.4.3.2 SUPERFUND ACCELERATED CLEANUP MODEL

The DON encourages the use of the SACM, which is intended to make cleanups more timely and efficient (U.S. EPA 1992a). Because the only response authorities under CERCLA are removal and remedial, SACM suggests that these authorities may be used under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to achieve prompt risk reduction (early action) or to conduct more complex, time-consuming remediations (long-term action). Figure 2-9 illustrates the various steps of the SACM process.

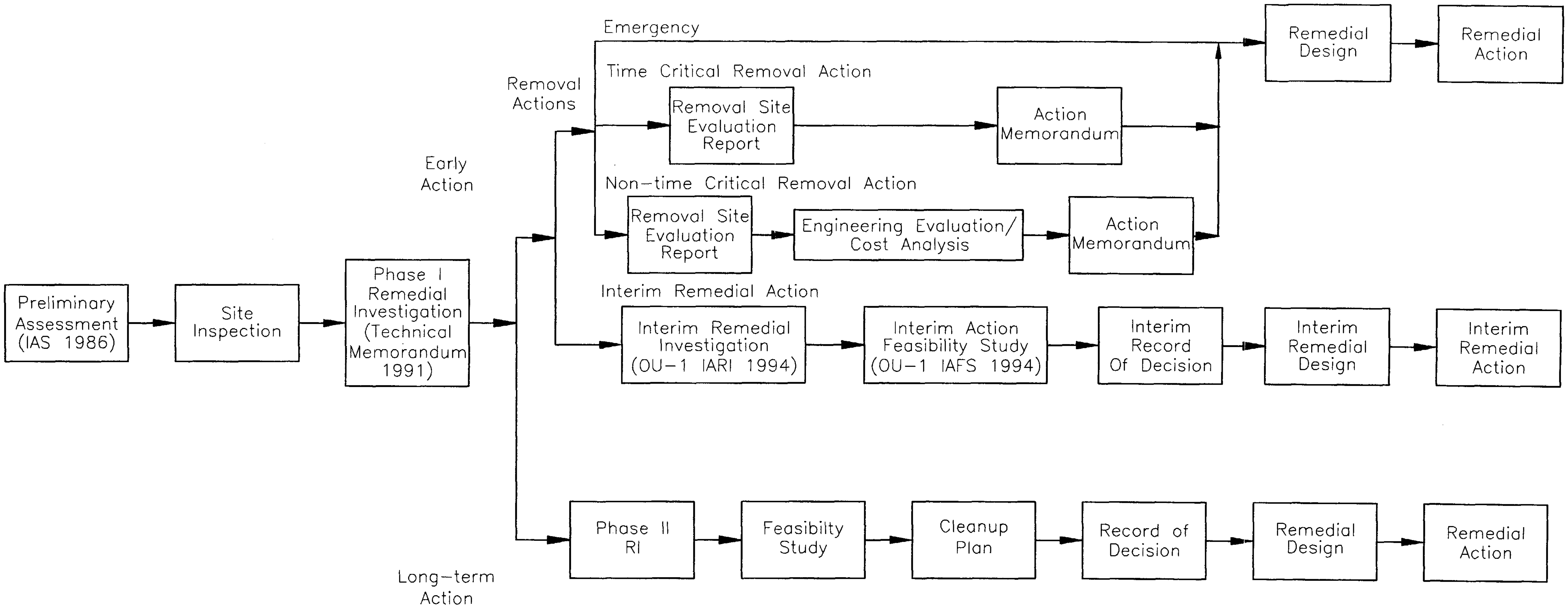
Early actions are responses performed under removal or interim remedial authority to eliminate or reduce human health or environmental threats from the release of hazardous substances or wastes (U.S. EPA 1992a). These risk-reduction activities can be conducted as emergency or time-critical removals (where quick response is necessary) or as non-time-critical removals and interim-remedial actions in less urgent situations. The NCP has special requirements for non-time-critical removals, including the need to prepare an EE/CA, an AM, and public review of the EE/CA. An EE/CA is a study to identify and assess removal action alternatives. In this WP, several sites or portions of the sites are designated for removal actions, and EE/CA has been or will be prepared for these removal actions.

Long-term actions are usually taken when extensive site characterization, cleanup costs are high, and duration of cleanup may take more than 5 years to complete. An FS is usually completed for a long-term remedial action. Identification of a remedial action as a long-term response does not mean that the work can be deferred.

At MCAS El Toro, the SACM approach has been initiated by designating portions of several sites for non-time-critical removals (Sites 4, 7, 11, 13, 14, 19, and 20) (Jacobs Engineering 1994f). To implement these non-time-critical removals, an EE/CA will be prepared. Additional site units may be added to the non-time-critical removal action lists, if eligible. An individual EE/CA will be issued for BCT and public comment, and these will be approved through an AM.

#### 2.4.3.3 COMMUNITY ENVIRONMENTAL RESPONSE FACILITATION ACT

To facilitate transfer of property at installations undergoing realignment or closure, Congress passed CERFA in October 1992. CERFA amends Section 120(h) of CERCLA and provides a mechanism for identifying and documenting uncontaminated real property, or parcels thereof, at installations undergoing closure that are suitable for transfer or reuse. As part of the closure process, a basewide Environmental Baseline Survey (EBS) was conducted at MCAS El Toro in accordance with DoD guidance (DoD n.d.) to assess the environmental condition of the property (Jacobs Engineering 1994g). According to the EBS, none of the IRP sites are eligible for CERFA transfer.




| Work Plan<br>**Figure 2-9**<br>**Superfund Accelerated Cleanup Model** | |
|---|---|
| MCAS El Toro, California | |
| CLEAN II Program | Date: 7/14/95<br>File No. SUPER-59<br>Job No. 22214-059 |

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# SECTION 3

## INITIAL EVALUATION

## Section 3
# INITIAL EVALUATION

The initial evaluation for a Phase II RI/FS generally involves a review of:

- types and volumes of waste present,
- potential pathways of contaminant migration,
- preliminary identification of OUs, and
- preliminary identification of response objectives and remedial action alternatives.

For the Phase II RI/FS at MCAS El Toro, the initial evaluation of the IRP sites was conducted by reviewing site history, summary and conclusions of the Phase I RI, regulatory agency comments, the list of COPCs, a conceptual site model of site-specific receptors and pathways, and identifying potential remedial levels and alternatives. Site-specific descriptions of these topics are presented in the DQO appendices.

## 3.1 TYPES AND VOLUMES OF WASTE PRESENT

To develop the initial evaluation of types and volumes of waste present, the Phase II RI/FS incorporated information from the:

- Phase I RI,
- RFA,
- aerial photographic surveys,
- employee interviews,
- soil gas survey, and
- results of other environmental restoration and compliance programs.

Summaries of this information are provided on Table 3-1 and site-specific DQO appendices.

Primarily based on the Phase I RI results (Jacobs Engineering 1993c), RFA results (Jacobs Engineering 1993b) and the soil gas survey (Jacobs Engineering 1994d), the COPCs and chemicals of potential ecological concern (COPECs) were identified from the types of potential wastes occurring at the IRP sites. The COPCs include chemicals that were detected in the various media sampled at the IRP sites. The COPECs were developed from the preliminary ecological risk assessment conducted during the Phase I RI. These COPCs and COPECs are listed on Tables 3-2 and 3-3, respectively. Also shown on Table 3-2 are the cumulative cancer risks and cumulative noncancer risk ratios (hazard index [HI]) as formulated in the Draft Phase II RI/FS Work Plan (Jacobs Engineering 1993a). Other hazardous wastes or COPCs may be detected during the Phase II RI, and these would be added to these lists.

## Table 3-1
## Site Characteristics

| Site | Site Name | Approximate Site Area | Approximate Depth to Groundwater (feet bgs[a]) | Waste Type | Phase I Activities[b] | Constituents Detected During Phase I | PHASE I RISK ASSESSMENT: Cumulative Cancer Risk | PHASE I RISK ASSESSMENT: Noncancer Cumulative Risk Ratio (Hazard Index) |
|---|---|---|---|---|---|---|---|---|
| 1 | Explosive Ordnance Disposal Range | 1,500,000 $ft^2$ | 50-60 | FS smoke, flares, small ammunition, explosives | C, E, F | VOCs[c], SVOCs[d], TFH[e] | $< 1 \times 10^{-6}$ | < 0.01 |
| 2 | Magazine Road Landfill | 22 acres | 10-70 | Municipal waste, construction debris, batteries, transformers | A, C, D, E, F, G, H | Metals[f], VOCs, SVOCs, TFH, pesticides, PCBs[g], herbicides, gross alpha/beta | $< 1 \times 10^{-6}$ | < 0.01 to 0.38 |
| 3 | Original Landfill | 20 acres | 240 | Metals, incinerator ash, solvents, paint residues, construction debris | A, F, G, H, C, D, E | Metals, VOCs, SVOCs, TFH, pesticides, PCBs, herbicides, gross alpha/beta | $1 \times 10^{-6}$ | 0.16 |
| 4 | Ferrocene Spill Area | 5,000 $ft^2$ | 225-240 | Ferrocene w/hydrocarbon carrier, misc. fuels, waste oil | C, D, E, F | VOCs, SVOCs, TFH, pesticides | $8 \times 10^{-6}$ | 0.48 |
| 5 | Perimeter Road Landfill | 1.5 acres | 190 | Metals, incinerator ash, solvents, paint residues, construction debris | A, F, G, H, C, D, E | Metals, VOCs, SVOCs, TFH, pesticides, PCBs, herbicides, gross alpha/beta | $< 1 \times 10^{-6}$ | 0.08 to 1.99 |
| 6 | Drop Tank Area No. 1 | 42,000 $ft^2$ | 140-150 | JP-5[h], lube oil, waste oil, possibly solvents | C, D, E | VOCs, SVOCs, metals | $1 \times 10^{-6}$ to $< 10^{-6}$ | 0.20 to 3.18 |

(table continues)

**Table 3-1** (continued)

| Site | Site Name | Approximate Site Area | Approximate Depth to Groundwater (feet bgs[a]) | Waste Type | Phase I Activities[bc] | Constituents Detected During Phase I | PHASE I RISK ASSESSMENT: Phase I Cumulative Cancer Risk | PHASE I RISK ASSESSMENT: Non-Cancer Cumulative Risk Ratio (Hazard Index) |
|---|---|---|---|---|---|---|---|---|
| 7 | Drop Tank Area No. 2 | 200,000 $ft^2$ | 110-120 | JP-5, lube oil, waste oil, flammable materials | A, C, D, E | VOCs, SVOCs, TFH, metals, pesticides | $10^{-5}$ to < $10^{-6}$ | < 0.01 to 1.87 |
| 8 | DRMO Storage Area | 290,000 $ft^2$ | 85-95 | PCB oil, fuels, solvents, lube oil | A, C, D, E, F | VOCs, SVOCs, TFH, pesticides, PCBs, metals | $10^{-3}$ to < $10^{-6}$ | < 0.01 to 3.63 |
| 9 | Crash Crew Pit No. 1 | 14,800 $ft^2$ | 120-125 | JP-5, other aviation fuels, waste oil, hydraulic fluid | A, C, D, E | VOCs, SVOCs, TFH, metals | < $10^{-6}$ | 0.39 |
| 10 | Petroleum Disposal Area | 960,000 $ft^2$ | 110-120 | Waste oil, antifreeze, hydraulic/ transmission fluids, solvents | A, C, D, E, F | VOCs, SVOCs | 1.2 x $10^{-5}$ to < $10^{-6}$ | < 0.01 |
| 11 | Transformer Storage Area | 1,025 $ft^2$ | 120 | PCB oil | C, D | Pesticides, PCBs | 1.2 x $10^{-4}$ to $10^{-6}$ | < 0.01 |
| 12 | Sludge Drying Beds | 107,000 $ft^2$ | 95-105 | Municipal waste, sludges, plating shop liquid waste | C, D, E, F | VOCs, SVOCs, TFH, pesticides, herbicides, metals | 9 x $10^{-5}$ to 3 x $10^{-6}$ | 0.47 to 2.33 |
| 13 | Oil Change Area | 30,000 $ft^2$ | 135-140 | Waste oil, solvents | C, D, E, F | VOCs, pesticides, metals | 7 x $10^{-5}$ to $10^{-6}$ | 0.09 to 0.50 |

(table continues)

Table 3-1 (continued)

| Site | Site Name | Approximate Site Area | Approximate Depth to Groundwater (feet bgs[a]) | Waste Type | Phase I Activities[bc] | Constituents Detected During Phase I | PHASE I RISK ASSESSMENT: Phase I Cumulative Cancer Risk | PHASE I RISK ASSESSMENT: Non-Cancer Cumulative Risk Ratio (Hazard Index) |
|---|---|---|---|---|---|---|---|---|
| 14 | Battery Acid Disposal Area | 600 $ft^2$ | 125 | Battery acid, solvents, paint, paint strippers, waste oil | C, D, E | VOCs, SVOCs, metals | $1.1 \times 10^{-4}$ to $1.8 \times 10^{-5}$ | 0.35 to 1.90 |
| 15 | Suspended Fuel Tanks | 2,915 $ft^2$ | 125-130 | Diesel fuel and possibly waste oil solvents | C, D, E, F | VOCs, TFH, metals | $< 1 \times 10^{-6}$ | 0.07 |
| 16 | Crash Crew Pit No. 2 | 57,100 $ft^2$ | 165-185 | JP-5, other aviation fuels, waste oil, hydraulic fluid | C, D, E, F | VOCs, SVOCs, TFH, metals | $< 1 \times 10^{-6}$ | 0.03 x 0.59 |
| 17 | Communication Station Landfill | 34 acres | 200 | Municipal waste, cooking grease, oils, fuels, empty drums | A, F, E, C, D | VOCs, SVOCs, TFH, pesticides, PCBs, herbicides | $1.1 \times 10^{-5}$ to $< 1 \times 10^{-6}$ | 0.24 to 1.81 |
| 19 | Aircraft Exp. Refueling Site | 180,000 $ft^2$ | 150-160 | JP-5, other aviation fuels | C, D, E, F | VOCs, SVOCs, TFH, metals | $4 \times 10^{-5}$ to $< 10^{-6}$ | < 0.01 to 0.03 |
| 20 | Hobby Shop | 15,600 $ft^2$ | 185-190 | Waste oil, solvents, kerosene | C, D, E, F | VOCs, SVOCs, TFH, metals, pesticides | $1.8 \times 10^{-5}$ to $< 10^{-6}$ | < 0.01 to 0.69 |
| 21 | Materials Management Group | 13,500 $ft^2$ | 95 | Waste oil, paint, solvents, herbicides, pesticides, PCB oil | D, E, F | VOCs, SVOCs, TFH, pesticides, herbicides, metals | $< 1.0 \times 10^{-6}$ | < 0.01 |

(table continues)

**Table 3-1** (continued)

| | | | | | | | PHASE I RISK ASSESSMENT | |
|---|---|---|---|---|---|---|---|---|
| Site | Site Name | Approximate Site Area | Approximate Depth to Groundwater (feet bgs[a]) | Waste Type | Phase I Activities[bc] | Constituents Detected During Phase I | Phase I Cumulative Cancer Risk | Non-Cancer Cumulative Risk Ratio (Hazard Index) |
| 22 | Tactical Air Fuel Dispensing System | 75,000 $ft^2$ | 110-120 | JP-5, other aviation fuels, pesticides | A, C, D, E, F | VOCs, SVOCs, TFH, pesticides | $1.0 \times 10^{-5}$ to $< 10^{-6}$ | 0.05 to 0.08 |
| 24 | Potential Volatile Organic Compound Source Area | 200 acres | 120-130 | VOCs | | | Not calculated | Not calculated |
| 25 | Major Drainages | Approximately 66,000 linear feet | 120-250 | VOCs, SVOCs, fuel hydrocarbons, pesticides, PCBs, herbicides, metals | | | $< 1 \times 10^{-6}$ to $1.6 \times 10^{-6}$ | < 0.01 |

Notes:
[a] bgs – below ground surface
[b] Phase I activities: A = soil gas sampling, B = cone penetrometer testing, C = shallow soil sampling, D = deep soil sampling, E = groundwater, F = surface geophysics, G = sediment sampling, H = surface water
[c] VOC – volatile organic compound
[d] SVOC – semivolatile organic compound
[e] TFH – total fuel hydrocarbons
[f] "Metals" indicated where any target analyte list metal concentration exceeding interim site background level as established during Phase I RI
[g] PCB – polychlorinated biphenyl
[h] JP-5 – jet propulsion fuel, grade 5

**Table 3-2**
**Chemicals of Potential Concern for the MCAS El Toro Phase II Remedial Investigation/Feasibility Study**

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| Total Petroleum Hydrocarbons | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | X | X |
| Total Recoverable Petroleum Hydrocarbons | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | X |
| **BTEX** | | | | | | | | | | | | | | | | | | | | | | | |
| Benzene | | X | | X | X | | X | | | | | | X | | X | X | | | | | | X | |
| Toluene | X | X | X | X | X | X | | X | X | X | | X | X | X | X | X | X | X | X | X | X | X | X |
| Ethylbenzene | | X | | | | | | X | | | | | X | | | X | | X | | | | X | |
| Xylene(s) | | X | X | X | | X | X | X | | X | | X | X | | X | X | | X | X | | | X | |
| **HALOGENATED VOLATILE ORGANIC COMPOUNDS** | | | | | | | | | | | | | | | | | | | | | | | |
| Bromodichloromethane | | | | | | | | | | | | | | | | | X | | | | | | |
| Carbon tetrachloride | | X | | | | X | X | | X | X | | X | X | X | | X | | | X | | X | X | X |
| Chloroform | | X | X | | | | X | | X | X | | X | | X | | X | X | | | X | X | X | |
| Chloromethane | X | | X | | X | X | X | | X | X | | | X | | X | | | | X | X | | X | X |
| Dibromochloromethane | | | X | | | | | | | | | | | | | | X | | | | | | |
| 1,1-Dichloroethane | | | | | | | | | X | | | | | | | | | | | | | X | |
| 1,2-Dichloroethane | | | | | | | | | X | | | | | | | | | | | | | X | |
| 1,1-Dichloroethene | | | | | | | X | | X | X | | | | | | | | | | | | X | |
| 1,2-Dichloroethene (total) | | X | | | | | | | | X | | | | | | | | | | | | X | |
| Methylene Chloride | | X | X | X | | X | X | X | | X | | X | | | X | X | X | X | X | X | X | X | X |
| Tetrachloroethene | | X | | | X | | X | X | X | X | | X | | | | | | X | | X | X | X | |
| 1,1,1-Trichloroethane | | | | | | X | X | | X | | | | X | | | | | | | | | X | |

(table continues)

**Table 3-2** (continued)

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| **HALOGENATED VOLATILE ORGANIC COMPOUNDS** (continued) | | | | | | | | | | | | | | | | | | | | | | | |
| 1,1,2-Trichloroethane | | X | | | | | | | | | | | | | | | | | | | | X | |
| Trichloroethylene | | X | | | X | | X | | X | X | | X | | X | | X | | X | X | X | X | X | |
| **VOLATILE ORGANIC COMPOUNDS** | | | | | | | | | | | | | | | | | | | | | | | |
| Acetone | | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | |
| 2-Butanone (Methyl ethyl ketone) | X | X | X | | | | X | X | X | | | X | X | | X | X | X | X | X | | X | X | X |
| Carbon disulfide | | | | | | | | X | | | | | | | X | | | | X | | | | |
| 2-Hexanone | | X | X | X | | X | | X | | | | | | | | X | | | X | | X | X | |
| 4-Methyl-2-pentanone | | X | | | | | | | | | | | | | | | | X | | | | | |
| Vinyl Chloride | | | | | | | | | | | | | | | | | | | | | | X | |
| **POLYNUCLEAR AROMATIC HYDROCARBONS** | | | | | | | | | | | | | | | | | | | | | | | |
| Acenaphthene | | | | | | | | | | | | | | | | | | X | | X | | | |
| Acenaphthylene | | | | | | | | | | | | | | | | | | X | | X | | | |
| Anthracene | | | | | | | | | | | | | | X | | | | X | | X | | | |
| Benzo(a)anthracene | | | | | | | X | | | X | | X | | X | | | X | X | | X | X | | |
| Benzo(a)pyrene | | | | X | | | X | X | | X | | X | X | X | | | X | X | X | X | X | | |
| Benzo(b)fluoranthene | | | | X | | | X | | | X | | X | X | X | | | | X | | X | X | | |
| Benzo(g,h,i)perylene | | | | | | | X | X | | X | | X | X | X | | | X | X | X | X | X | | |
| Benzo(k)fluoranthene | | | | X | | | X | | | X | | X | X | X | | | | X | | X | | | |
| Chrysene | | | | X | | | X | X | | X | | X | X | X | X | | X | X | | X | X | | |
| Dibenzo(a,h)anthracene | | | | | | | X | | | | | X | | X | | | | X | | X | | | |

(table continues)

**Table 3-2** (continued)

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| **POLYNUCLEAR AROMATIC HYDROCARBONS** (continued) | | | | | | | | | | | | | | | | | | | | | | | |
| Fluoranthene | | | | X | | X | X | X | | X | | X | X | X | | X | X | X | | X | X | | |
| Fluorene | | | | | | | | | | | | | | | | X | | X | | X | | | |
| Indeno(1,2,3-cd)pyrene | | | | | | | X | X | | X | | X | X | X | | | X | X | | X | X | | |
| Naphthalene | | | | X | | | | | | | | | | | | X | | X | | | X | | X |
| Phenanthrene | | | | | | | X | | | X | | X | X | X | X | X | | X | | X | X | | X |
| Pyrene | | | | X | | X | X | X | | X | | X | X | X | | X | X | X | X | X | X | | |
| **SEMIVOLATILE ORGANIC COMPOUNDS** | | | | | | | | | | | | | | | | | | | | | | | |
| Benzyl butyl phthalate | | X | | X | | X | | X | X | X | | X | X | X | X | | | | | X | | | X |
| Bis(2-ethylhexyl) phthalate | X | X | X | X | X | | | X | X | X | | | X | X | X | X | | X | X | X | | | X |
| Carbazole | | | | | | | X | | | | | | | X | | | | X | | X | | | |
| 2-Chlorophenol | | | | | | | | | | | | | | | | | | X | | | | | |
| 4-Chloro-3-methylphenol | | | | | | | | | | | | | | | | | | X | | | | | |
| Dibenzofuran | X | | | | | | | | | | | | | | | X | | X | | X | | | X |
| 1,4-Dichlorobenzene | | | | | | | | | | | | | | | | | | X | | | | | |
| Diethyl phthalate | | | | | | | X | | | X | | | | | | | | X | | | | | |
| Dimethyl phthalate | | | | | | | | X | X | | | | | | | | | | | | | | |
| 2,4-Dimethylphenol | | | | | | | | | | | | | | | | | X | | | | | | |
| Di-*n*-butyl phthalate | | | | | | | | X | | | | | | | | | | | | | | | |
| Di-*n*-octyl phthalate | | | | | | | | | | | | | | | | | | X | | | | | |
| Hexachloroethane | | | | | | | | X | | | | | | | | | | | | | | | |

(table continues)

**Table 3-2** (continued)

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| **SEMIVOLATILE ORGANIC COMPOUNDS** (continued) | | | | | | | | | | | | | | | | | | | | | | | |
| Isophorone | | | | | | | | | | | | | | | | | | | | | X | | |
| 2-Methyl naphthalene | | | | X | | | | | | | | | | | | X | | X | X | X | X | | X |
| 4-Methyl phenol | | | | | | | | | | | | | | | | | X | | | | | | |
| 4-Nitrophenol | | | | | | | | | | | | | | | | | | X | | | | | |
| n-Nitrosodipropylamine | | | | | | | | | | | | | | | | | | X | | | | | |
| Pentachlorophenol | | | | | | | | | | | | | | | | | | X | | | | | |
| Phenol | | | | X | | X | | | | | | | | | X | | | X | | | | | |
| 1,2,4-Trichlorobenzene | | | | | | | | | | | | | | | | | | X | | | | | |
| **PESTICIDES/POLYCHLORINATED BIPHENYLS** | | | | | | | | | | | | | | | | | | | | | | | |
| Alpha chlordane | | X | | X | | | | X | | | | X | | | | | X | | | X | | | X |
| Alpha BHC | | | | | | | | | | | | | | | | | | | X | | | | |
| 4,4'-DDD | | X | X | X | | | X | | | | | X | X | | | | X | | X | X | X | | X |
| 4,4'-DDE | | X | X | X | | | X | X | | | | X | | | | | X | | X | X | X | | X |
| 4,4'-DDT | | X | X | X | X | | X | | | | | X | X | | | | X | | X | X | X | | X |
| Delta BHC | | | | X | | | | X | | | | | X | | | | X | | X | | | | X |
| Dieldrin | | | X | X | | | X | X | | | | X | | | | | X | | X | X | | | |
| Endosulfan I | | | | X | | | | | | | | | | | | | | | X | | | | |
| Endosulfan II | | | | X | | | | | | | X | | | | | | | | | X | | | |
| Endosulfan sulfate | | | | X | | | X | X | | | | X | X | | | | X | | X | X | | | X |
| Endrin | | | | X | | | X | | | | X | | | | | | | | X | X | | | X |

(table continues)

**Table 3-2** (continued)

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| **PESTICIDES/POLYCHLORINATED BIPHENYLS** (continued) | | | | | | | | | | | | | | | | | | | | | | | |
| Endrin aldehyde | | | | X | | | | | | | X | X | | | | | | | | | | | |
| Endrin ketone | | | | X | | | X | | | | | X | X | | | | X | | X | X | | | X |
| Gamma chlordane | | X | X | X | | | | | | | | X | | | | | X | | X | | | | X |
| Heptachlor | | | X | | | | | | | | | | | | | | | | | | | | |
| Heptachlor epoxide | | | | | | | | | | | | | | | | | X | | | | | | |
| Lindane (gamma BHC) | | | X | X | | | | | | | | | | | | | | | | X | | | |
| Methoxychlor | | | | | | X | | | | | | X | | | | | X | | | X | | | |
| PCB 1248 | | | | | | | | X | | | X | | | | | | | | | | | | |
| PCB 1254 | | | | | | | | X | | | X | X | | | | | | | | | | | |
| PCB 1260 | | | | | | | | X | | | X | X | | | | | | | | | | | X |
| **HERBICIDES** | | | | | | | | | | | | | | | | | | | | | | | |
| 2,4-D | | | | | | | | | | | | X | | | | | | | | | | | |
| 2,4-DB | | X | | | | | | | | | | X | | | | | X | | | X | | | X |
| Dalapon | | X | X | | | | | | | | | X | | | | | X | | | | | | X |
| Dichloroprop | | X | | | | | | | | | | X | | | | | X | | | | | | X |
| Dinoseb | | | | | | | | | | | | | | | | | X | | | | | | |
| MCPA | | X | | | | | | | | | | | | | | | X | | | | | | |
| MCPP | | X | X | | X | | | | | | | X | | | | | X | | | | | | |
| 2,4,5-trichlorophenoxy acetic acid | | | X | X | | | | | | | | | | | | | | | | X | | | |
| 2,4,5-trichlorophenoxy propionic acid (Silvex) | | | X | | X | | | | | | | X | | | | | | | | | | | X |

(table continues)

**Table 3-2** (continued)

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| **DIOXIN/DIBENZOFURANS** | | | | | | | | | | | | | | | | | | | | | | | |
| Octachlorodibenzo-p-dioxins | X | | | | | | | | | | | | | | | | | | | | | | |
| **RADIONUCLIDES** | | | | | | | | | | | | | | | | | | | | | | | |
| Gross alpha | X | X | X | | X | | X | | X | | | | | | | | | | | | | | |
| Gross beta | X | X | X | X | X | | X | | X | | | | | | | | | | | | | | |
| **EXPLOSIVES** | | | | | | | | | | | | | | | | | | | | | | | |
| HMX | X | | | | | | | | | | | | | | | | | | | | | | |
| RDX | X | | | | | | | | | | | | | | | | | | | | | | |
| 2,4,6-Trinitrotoluene | X | | | | | | | | | | | | | | | | | | | | | | |
| **INORGANICS** | | | | | | | | | | | | | | | | | | | | | | | |
| Total Cyanide/metallo | | | X | | | | | | | | | | | | | | | | | | | | |
| Nitrate-Nitrite | X | | X | X | | | | | | | | | | | | | | | | | | | |
| Phosphorus | X | | | | | | | | | | | | | | | | | | | | | | |
| **TARGET ANALYTE LIST METALS** | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Antimony | | X | | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Arsenic | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Barium | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Beryllium | | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Cadmium | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Calcium | | X | | | X | | | | | | | | | | | | | | | | | | |
| Chromium, Hexavalent | | | | | | | | | | | | | | | | | | | | | | | |

(table continues)

**Table 3-2** (continued)

| Chemicals of Potential Concern | IR PROGRAM SITES | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 24 | 25 |
| **TARGET ANALYTE LIST METALS** (continued) | | | | | | | | | | | | | | | | | | | | | | | |
| Chromium | | X | X | X | X | | | X | | | | X | X | X | X | | X | | X | X | | | X |
| Cobalt | X | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Copper | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Lead | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Manganese | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Mercury | X | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | |
| Nickel | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Selenium | X | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Silver | X | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Sulfate | X | X | X | | | | | | | | | | | | | | X | | | | | | X |
| Thallium | | X | X | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Vanadium | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |
| Zinc | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | | X |

**Table 3-3**
**Chemicals of Potential Ecological Concern from Site Investigations**

| Soil | Sediment | Surface Water |
|---|---|---|
| Benzo(a)pyrene | Dichlorodiphenyltrichloroethane | Aluminum |
| Benzo(a)anthracene | Dichlorodiphenyltrichloroethene | Cadmium |
| Polychlorinated Biphenyl-1254 | Dichlorodiphenyldichloroethane | Copper |
| 2,4,5-Trichlorophenoxyacetic Acid | Bis(2-ethylhexyl) phthalate | Lead |
| 2,4-Dichlorophenoxyacetic Acid | Arsenic | Mercury |
| 2-Butanone | Cadmium | Zinc |
| Acetone | Copper | |
| Chlordane | Lead | |
| Carbazole | Mercury | |
| Dalapon | Zinc | |
| Dibenzofuran | | |
| Dichloroprop | | |
| Endosulfan | | |
| Endrin | | |
| Aluminum | | |
| Antimony | | |
| Barium | | |
| Cadmium | | |
| Chromium | | |
| Cobalt | | |
| Lead | | |
| Manganese | | |
| Mercury | | |
| Selenium | | |
| Silver | | |
| Thallium | | |
| Vanadium | | |

Source: Jacobs Engineering 1993b

The volumes of wastes present at the IRP sites cannot be estimated. The Phase I RI specifically conducted sampling to characterize the nature and risks of the sites, not to characterize the extent. However, the following general observations are presented in regard to volumes of waste:

- boundaries of solid wastes in landfill sites (Sites 2, 3, 5, and 17) have been estimated;
- soil gas and air emissions have been assessed and are present in Sites 2 and 3;
- the presence of groundwater contamination has been assessed at landfill Sites 2, 3, and 5, and has not been assessed at Site 17;
- the extent of shallower soil and soil gas contamination (surface to 30 feet bgs) in Site 24 (VOC Source Area) has been estimated;
- the presence of a groundwater hot spot beneath Site 24 has been detected;
- sediment and surface water in the major drainages (Site 25) contain substances that exceed preliminary ecological risk estimates; and
- shallow soil at the remaining sites contains SVOCs, petroleum hydrocarbons, metals, VOCs, and PCBs.

## 3.2 POTENTIAL PATHWAYS OF CONTAMINANT MIGRATION

Conceptual site models are used to show relationships between potential sources, migration pathways, and receptors. Complete pathways include sources, mechanisms of contaminant release, transport media, exposure points, and exposure routes at points of receptor contact. A conceptual model is based on existing data and is updated as more analytical data and receptor information are gathered. During the DQO development, the conceptual site model is used to identify data deficiencies that need to be addressed in the data collection phase.

The conceptual site models used for the Phase II RI/FS are built upon the models developed during Phase I RI. The models used for the Phase II RI/FS are outlined in the site-specific appendices (A through X). Table 3-4 lists the exposure scenarios and routes for soil, sediment, and surface water.

## 3.3 PRELIMINARY IDENTIFICATION OF OPERABLE UNITS

Twenty-three MCAS El Toro RI/FS Sites will be investigated in Phase II RI: 21 Phase I sites, and 2 new sites (Sites 24 and 25). These Phase II sites are grouped into two OUs: OU-2 and OU-3. The third, OU-1, includes the regional groundwater VOC investigation (Site 18), which is being investigated as a separate RI/FS (Jacobs Engineering 1994b,c). The sites considered under OU-2 include the landfill Sites 2, 3, 5, 17, and Sites 24 and 25. OU-2A consists of Site 24, which includes the entire source area investigation in the southwest quadrant, and Site 25, which includes shallow soil, subsurface soil, and surface water in the four washes and San Diego Creek at MCAS El Toro. OU-2B and OU-2C consist of the landfill sites (Sites 2, 3, 5, and 17). OU-3 includes the remaining sites.

**Table 3-4**
**Exposure Route Scenarios for Soil, Sediment, and Surface Water**

| Exposure Route | Soil (Residential) | Sediment (Recreational) | Surface Water (Recreational) |
|---|---|---|---|
| Ingestion | X | X | X |
| Dermal contact | X | X | X |
| Dust inhalation | X | X | |
| Vapor inhalation | X | X | |

## 3.4 PRELIMINARY IDENTIFICATION OF RESPONSE OBJECTIVES AND RESPONSE ACTION ALTERNATIVES

Preliminary identification of response objectives and response action alternatives is intended to be a general classification of potential response actions so that the data collected during the Phase II RI/FS are sufficient to evaluate the universe of possible alternatives. The decisions on the most appropriate response actions will be based on Phase II RI results. The Phase II FS will evaluate the implementability, effectiveness, and costs of specific technologies to achieve the response action objectives.

Response objectives are stipulated by CERCLA (Section 121[d]), which states that the general objective of remedial actions is "to attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and/or control of further release at a minimum, which assures protection of human health and the environment." Protectiveness can be accomplished either by treating the toxic substance or by interrupting the exposure pathway, since risk requires both toxicity and exposure. CERCLA expresses a preference for reducing toxicity by treating the toxic substance.

Remedial objectives are established for COPCs, the potential exposure pathways, and the cleanup levels. The cleanup levels are the acceptable exposure levels that will protect both human health and the environment (U.S. EPA 1989a). The levels are developed through consideration of applicable or relevant and appropriate requirements (ARARs) and the following factors, as quoted from 40 *Code of Federal Regulations* (CFR) 300.430(e):

- For systemic toxicants, acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety.
- For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual between $10^{-4}$ and $10^{-6}$ using information on the relationship between dose and response. The $10^{-6}$ risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are

not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.

There are no cleanup levels specified by the U.S. EPA or Cal/EPA for acceptable levels of risk for nonhuman receptors. Therefore, the remedial objective for nonhuman receptors is to minimize, to the maximum extent feasible, adverse environmental effects such as changes in population abundance, age structure, reproductive potential and fecundity, species diversity, and food web or trophic diversity (U.S. EPA 1989a).

If the Phase II human health or ecological risk assessments estimate that risks are unacceptable at a site, response action alternatives will be evaluated. The goal of evaluation is to select a remedy that protects human health and the environment, maintains such protection over time, minimizes untreated waste, and complies with ARARs (40 CFR 300.430). Possible response alternatives will be screened and developed on the basis of the following criteria:

- **effectiveness** – the degree to which the alternative will reduce toxicity, mobility, or volume through treatment, minimize residual risks and afford long-term protection, comply with ARARs, minimize short-term impacts, and achieve protection in a timely manner;
- **implementability** – the technical feasibility and availability of technologies each alternative would employ, and the administrative feasibility of implementing the alternatives; and
- **cost** – the costs of construction and any long-term costs to operate and maintain the remedial alternative.

## SECTION 4

# WORK PLAN RATIONALE

## Section 4
# WORK PLAN RATIONALE

The WP presents the methods used to satisfy the data requirements. This section presents the process used to identify data requirements and methods used to satisfy requirements for the Phase II RI/FS. Formulation of data requirements uses the DQO process.

## 4.1 DATA QUALITY OBJECTIVES

The U.S. EPA has developed the seven-step DQO process as a systematic planning tool for data collection. This process was developed through U.S. EPA total quality management activities to help users decide the type, quality, and quantity of data that will be sufficient to support environmental decision making. Because regulatory compliance decisions are made on the basis of the environmental data collected, the DQO process emphasizes participation by and collaboration among all the data users during the data collection planning process. The DON has decided to use the DQO process to plan for the Phase II RI/FS at MCAS El Toro to streamline the process of reaching ROD.

The DQO process involves a series of planning steps based on a method that is designed to help assure that the type, quantity, and quality of data to be collected and used in the decision-making process are appropriate and applicable for the intended application. The process consist of seven steps. The output of each step may influence prior steps and cause them to be redefined. Thus, the DQO process is iterative, and produces a more efficient design of the data collection and decision-making processes. The following is a description of each DQO step.

Step 1 – State the Problem: Describe the problem to be studied. This usually involves reviewing prior studies and existing information to help identify data gaps and better understand the problem.

Step 2 – Identify the Decision: Define a decision statement that will be used to solve the problem identified in Step 1. This statement presents the question that must be resolved. In addition to the decision, the actions or effects of actions that lead to the decision are defined.

Step 3 – Identify Inputs into the Decision: Identify the information that is required to reach a decision that will resolve the problem. This includes the sources for each item of information as well as the appropriate sampling techniques and analytical methods to provide the necessary data.

Step 4 – Define the Study Boundaries: Specify the spatial and temporal circumstances covered by the decision. This process encompasses the following parameters:

- the domain or geographical area of the decision,
- the distinct characteristics of the population of interest,
- the period for data collection,

- any potential constraints to the collection of data, and
- the stratification of each medium into categories that exhibit homogeneous properties.

Step 5 – Develop a Decision Rule: Combine the outputs from previous steps into a single statement that defines the basis for determining alternative actions (i.e., an "if....then" statement that includes the parameter of interest, an action level, and the alternative actions).

Step 6 – Specify Acceptable Limits on Decision Errors: Define acceptable decision error rates based on the consequences of making an incorrect decision, which are then used to establish appropriate performance goals to limit uncertainty in the data. This process defines the possible ranges of the parameter of interest, the types of decision errors and their consequences, probability values to points above and below the action level, and limits on decision errors that assure the accurate reflection of the decision maker's concerns regarding the consequences for each type of decision error.

Step 7 – Optimize the Design for Obtaining Data: Evaluate the information from the previous steps to generate alternative sampling designs and ultimately identify the most resource-effective sampling and analysis design for generating data and satisfying the DQO. This process may include reviewing the outputs and existing data, translating the information from the DQO to a statistical hypothesis, developing general sampling and analysis design alternatives, and formulating mathematical expressions needed to solve the design problems.

Appendices A through X present the results of the DQO process for each IRP site at MCAS El Toro as stand-alone documents. Each appendix contains background information and a summary of the DQO process for each site. These self-contained documents provide quick and convenient reference to the rationale used to develop the Phase II RI/FS sampling design.

The initial planning for developing the DQOs at MCAS El Toro began at the Navy in mid-1992 with the initiation of team-building among the following regulatory agencies: the U.S. EPA, Cal/EPA, and RWQCB, Santa Ana Region. This approach assured that all decision makers are involved in the development of the DQO. Planning for the Phase II RI/FS DQO process continues.

A series of meetings, positions papers, and other activities were considered during the planning of the Phase II RI/FS. Specific Phase II activities will include:

- collection of a second round of groundwater monitoring samples,
- preparation of a groundwater monitoring plan to guide ongoing groundwater sampling activities,
- a soil gas survey of the southwest quadrant of MCAS El Toro,
- an RI Report for OU-1 (Site 18 - Regional Groundwater Contamination),

- an IAFS Report for OU-1 (Site 18 - Regional Groundwater Contamination),
- interviews with MCAS El Toro employees, and
- regulatory agency review comments regarding the initial submittal of the Draft Phase II RI WP (including the submittals of DQO).

## 4.2 WORK PLAN APPROACH

The following sections of the WP present the types of data required to satisfy individual DQO steps and identifies the source(s) of these data. The final step (optimizing the sampling design) includes a summary of Phase II RI/FS sampling programs. The appendices provide a detailed discussion of each DQO step for individual sites.

### 4.2.1 Step 1 – Problem Statement

The problem statement requires developing a concise description of the problem. The data required to develop the problem statement include:

- existing site information,
- wastes (COPCs) known or suspected to be present at the site, and
- estimated risks associated with the wastes.

This information is used to define specific problems associated with hazardous waste activities at each site, which will focus development of the problem statement.

#### 4.2.1.1 EXISTING INFORMATION

Existing information for the sites provide data on types of wastes and, possibly, extent of the wastes. This information is available from several sources (Brown and Caldwell 1986; Jacobs Engineering 1993b,c,d,e; Strata 1991). Information summaries are presented on Tables 1-1 and 3-1. More specific site descriptions are provided in the appendices.

#### 4.2.1.2 CHEMICALS OF POTENTIAL CONCERN

The problem statement designates COPCs and COPECs, which are wastes that are known or suspected to be present at each site. Site-specific COPCs and basewide COPECs are presented on Tables 3-2 and 3-3.

#### 4.2.1.3 ESTIMATED RISK

The severity of the problem is provided as a risk estimate. The Draft Phase II WP produced cancer and noncancer risk estimates for shallow soils at many sites (Table 3-1). Shallow soils are defined as those occurring to depths of 10 feet bgs. Under residential scenarios, the BCT agreed that shallow soil would present the greatest risks. Soils deeper than 10 feet bgs (subsurface soil) are considered as risk only if contaminants have a potential to migrate to groundwater (drinking water source). Sediments and surface water risks are associated with recreational and wildlife uses. For sites where risk estimates were completed, the risk generally exceeded the excess cancer risk of $1 \times 10^{-6}$ for a residential exposure scenario. However, the risk estimates for many sites were not completed, and those risk estimates are designated as unknown.

The risk estimates provided in Table 3-1 for cancer and noncancer risks are based on cumulative risk ratios. The ratios were formulated by dividing the highest concentration of a chemical by the risk-based concentration (RBC) (both cancer and noncancer) for that chemical as calculated in the Phase RI (Jacobs Engineering 1993c). These individual ratios were summed by chemical class and then by strata (or unit) for each site. The cumulative cancer ratio for each strata (or unit) was assumed to represent a cumulative cancer risk when the ratio was multiplied by $1 \times 10^{-6}$, as shown on Table 3-1. The noncancer cumulative risk ratio (or HI) is also shown on Table 3-1.

During the Phase I RI, chemicals detected in surface and shallow soil, sediment, and surface water were evaluated as COPECs. COPECs were selected by 1) eliminating chemicals not detected from consideration on a site-by-site basis; 2) eliminating inorganic constituents commonly found in the environment at relatively nontoxic levels or as macronutrients, including calcium, chloride, iron, magnesium, nitrate, phosphorous, potassium, sodium, and sulfate; and 3) eliminating chemicals that did not exceed remediation criteria from literature (Jacobs Engineering 1993c).

Chemicals detected in surface and shallow soil and remaining following the selection process and all chemicals detected in sediments and surface water were retained for evaluation as COPECs in the Phase I RI ecological risk assessment. A list of these COPECs is presented as Table 3-3.

### 4.2.2 Step 2 – Identify the Decisions

Defining question(s) that the study will attempt to resolve requires identification of questions and alternative outcomes. The general types of questions and alternative outcomes for the Phase II RI are presented below.

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present a risk to human health or the environment?

   If uncertain, collect additional soil samples to determine risk.

   If yes, proceed to the next decision.

   If no, recommend the unit for NFI.

2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, if necessary, to determine if impacted soil has reached groundwater.

   If no, evaluate a response action.

4. Does the extent of impacted soil extend to groundwater?

   If yes, conduct groundwater investigation.

   If no, model the fate and transport to groundwater.

5. Does the fate and transport model indicate a potential impact to groundwater?

   If yes, conduct groundwater investigation.

   If no, evaluate response action.

6. Is the horizontal and vertical extent of impacted groundwater sufficiently characterized to evaluate response actions?

   If yes, no further characterization is necessary.

   If no, further characterize the horizontal and vertical extent of impacted groundwater where needed to evaluate response actions.

7. Does impacted groundwater contribute to an unacceptable risk to human health or the environment?

   If yes, evaluate response actions with consideration to ARARs.

   If no, recommend NFA for groundwater.

8. SCAQMD Rule 1150.1 or 40 CFR Part 258.23 levels in air exceeded?

   If yes, evaluate a response action.

   If no, recommend NFA for air.

9. Are soil gas hot spots present within the landfills?

   If yes:

   a) does evidence exist to indicate the presence and approximate location of wastes?

   b) is the hot spot known to be principal threat waste (materials considered to be highly toxic or highly mobile that generally cannot be reliably contained as defined by the U.S. EPA [U.S. EPA 1991a])?

   c) is the waste in a discrete, accessible part of the landfill?

d) is the hot spot known to be significant enough that its remediation will reduce the threat posed overall by the landfill, but small enough to be economically removable?

If yes to the four proceeding questions, then evaluate treatment and removal actions.

If no to any of the above, then recommend NFA for hot spots; however, landfill site may require further remedial action (RA).

10. Are background or action levels exceeded in sediments or surface water?

If yes, evaluate potential sources.

If no, recommend NFA for sediment or surface water.

11. Does the site being evaluated for a response action qualify for Early Action?

If yes, recommend an EE/CA.

If no, recommend an FS to assess appropriate remedial responses.

12. Are pilot tests necessary to evaluate remedial alternatives as part of the RI/FS process (i.e., soil vapor extraction, air sparging, and groundwater capture)?

If yes, conduct necessary pilot testing.

If no, do not conduct pilot testing.

13. Are ecological risks known or suspected?

If yes, mitigate ecological risks in the RA.

If no, no further evaluation of ecological risks required.

### 4.2.3 Step 3 – Inputs to the Decisions

Inputs to the decision are key types of information needed to resolve decision statements and assure an optimized sampling design for the Phase II RI/FS. For the Phase II RI/FS, the primary types of data and issues to be considered are:

- possible IRP actions,
- existing information,
- preliminary remediation goals and action levels,
- background concentrations,
- tiered sampling programs,
- sampling designs,
- field sampling methods,
- analytical methods,
- fate and transport models,

- reuse of the Station,
- cleanup levels, and
- technology implementability, effectiveness, and cost.

#### 4.2.3.1 POSSIBLE INSTALLATION RESTORATION PROGRAM ACTIONS

A primary influence on the decisions is the type of IRP action that may be taken at the site. Possible IRP actions are:

- NFRAP,
- Early Action, and
- Long-Term Action.

***No Further Response Action Planned***

The NCP, Section 300.5, Definitions, defines sites that "do not warrant moving further in the site evaluation process" as "NFRAP." The DON will not expend resources on sites that pose little or no threat to humans or the environment. A NFA decision can be made at several points within the remedial process, but must be based on a defensible and properly documented "assessment of risk to human health and the environment." For the MCAS El Toro RI/FS effort, a NFRAP decision may be made, if:

- on the basis of the Phase I RI, results of a sampling program or other information indicate that there has not been nor is there likely to be a release;
- on the basis of a Baseline Risk Assessment, it is shown that the release poses no significant risk; or
- on the basis of a complete RI/FS, the No Action alternative is the preferred alternative considering all the criteria applicable to remedy selection.

The formulation of NFRAP will be based on the U.S. Air Force Environmental Restoration Program NFRAP guidance (U.S. Air Force 1994).

***Early Action***

Early Actions are responses performed under removal or interim remedial authority to eliminate or reduce human health or environmental threats from the release of hazardous substances or wastes (U.S. EPA 1992a). These risk-reduction activities can be conducted as emergency or time-critical removal actions (where quick response is necessary) or as non-time-critical removal actions and interim RAs in less urgent situations. The NCP has special requirements for non-time-critical removal actions, including the need to prepare an EE/CA and conduct community relations activities. An EE/CA is a study to identify and assess removal action alternatives.

***Long-Term Actions***

Long-Term Actions are usually taken when extensive site characterization and cleanup costs are high, and when the duration of cleanup may take more than 5 years to complete. An FS is usually completed for a long-term RA. Identification of a RA as a long-term response does not mean that the work can be deferred.

### 4.2.3.2 EXISTING INFORMATION

Existing information for the sites provides data on site conditions and features and are available from several existing sources (Jacobs Engineering 1993b,c, 1994b,c; Strata 1991). Summaries are presented in Tables 1-1 and 3-1. More site-specific information required for this step is provided in the appendices.

### 4.2.3.3 PRELIMINARY REMEDIATION GOALS

The U.S. EPA Region IX PRGs will be used for decision-making purposes to determine whether the extent of contamination in the Phase II RI has been determined (U.S. EPA 1995). Originally RBCs were developed as part of the Preliminary Health Risk Assessment for 22 OU-2 and OU-3 sites. These RBCs were to be used to assess possible remedial technologies, identify COPCs for the Phase II RI/FS, and estimate risks (Jacobs Engineering 1993c). However, for this WP, the U.S. EPA PRG tables will be used for health risk screening, rather than RBCs. Table 4-1 presents the COPCs and PRGs for MCAS El Toro.

Risk screening will be conducted according to the U.S. EPA PRG approach and will be used to make preliminary risk management decisions during Phase II RI/FS work. The preliminary risk management decisions will be based on Phase II RI sample results and will determine the types of Phase II RI/FS field activities. Risk screening is calculated for a cumulative human cancer risk of $1 \times 10^{-6}$ and an HI of 1.0 for noncancer chronic systemic toxicity in humans based on the concentrations of all COPCs detected for each site and using exposure times for residential exposures. The risk screening will be conducted in accordance with the U.S. EPA PRG stepwise approach (U.S. EPA 1995).

### 4.2.3.4 BACKGROUND AND AMBIENT CONCENTRATIONS

Background concentrations for inorganics and ambient concentrations for organics are needed as inputs because they provide a basis for comparing sample results and assessing whether the sample results indicate a naturally occurring concentration or the impacts of waste disposal. Consensus for establishing background concentrations for MCAS El Toro were presented in a series of documents, including the Phase I Technical Memorandum (Jacobs Engineering 1993c), the Phase II Draft WP (Jacobs Engineering 1993a), the BCP (Jacobs Engineering 1994a), Draft Evaluation of Background Concentrations of Inorganic Constituents in Groundwater (Jacobs Engineering 1994h), and BCT meetings. The following sections present criteria used by the Navy to evaluate background and ambient levels for surface soils, groundwater, surface water, and sediments.

**Table 4-1**
**Chemicals of Potential Concern, Method Detection Limits, and Preliminary Remediation Goals[a]**

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | Proposed Detection Limit water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m³[e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **TPH[f]** | **DHS[g]-TPH (CA LUFT[h])** | **8015M-A** | 10,000 | 500 | | | | |
| **Methane** | **TPH** | **8015** | NL[i] | NL | NL | NL | NL | NL |
| **TRPH[j]** | **IR[k]** | **418.1** | 10,000 | 500 | | | | |
| **BTEX[l]** | **GC[m]** | **8020A** | **MDLs[n]** | | | | | |
| Benzene | | | 50 | 0.5 | 1.4 | 3.2 | 0.23 | 0.39 |
| Toluene | | | 50 | 0.5 | 1,900 | 2,700 | 400 | 720 |
| Ethylbenzene | | | 50 | 0.5 | 2,900 | 3,100 | 1,100 | 1,300 |
| Xylene | | | 50 | 0.5 | 980 | 980 | 730 | 1,400 |
| **HVOCs[o]** | **GC** | **8010B** | **CLP[p] EQLs[q]** | | | | | |
| Benzyl chloride | | | 0.1 | 0.1 | 1.4 | 3.9 | 0.04 | 0.066 |
| Bromodichloromethane | | | 0.2 | 0.2 | 1.4 | 3.4 | 0.11 | 0.18 |
| Bromoform | | | 2.0 | 2.0 | 56 | 240 | 1.7 | 8.5 |
| Bromomethane | | | 3.0 | 3.0 | 15 | 57 | 52 | 87 |
| Carbon tetrachloride | | | 0.1 | 0.1 | 0.47 | 1.1 | 0.13 | 0.17 |
| Chlorobenzene | | | 0.1 | 0.1 | 160 | 570 | 21 | 39 |
| Chloroethane | | | 1.0 | 1.0 | 1,100 | 220 | 10,000 | 710 |
| 2-Chloroethyl vinyl ether | | | 1.3 | 1.3 | NL | NL | NL | NL |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (μg/kg[b]) | water (μg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (μg/m[3e]) | Tap Water (μg/L) |
|---|---|---|---|---|---|---|---|---|
| **HVOCs[o] (continued)** | **GC** | **8010B** | **CLP[p] EQLs[q]** | | | | | |
| Chloroform | | | 0.2 | 0.2 | 0.53 | 1.1 | 0.084 | 0.16 |
| Chloromethane | | | 0.3 | 0.3 | 2.0 | 4.3 | 1.1 | 1.5 |
| Dibromochloromethane | | | 0.3 | 0.3 | 5.3 | 23 | 0.08 | 1.0 |
| Dibromomethane | | | 22 | 22 | 650 | 6,800 | 37 | 370 |
| Dichlorodifluoromethane (Freon 12) | | | 0.5 | 0.5 | 110 | 350 | 210 | 390 |
| 1,1-Dichloroethane | | | 0.7 | 0.7 | 840 | 3,900 | 520 | 810 |
| 1,2-Dichloroethane | | | 0.3 | 0.3 | 0.44 | 0.98 | 0.074 | 0.12 |
| 1,1-Dichloroethene | | | 0.7 | 0.7 | .038 | 0.082 | 0.038 | 0.046 |
| cis-1,2-Dichloroethene | | | 0.1 | 0.1 | 59 | 200 | 37 | 61 |
| trans-1,2-Dichloroethene | | | 1.0 | 1.0 | 170 | 600 | 730 | 120 |
| 1,2-Dichloropropane | | | 0.4 | 0.4 | 0.68 | 1.5 | 0.099 | 0.16 |
| trans-1,3-Dichloropropene | | | 3.4 | 3.4 | 0.51 | 1.2 | 0.052 | 0.081 |
| Methylene chloride | | | 0.2 | 0.2 | 11 | 25 | 4.1 | 4.3 |
| 1,1,1,2-Tetrachloroethane | | | 0.05 | 0.05 | 4.8 | 12 | 0.26 | 0.43 |
| 1,1,2,2-Tetrachloroethane | | | 0.1 | 0.1 | 0.90 | 2.4 | 0.033 | 0.055 |
| Tetrachloroethene | | | 0.3 | 0.3 | 7.0 | 25 | 3.3 | 1.1 |
| 1,1,1-Trichloroethane | | | 0.3 | 0.3 | 3,200 | 3,000 | 1,000 | 1,300 |
| 1,1,2-Trichloroethane | | | 0.2 | 0.2 | 1.4 | 3.3 | 0.12 | 0.20 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air ($\mu g/m^3$[e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **HVOCs[o] (continued)** | **GC** | **8010B** | **CLP[o] EQLs[p]** | | | | | |
| Trichloroethene | | | 0.2 | 0.2 | 7.1 | 17 | 1.1 | 1.6 |
| Trichlorofluoromethane (Freon 11) | | | 0.3 | 0.3 | 710 | 2,400 | 730 | 1,300 |
| Trichlorotrifluoromethane (Freon 113) | | | 50[r] | 0.5[r] | 3,600 | 3,600 | 31,000 | 59,000 |
| Vinyl chloride | | | 0.2 | 0.2 | 0.0052 | 0.011 | 0.022 | 0.02 |
| **VOCs[s]** | **GC/MS[t]** | **8240B** | **CLP EQLs** | | | | | |
| Acetone | | | 100 | 100 | 2,000 | 8,400 | 370 | 610 |
| Acetonitrile | | | 100 | 100 | 390 | 4,100 | 52 | 220 |
| Acrolein (Propanol) | | | NL | NL | 1,300 | 12,000 | 0.021 | 730 |
| Acrylonitrile | | | NL | NL | 0.13 | 0.30 | 0.028 | 3.7 |
| Allyl alcohol | | | NL | NL | 330 | 3,400 | 18 | 180 |
| Allyl chloride | | | 5 | 5 | 3,300 | 34,000 | 1.0 | 1,800 |
| Benzyl chloride | | | 100 | 100 | 1.45 | 3.9 | 0.04 | 0.066 |
| Bromoacetone | | | NL | NL | NL | NL | NL | NL |
| Bromoform | | | 5 | 5 | 56 | 240 | 1.7 | 8.5 |
| Bromomethane | | | 10 | 10 | 15 | 57 | 52 | 87 |
| 2-Butanone (Methyl ethyl ketone) | | | 100 | 100 | 8,700 | 34,000 | 1,000 | 1,900 |
| Carbon disulfide | | | 100 | 100 | 16 | 52 | 10 | 21 |
| Chlorobenzene | | | 5 | 5 | 160 | 570 | 21 | 39 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m[3e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **VOCs[s] (continued)** | **GC/MS[t]** | **8240B** | **CLP EQLs** | | | | | |
| Chloroethane | | | 10 | 10 | 1,100 | 2,200 | 10,000 | 710 |
| 2-Chloroethyl vinyl ether | | | 10 | 10 | NL | NL | NL | NL |
| Chloromethane | | | 10 | 10 | 2.0 | 4.3 | 1.1 | 1.5 |
| Chloroprene | | | 5 | 5 | 6.3 | 21 | 7.3 | 14 |
| 1,2-Dibromo-3-chloropropane | | | 100 | 100 | 0.06[u] | 1.4 | 0.00096[u] | 0.0048[u] |
| Dibromomethane | | | 5 | 5 | 650 | 6,800 | 37 | 370 |
| 1,2-Dibromoethane | | | 5 | 5 | 0.0051 | 0.021 | 0.0087 | 0.00076 |
| 1,4-Dichloro-2-butene | | | 5 | 5 | 0.0076 | 0.018 | 0.00072 | 0.0012 |
| Dichlorodifluoromethane | | | 5 | 5 | 110 | 350 | 210 | 390 |
| 1,1-Dichloroethane | | | 5 | 5 | 840 | 3,900 | 520 | 810 |
| cis-1,2-Dichloroethene | | | 5 | 5 | 59 | 200 | 37 | 61 |
| trans-1,2-Dichloroethene | | | 5 | 5 | 170 | 600 | 73 | 120 |
| 1,3-Dichloropropene | | | 5 | 5 | 0.51 | 1.2 | .052 | 0.081 |
| 1,4-Dioxane | | | NL | NL | 14 | 37 | 0.61 | 1.0 |
| Epichlorohydrin | | | NL | NL | 8.6 | 30 | 1.0 | 2.0 |
| Ethylbenzene | | | 5 | 5 | 2,900 | 3,100 | 1,100 | 1,300 |
| Ethylene oxide | | | NL | NL | 0.12 | 0.30 | 0.19 | 0.024 |
| Ethyl methacrylate | | | 5 | 5 | 340 | 340 | 330 | 550 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air ($\mu g/m^3$[e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **VOCs[s]** | **GC/MS[t]** | **8240B** | **CLP EQLs** | | | | | |
| 2-Hexanone | | | 50 | 50 | 5,200 | 55,000 | 83 | 2,900 |
| 2-Hydroxypropionitrile | | | NL | NL | 20,000 | 100,000 | 1,100 | 11,000 |
| Malononitrile | | | NL | NL | 1.3 | 14 | 0.073 | 0.73 |
| Methacrylonitrile | | | 100 | 100 | 1.3 | 5.1 | 0.73 | 1.0 |
| Methylene chloride | | | 5 | 5 | 11 | 25 | 4.1 | 43 |
| Methyl methacrylate | | | 5 | 50 | 520 | 55,000 | 290 | 2,900 |
| 4-Methyl-2-pentanone | | | 50 | 50 | 5,200 | 55,000 | 8.3 | 2,900 |
| Propargyl alcohol | | | NL | NL | 130 | 1,400 | 7.3 | 73 |
| Propionitrile | | | 100 | 100 | NL | NL | NL | NL |
| Pyridine | | | NL | NL | 65 | 680 | 3.7 | 37 |
| Styrene | | | 5 | 5 | 2,200 | 2,200 | 1,100 | 1,600 |
| Toluene | | | 5 | 5 | 1,900 | 2,700 | 400 | 720 |
| 1,1,1-Trichloroethane | | | 5 | 5 | 3,200 | 3,000 | 1,000 | 1,300 |
| Trichlorofluoromethane (Freon 11) | | | 10[r] | 10[r] | 710 | 2,400 | 730 | 1,300 |
| Trichlorotrifluoromethane (Freon 113) | | | 10[r] | 10[r] | 3,600 | 3,600 | 31,000 | 59,000 |
| 1,2,3-Trichloropropane | | | 5 | 5 | 0.0066 | 0.015 | 0.00096 | 31 |
| Vinyl chloride | | | 50 | 50 | 0.0052 | 0.011 | 0.022 | 0.02 |
| Xylene(s) | | | 5 | 5 | 980 | 980 | 730 | 1,400 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m[3e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **Pesticides/PCBs[v,w]** | **GC** | **8080A** | **PQLs[x]** | | | | | |
| Aldrin | | | 2.68 | 0.04 | 0.026 | 0.11 | 0.00039 | 0.0040 |
| Alpha BHC | | | 2.01 | 0.03 | NL | NL | NL | NL |
| Chlordane | | | 40[r] | 1[r] | 0.34 | 1.5 | 0.0052 | 0.052 |
| 4',4'-DDD | | | 7.37 | 0.11 | 1.9 | 7.9 | 0.028 | 0.28 |
| 4',4'-DDE | | | 2.68 | 0.04 | 1.3 | 5.6 | 0.020 | 0.20 |
| 4',4'-DDT | | | 8.04 | 0.12 | 1.3 | 5.6 | 0.020 | 0.20 |
| Delta BHC | | | 6.03 | 0.09 | NL | NL | NL | NL |
| Dieldrin | | | 1.34 | 0.02 | 0.028 | 0.12 | 0.00042 | 0.042 |
| Endosulfan | | | 9.38 | 0.14 | 3.3 | 34 | 0.18 | 1.8 |
| Endosulfan sulfate | | | 44.2 | 0.66 | NL | NL | NL | NL |
| Endrin | | | 4.02 | 0.06 | 20 | 200 | 1.1 | 11 |
| Endrin aldehyde | | | 15.4 | 0.23 | NL | NL | NL | NL |
| Endrin ketone | | | 3.3[r] | 0.1[r] | NL | NL | NL | NL |
| Heptachlor | | | 2.01 | 0.03 | 0.099 | 0.42 | 0.0015 | 0.015 |
| Heptachlor epoxide | | | 55.6 | 0.83 | 0.049 | 0.21 | 0.00074 | 0.0074 |
| Lindane (gamma BHC) | | | 2.68 | 0.04 | NL | NL | NL | NL |
| Methoxychlor | | | 117.9 | 1.76 | 330 | 3400 | 18 | 180 |
| PCB 1016 | | | 13[r] | 1[r] | 4.9 | 65 | 0.26 | 2.6 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | Proposed Detection Limit water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m³[e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **Pesticides/PCBs[v,w] (continued)** | **GC** | **8080A** | **PQLs[x]** | | | | | |
| PCB 1221 | | | 13[r] | 2[r] | 0.066 | 0.34 | 0.00087 | 0.0087 |
| PCB 1232 | | | 13[r] | 1[r] | 0.066 | 0.34 | 0.00087 | 0.0087 |
| PCB 1242 | | | 43.6 | 0.65 | 0.066 | 0.34 | 0.00087 | 0.0087 |
| PCB 1248 | | | 13[r] | 1[r] | 0.066 | 0.34 | 0.00087 | 0.0087 |
| PCB 1254 | | | 13[r] | 1[r] | 1.4 | 19 | 0.073 | 0.73 |
| PCB 1260 | | | 13[r] | 1[r] | 0.066 | 0.34 | 0.00087 | 0.0087 |
| **Polyaromatic Hydrocarbons** | **HPLC[y]** | **8310** | **PQLs** | | | | | |
| Acenaphthene | | | 1,206 | 18 | 360 | 360 | 220 | 370 |
| Acenaphthylene | | | 1,540 | 23 | NL | NL | NL | NL |
| Anthracene | | | 140 | 2.1 | 19 | 19 | 1,100 | 1,800 |
| Benzo(a)anthracene | | | 10 | 0.15 | 0.61 | 2.6 | 0.0092 | 0.092 |
| Benzo(a)pyrene | | | 15 | 0.23 | 0.061 | 0.26 | 0.00092 | 0.0015[u] |
| Benzo(b)fluoranthene | | | 12 | 0.18 | 0.61 | 2.6 | 0.0092 | 0.092 |
| Benzo(g,h,i)perylene | | | 50 | 0.76 | NL | NL | NL | NL |
| Benzo(k)fluoranthene | | | 11 | 0.17 | 0.61[u] | 26 | 0.092 | 0.92 |
| Chrysene | | | 100 | 1.5 | 6.1[u] | 24 | 0.92 | 9.2 |
| Dibenzo(a,h)anthracene | | | 20 | 0.30 | 0.061 | 0.26 | 0.00092 | 0.0092 |
| Fluoranthene | | | 140 | 2.1 | 2,600 | 27,000 | 150 | 1,500 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/$m^3$[e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **Polyaromatic Hydrocarbons (continued)** | **HPLC** | **8310** | **PQLs** | | | | | |
| Fluorene | | | 140 | 2.1 | 30 | 300 | 150 | 240 |
| Indeno(1,2,3-cd)pyrene | | | 29 | 0.43 | 0.61 | 2.6 | 0.0092 | 0.092 |
| Naphthalene | | | 1,206 | 18 | 800 | 800 | 150 | 240 |
| Phenanthrene | | | 429 | 6.4 | NL | NL | NL | NL |
| Pyrene | | | 180 | 2.7 | 2,000 | 20,000 | 110 | 1,100 |
| **SVOCs[z]** | **GC/MS** | **8270B** | **CLP EQLs** | | | | | |
| Benzyl butyl phthalate | | | 660 | 10 | 13,000 | 100,000 | 730 | 7,300 |
| Bis(2-ethylhexyl) phthalate | | | 660 | 10 | 32 | 140 | 0.48 | 4.8 |
| Carbazole | | | NL | NL | 22 | 95 | 0.34 | 3.4 |
| 2-Chlorophenol | | | 660 | 10 | 330 | 3,400 | 18 | 180 |
| 4-Chloro-3-methyl phenol | | | 1,300 | 20 | NL | NL | NL | NL |
| Dibenzofuran | | | 660 | 10 | 260 | 2,700 | 15 | 150 |
| Diethyl phthalate | | | 660 | 10 | 52,000 | 100,000 | 2,900 | 29,000 |
| Dimethyl phthalate | | | 660 | 10 | 100,000 | 100,000 | 37,000 | 370,000 |
| Di-*n*-butyl phthalate | | | NL | 10 | 6,500 | 68,000 | 370 | 3,700 |
| Di-*n*-octyl phthalate | | | 660 | 10 | 1,300 | 14,000 | 73 | 730 |
| Hexachloroethane | | | 660 | 10 | 32 | 140 | 0.48 | 4.8 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | Proposed Detection Limit water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m[3e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **SVOCs[z] (continued)** | **GC/MS** | **8270B** | **CLP EQLs** | | | | | |
| Isophorone | | | 660 | 10 | 470 | 2,000 | 7.1 | 71 |
| 2-Methyl naphthalene | | | 660 | 10 | NL | NL | NL | NL |
| 4-Methyl phenol | | | 660 | 10 | 330 | 3,400 | 18 | 180 |
| 2-nitrophenol | | | 660 | 10 | NL | NL | NL | NL |
| 4-nitrophenol | | | 3,300 | 50 | NL | NL | NL | NL |
| *n*-Nitrosodipropylamine | | | 660 | 10 | 630 | 0.27 | 0.00096 | 0.0096 |
| Pentachlorophenol | | | 3,300 | 50 | 2.5 | 7.9 | 0.056 | 0.56 |
| Phenol | | | 660 | 10 | 39,000 | 100,000 | 2,200 | 22,000 |
| **Herbicides[w]** | **GC** | **8150B** | **CLP EQLs** | | | | | |
| 2,4-D | | | 240 | 12 | 650 | 6,800 | 37 | 370 |
| 2,4-DB | | | 182 | 9.1 | 520 | 5,500 | 29 | 2,990 |
| Dalapon | | | 1,160 | 58 | 2,000 | 20,000 | 110 | 1,100 |
| Dicamba | | | 54 | 2.7 | 2,000 | 20,000 | 110 | 1,100 |
| Dichloroprop | | | 130 | 6.5 | NL | NL | NL | NL |
| Dinoseb | | | 14 | 0.7 | 65 | 680 | 3.7 | 37 |
| MCPA | | | 49,800 | 200[f] | 33 | 340 | 1.8 | 18 |
| MCPP | | | 38,400 | 200[f] | 65 | 680 | 3.7 | 37 |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | Proposed Detection Limit water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m[3e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **Herbicides[w] (continued)** | **GC** | **8150B** | **CLP EQLs** | | | | | |
| 2,4,5-trichlorophenoxy acetic acid | | | 40 | 2.0 | 650 | 6,800 | 37 | 370 |
| 2,4,5-trichlorophenoxy propionic acid (Silvex) | | | 34 | 1.7 | 520 | 5,500 | 29 | 290 |
| **Dioxin** | **GC/MS** | **8280** | **CLP EQLs (soil)** | | | | | |
| Octochlorodibenzo-p-dioxins | | | 0.002[r] | | 0.00072 | 0.00031 | 0.0000015 | 0.000011 |
| **Radionuclides** | **Scintillation counter** | **703** | | | | | | |
| Gross alpha | | | NL | | NL | NL | NL | NL |
| Gross beta | | | NL | | NL | NL | NL | NL |
| **Explosives** | **HPLC (GC/MS)** | **8330A** | **CLP EQLs (soil)** | | | | | |
| HMX | | | 2,200 | | 3,300 | 34,000 | 180 | 1,800 |
| RDX | | | 1,000 | | 4.0 | 17 | 0.061 | 0.61 |
| 1,3,5-TNB | | | 250 | | 3.3 | 34 | 0.18 | 1.8 |
| 1,3-DNB | | | 250 | | 6.5 | 68 | 0.37 | 3.7 |
| Tertyl | | | 650 | | 650 | 6,800 | 37 | 370 |
| Nitrobenzene | | | 260 | | 33 | 340 | 2.1 | 18 |
| 2,4,6-Trinitrotoluene | | | 250 | | 48 | 64 | 0.22 | 2.2 |
| 4-Amino-4,6-dinitrotoluene | | | NL | | NL | NL | NL | NL |
| 2-Amino-4,6-dinitrotoluene | | | NL | | NL | NL | NL | NL |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air ($\mu g/m^3$[e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **Explosives (continued)** | **HPLC (GC/MS)** | **8330A** | **CLP EQLs (soil)** | | | | | |
| 2,4-Dinitrotoluene | | | 260 | | 130 | 1,400 | 7.3 | 73 |
| 2,6-Dinitrotoluene | | | 250 | | 65 | 680 | 3.7 | 37 |
| 2-Nitrotoluene | | | 250 | | NL | NL | NL | NL |
| 3-Nitrotoluene | | | 250 | | 650 | 6,800 | 37 | 370 |
| 4-Nitrotoluene | | | 250 | | 650 | 6,800 | 37 | 370 |
| **INORGANICS** | | | **CLP CRDLs[aa]/EDLs[bb]** | | | | | |
| *Total Cyanide/metallo* | Colorimetric | 9010/335 | NL | 10 | 1,300 | 14,000 | NL | 730 |
| *Nitrate-Nitrite* | Colorimetric | 353.2 | NL | 10 | 100,000/6,500 | 100,000 | NL | 58,000/3,700 |
| *Phosphorus* | Colorimetric | 365.2 | 51 | 10 | NL | NL | 0.073 | NL |
| *Sulfate* | Colorimetric | 375.4 | 5 | 5 | NL | NL | NL | NL |
| **General Chemistry** | | | | | | | | |
| TKN | Segmented flow analyzer | 351.2 | NL | 10.0[r] | | | | |
| TDS | Balance | 160.1 | NL | 5,000[r] | | | | |
| TOC | — | 415.1 | 0.5%[r] | 500[r] | | | | |
| BOD | — | 405.1 | NL | 4,000[r] | | | | |
| COD | Filtration | 410.4 | NL | 5,000[r] | | | | |
| Total phenolics | Segmented flow analyzer | 420.1 | 500[r] | 10[r] | | | | |

(table continues)

**Table 4-1** (continued)

| Chemicals of Potential Concern | Method | Method Number | Proposed Detection Limit soil (µg/kg[b]) | water (µg/L[c]) | PRELIMINARY REMEDIATION GOALS Residential Soil (mg/kg[d]) | Industrial Soil (mg/kg) | Ambient Air (µg/m[3e]) | Tap Water (µg/L) |
|---|---|---|---|---|---|---|---|---|
| **TAL[cc] Metals[w]** | | | | | | | | |
| Aluminum | ICP[dd] | 200.7 | 45 | 45 | 77,000 | 100,000 | NL | 37,000 |
| Antimony | ICP-MS[ee] | 200.8 | 32 | 0.02[r] | 31 | 680 | NL | 15 |
| Arsenic | ICP-MS | 200.8 | 53 | 0.1[r] | 0.32 | 2.0 | 0.00045 | 0.038 |
| Barium | ICP | 200.7 | 2 | 2 | 5,300 | 100,000 | 0.52 | 2,600 |
| Beryllium | ICP-MS | 200.8 | 0.3 | 0.02[r] | 0.14 | 1.1 | 0.00080 | 0.016 |
| Cadmium | ICP | 200.7 | 4 | 4 | 9.0[u] | 850 | 0.0011 | 18 |
| Chromium, Hexavalent | GFAA[ff] | 7196 | 200 | 20 | 0.20[u] | 230 | 0.000023 | 0.16[u] |
| Chromium | ICP | 200.7 | 7 | 7 | 210 | 1,600 | 0.00016 | NL |
| Cobalt | ICP | 200.7 | 7 | 7 | NL | NL | 1.0 | NL |
| Copper | ICP | 200.7 | 6 | 6 | 2,800 | 63,000 | NL | 1,400 |
| Organic lead | GFAA | DHS method | 50 | 50 | NL | NL | NL | NL |
| Lead | GFAA | 200.9 | 42 | 3 | 130[u] | 1,000 | NL | 4.0 |
| Manganese | ICP | 200.7 | 2 | 2 | 380 | 8,300 | 0.051 | 180 |
| Mercury | CVAA[gg] | 200 Series | 0.2 | 0.2 | 23 | 510 | 0.31 | 11 |
| Nickel | ICP | 200.7 | 15 | 40 | 150[u] | 34,000 | NL | 730 |
| Selenium | HAA[hh] | 6010/200 Series | 75 | 5 | 380 | 8,500 | NL | 180 |
| Silver | ICP | 200.7 | 7 | 7 | 380 | 8,500 | NL | 180 |
| Thallium | ICP-MS | 200.8 | 40 | 0.03[r] | 6.1 | 140 | NL | 2.9 |
| Vanadium | ICP | 200.7 | 8 | 8 | 540 | 12,000 | NL | 260 |
| Zinc | ICP | 200.7 | 2 | 2 | 23,000 | 100,000 | NL | 11,000 |

(table continues)

**Table 4-1** (continued)

Notes:

[a] The compound list provided under each method does not reflect the complete method compound list, only the compounds of potential concern at MCAS El Toro.
[b] µg/kg – micrograms per kilogram
[c] µg/L – micrograms per liter
[d] mg/kg – milligrams per kilogram
[e] µg/m$^3$ – micrograms per cubic meter
[f] TPH – total petroleum hydrocarbons
[g] DHS – Department of Health Services - U.S. Environmental Protection Agency (U.S. EPA) SW-846 Test Methods for Evaluating Solid Waste
[h] LUFT – California Leaking Underground Fuel Tank Field Manual, November 1989
[i] NL – not listed
[j] TRPH – total recoverable petroleum hydrocarbons
[k] IR – infrared spectroscopy
[l] BTEX – benzene, toluene, ethylbenzene, and xylenes
[m] GC – gas chromatography
[n] MDL – method detection limit using purge and trap method (U.S. EPA Method 5030)
[o] HVOC– halogenated volatile organic compound
[p] CLP – U.S. EPA Contract Laboratory Program
[q] EQL– estimated quantitation limit
[r] CLEAN II contract laboratory QA Manual method reporting limits
[s] VOC – volatile organic compound
[t] GC/MS – gas chromatography/mass spectroscopy
[u] California-modified Preliminary Remediation Goal
[v] PCB– polychorinated biphenyl
[w] Background detection limits proposed are based on risk-based concentrations and background concentration.
[x] PQL – practical quantitation limit
[y] HPLC – high-performance liquid chromatography
[z] SVOC – semivolatile organic compound
[aa] CRDL – contract-required detection limit
[bb] EDL – estimated detection limit
[cc] TAL – target analyte list
[dd] ICP – inductively coupled plasma spectroscopy
[ee] ICP-MS – inductively coupled plasma spectroscopy-mass spectrometry
[ff] GFAA – graphite furnace atomic absorption
[gg] CVAA – cold vapor atomic absorption spectroscopy
[hh] HAA – hydride atomic absorption spectroscopy

### *Shallow Soils*

Background levels for metals, pesticides, and herbicides in shallow soils (less than 10 feet bgs) at MCAS El Toro were calculated using a statistical approach to estimate the upper range of naturally occurring metal concentrations, and pesticide and herbicide concentrations (Jacobs Engineering 1993a). The data used for this purpose were analytical results of samples collected from randomly selected locations in areas not exposed to potential MCAS El Toro activities. The metal values were based on samples collected from two depths at 11 locations. The pesticide and herbicide values were based on samples collected at 22 off-Station locations, divided among residential, commercial, and agricultural areas.

The upper end of the range of naturally occurring metals and ambient (or anthropogenic) pesticides and herbicides concentrations was estimated by calculating the 99th percentile of the distribution of the data values assuming a lognormal distribution with a 50-percent confidence. Tables 4-2 and 4-3 present the results of the statistical analysis for the parameters in background and ambient soil samples. The *arithmetic mean* is the average value of the concentration values. The estimated mean is the estimated value of the *arithmetic mean* based on the lognormal distribution. The *coefficient of variation (CV)* is the standard deviation divided by the arithmetic mean. The critical value to be used for background and ambient comparisons is given by the estimated 99th percentile of the distribution of background and ambient concentrations for each chemical (Jacobs Engineering 1993a).

A study is currently proposed to assess the regional trend and establish ambient concentrations of polynuclear aromatic hydrocarbons (PAH) at MCAS El Toro. This study should be conducted under the RCRA Corrective Action program. Surface and shallow soils will be collected from locations across the Station, and a separate WP will be prepared for approval by the BCT for this study.

### *Groundwater*

A draft report of regional background concentrations for inorganics in groundwater is currently available (Jacobs Engineering 1994h). These values will be considered when Phase II RI/FS work at OU-2 and OU-3 require groundwater investigation.

### *Surface Water*

Background levels in surface waters have not been established for MCAS El Toro. Surface water sampling was conducted for the five major drainages as part of the Phase I RI, both upstream and downstream of MCAS El Toro (Jacobs Engineering 1993c). Additional surface water samples have been proposed during the Phase II RI. These data will be combined with Phase I RI data and National Pollutant Discharge Elimination System storm water monitoring results at MCAS El Toro to evaluate background concentrations and the potential contribution of MCAS El Toro activities on

**Table 4-2**
**Results of Background Soil Statistical Analysis - Metals**
**(MCAS El Toro BRAC Cleanup Plan)**

| Parameter | Number Stations | Arithmetic Mean (mg/kg[a]) | Estimated Mean (mg/kg) | CV[b] (mg/kg) | 99th Percentile 50-Percent Confidence |
|---|---|---|---|---|---|
| Silver | 11 | .3 | .3 | .30 | .55 |
| Aluminum | 11 | 7212.0 | 7307.1 | .53 | 25396.26 |
| Arsenic | 11 | 1.9 | 2.3 | 2.18 | 37.61 |
| Barium | 11 | 69.6 | 70.4 | .60 | 281.01 |
| Beryllium | 11 | .3 | .3 | .55 | 1.20 |
| Calcium | 11 | 8651.6 | 6645.9 | 1.28 | 62164.12 |
| Cadmium | 11 | 1.6 | 1.5 | 2.09 | 23.11 |
| Cobalt | 11 | 3.2 | 3.6 | 1.19 | 31.02 |
| Chromium | 11 | 11.1 | 11.6 | 1.45 | 124.81 |
| Copper | 11 | 7.7 | 7.9 | 1.41 | 82.91 |
| Iron | 11 | 8404.3 | 8881.8 | .88 | 54001.66 |
| Mercury | 11 | .1 | .1 | 1.01 | .37 |
| Potassium | 11 | 2150.2 | 2258.5 | .92 | 14399.89 |
| Magnesium | 11 | 3359.5 | 3377.4 | .78 | 18014.29 |
| Manganese | 11 | 170.4 | 181.8 | .89 | 1114.98 |
| Sodium | 11 | 228.3 | 228.8 | .38 | 592.31 |
| Nickel | 11 | 13.1 | 13.0 | 2.00 | 193.61 |
| Lead | 11 | 6.0 | 6.3 | .71 | 29.91 |
| Antimony | 11 | 1.4 | 1.4 | .26 | 2.81 |
| Selenium | 11 | .1 | .1 | .69 | .48 |
| Thallium | 11 | .2 | .2 | .53 | .60 |
| Vanadium | 11 | 30.4 | 30.8 | 1.27 | 285.55 |
| Zinc | 11 | 31.9 | 32.3 | .81 | 179.47 |

Source:
Jacobs Engineering 1994a

Notes:
[a] mg/kg – milligrams per kilogram
[b] CV – coefficient of variation

**Table 4-3**
**Results of Background Statistical Analysis - Pesticides/Herbicides**
**(MCAS El Toro BRAC Cleanup Plan)**

| Parameter | Number Stations | Arithmetic Mean (µg/kg[a]) | Estimated Mean (µg/kg) | CV[b] (µg/kg) | 99th Percentile 50-Percent Confidence |
|---|---|---|---|---|---|
| **HERBICIDES** | | | | | |
| 2, 4 Dichlorophenoxy Acetic Acid | 21 | 58.4 | 58.4 | .04 | 64.47 |
| 2, 4, 5-T | 21 | 14.6 | 14.6 | .04 | 16.13 |
| 2, 4-DB | 21 | 29.9 | 29.9 | .10 | 38.27 |
| Dicamba | 21 | 29.2 | 29.2 | .04 | 32.25 |
| MCPA | 21 | 15986.3 | 15812.0 | .25 | 28808.83 |
| Dalapon | 21 | 29.2 | 29.2 | .04 | 32.25 |
| Dinose | 21 | 14.6 | 14.6 | .04 | 16.13 |
| MCPP | 21 | 14601.2 | 14601.6 | .04 | 16127.24 |
| Dichloroprop | 21 | 60.4 | 60.4 | .12 | 81.44 |
| 2, 3, 5-TP (Silvex) | 21 | 14.6 | 14.6 | .04 | 16.13 |
| **PESTICIDES** | | | | | |
| Aldrin | 21 | 1.0 | 1.0 | .04 | 1.09 |
| BHC-Alpha | 21 | 1.0 | 1.0 | .04 | 1.09 |
| BHC-Delta | 21 | 1.0 | 1.0 | .04 | 1.09 |
| BHC-Gamma (Lindane) | 21 | 1.0 | 1.0 | .04 | 1.09 |
| Alpha-Chlordane | 21 | 1.2 | 1.2 | .40 | 2.94 |
| Gamma-Chlordane | 21 | 1.3 | 1.2 | .42 | 3.19 |
| 4, 4'-DDD | 21 | 5.5 | 4.5 | 1.12 | 29.37 |
| 4, 4'-DDE | 21 | 20.1 | 12.5 | 2.84 | 177.29 |
| 4, 4'-DDT | 21 | 23.7 | 16.3 | 3.20 | 248.37 |
| Dieldrin | 21 | 7.2 | 4.2 | 1.21 | 29.42 |
| Endrin Aldehyde | 21 | 2.9 | 2.5 | .57 | 8.31 |
| Endrin Ketone | 21 | 1.9 | 1.9 | .04 | 2.13 |
| Endrin | 21 | 2.3 | 2.2 | .38 | 5.34 |
| Endosulfan Sulfate | 21 | 2.0 | 2.0 | .15 | 2.95 |

(table continues)

Table 4-3 (continued)

| Parameter | Number Stations | Arithmetic Mean (µg/kg[a]) | Estimated Mean (µg/kg) | CV[b] (µg/kg) | 99th Percentile 50-Percent Confidence |
|---|---|---|---|---|---|
| **PESTICIDES** (continued) | | | | | |
| Endosulfan I | 21 | 1.0 | 1.0 | .42 | 2.51 |
| Endosulfan II | 21 | 2.1 | 2.1 | .27 | 3.96 |
| Heptachlor Epoxide | 21 | 1.0 | 1.0 | .04 | 1.09 |
| Heptachlor | 21 | 1.0 | 1.0 | .04 | 1.09 |
| Methoxychlor | 21 | 10.4 | 10.4 | .11 | 13.67 |

Source:
Jacobs Engineering 1994a

Notes:
[a] µg/kg – micrograms per kilogram
[b] CV – coefficient of variation

inorganic and organic compound concentrations. Upstream surface water quality data from Phase I and Phase II results will be considered as background values and will be compared to downstream values to analyze the potential contribution of MCAS El Toro discharges to surface water.

***Sediment***

Sediment background concentrations will be established on a site-specific basis where a site is bisected by a stream or wash. A sediment sample will be collected immediately upstream from the site and analyzed for inorganics, organics, and grain-size distribution. This upstream sample will then be compared to sediment samples collected immediately downstream and analyzed for the same parameters to assess potential contribution of the site to COPC concentrations in surface drainage sediments.

### 4.2.3.5 TIERED SAMPLING PROGRAMS

Inputs to decisions usually require an iterative, flexible, or tiered sampling program. Three primary tiers are recognized for the Phase II RI/FS. The objectives of the sampling programs are different for the OU-2 sites and the OU-3 sites. Therefore, the types of activities conducted under each tier are not necessarily equivalent.

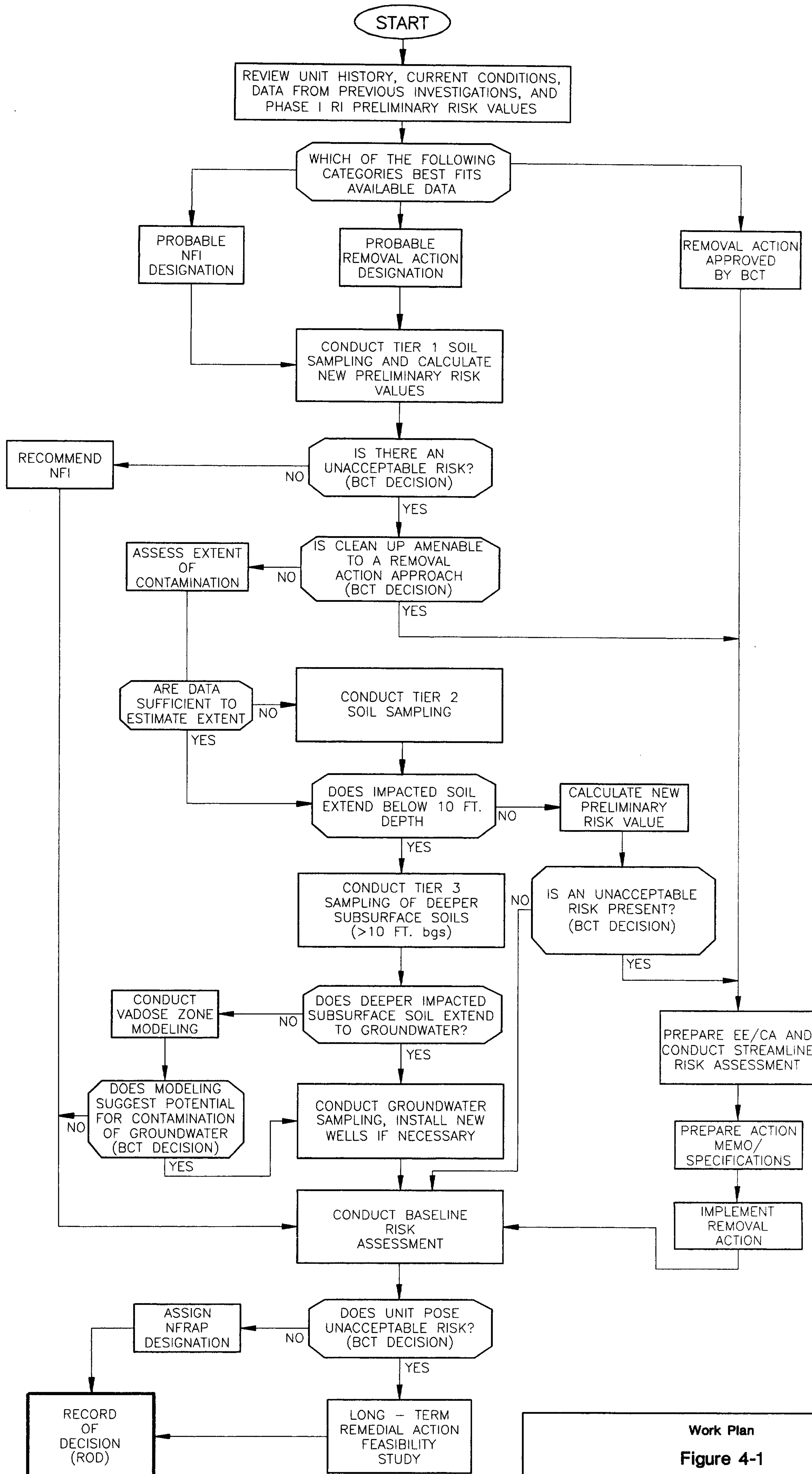
For the OU-2 landfill sites, presumptive remedies (i.e., capping, groundwater treatment, gas control and treatment, and/or deed restrictions) are the preferred approach, although other remedial alternatives may be considered. Further, adverse impacts on groundwater quality associated with landfill activities have already been identified at Site 2. Therefore, the focus of the Phase II RI/FS for the landfills is the collection of data supporting design of the presumptive remedy. For OU-2 Sites 24 and 25, the objective of the Phase II RI/FS is to assess the extent of the VOC source areas, characterize migration pathways to groundwater, and develop alternatives for remediation of VOC contamination that has resulted in off-site migration of VOC-contaminated groundwater. For the OU-2 landfill sites, the Site 24 VOC Source Investigation, and Site 25 Major Drainages, activities conducted under the three tiers can be summarized as follows:

- Tier 1– generally this tier consists of sampling activities using less expensive field screening methods for limited lists of analytes supported by limited expensive Contract Laboratory Program (CLP) analytical methods by a fixed-base laboratory that are used to cover large areas to verify or revise established unit boundaries and designate areas with higher concentrations of contaminants requiring further characterization;
- Tier 2 – sampling procedures that use more expensive CLP analytical methods by a fixed-base laboratory focusing on smaller areas of higher concentrations; and
- Tier 3 – assessment of risks and analyses of feasible removal or RAs.

For the OU-3 sites, the risks and extent of contamination are the primary objectives of the Phase II RI/FS. Therefore, the three-tiered approach used for the OU-3 sites is as follows:

- Tier 1 – sampling procedures that use less expensive field screening methods for a limited list of analytes supported by limited expensive CLP analytical methods by a fixed-base laboratory to assess level of risk and designate areas with higher concentrations requiring further characterization of shallow soils;
- Tier 2 – sampling procedures that use less expensive field screening methods for a limited list of analytes supported by limited expensive CLP analytical methods by a fixed-base laboratory to assess the extent of shallow soil contamination or, where applicable, to target areas for deeper subsurface soil investigation; and
- Tier 3 – sampling procedures that use less expensive field screening methods for a limited list of analytes supported by limited expensive CLP analytical methods by a fixed-base laboratory to assess horizontal and vertical extent of deeper subsurface soil contamination and determine whether deeper soil contaminants impact groundwater.

This tiered sampling approach is crucial to the reclassification of units within the OU-3 sites for NFI or removal action. The integration of this approach into the process of reclassifying units within the OU-3 sites is graphically illustrated in Figure 4-1. Units proposed for NFI would be designated upon completion of the tier 1 sampling, based upon the absence of an unacceptable preliminary human health risk value (i.e., $< 1 \times 10^{-6}$). Units satisfying removal action criteria could be delineated following any of the three sampling tiers. The point at which a removal action designation is made would depend upon the nature of the data available at that time.




**Work Plan**

## Figure 4-1

**OU-3 Site Classification Tiered Sampling Approach**

MCAS El Toro, California

CLEAN II Program

Date: 7/13/95
File No. ou3-appr
Job No. 22214-059

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### 4.2.3.6 SAMPLING DESIGNS

Sampling designs are needed to provide resource-effective sampling procedures. The Phase II RI/FS revised draft WP includes four proposed sampling designs to achieve the necessary inputs to the DQO. These sampling designs provide a mechanism to locate sampling locations on the surface. However, samples may be taken at depth at each sample location, depending on the site-specific objective of the Phase II RI/FS. Each sampling design is intended to provide data required to satisfy a particular site-specific objective or set of site-specific objectives. These site-specific objectives include:

- determining nature and extent of COPCs,
- characterization of potential migration pathways,
- identification of hot spots, and
- estimation of human health and environmental risks.

Each site at MCAS El Toro will have a site-specific sampling program that will use one or a combination of these sampling designs. The four sampling design types are:

- judgmental sampling,
- stratified random sampling,
- systematic random sampling along an axis, and
- areal systematic random sampling based on a grid.

The three random sampling designs are probabilistic and are intended to provide random data that can be statistically evaluated in combination with the Phase I RI data. Because judgmental samples are deliberately located and involve no degree of randomness in their placement, they are considered biased rather than unbiased representations of a site. As such, they do not provide acceptable values for use in estimating the mean or variance in a data set and cannot be evaluated statistically in combination with other randomly located data.

The procedures and subsequent limitations associated with the use of data obtained from each sample design type are described in the following paragraphs. Several of these general sample design types include multiple permutations of the basic design. Some of these permutations are also identified and addressed in the following paragraphs.

#### *Judgmental Sampling Design*

Judgmental sample locations are selected using professional judgment and experience; no statistical analysis is involved. A judgmental sampling design is used when:

- existing data for a site are available and the objective of sampling is simply to confirm the existing data in support of any conclusions drawn from those data;
- existing data for a site are available, the decision to remediate has been made, and the objective of sampling is to refine definition of the extent;

- the objective of sampling is to provide additional information for risk assessment or fate and transport analysis at specific locations; and
- the objective of sampling is to obtain information about conditions at a specific location (e.g., stain, upstream and downstream locations in the major drainages; deposit of unknown chemical).

Thus, the lack of randomness in the judgmental sampling design precludes its utility in comparing those data with an unbiased sampling design.

### *Stratified Random Sampling*

The second sample design is stratified random sampling, which consists of randomly located sampling points within the area being investigated. The stratified random sampling design is used when:

- little or no information on the source or migration of contamination is available and the objective is to conduct limited sampling to determine whether the site poses a risk (human health or ecological) that would necessitate further, more detailed investigation;
- the volume of available random sample data is insufficient for conducting a risk assessment and the objective is to collect additional random data to satisfy risk assessment requirements; and
- existing data for a site are available and the objective of sampling is to confirm the existing data in support of any conclusions drawn from those data.

The stratified random sampling design can be applied to an entire site if it is being sampled for the first time, or to portions of a site where additional samples are needed.

If existing samples appear to be clustered in one part of the site and an objective of the investigation is improved site characterization, a permutation of the basic stratified random sampling design could be used. In this case, the site could be divided into two or more subareas, where one subarea encompasses the existing sample locations. The new samples would then be randomly located at depth in the one or more additional subareas to provide more areal, random sample coverage of the site. Because the new and existing sample locations were randomly placed, it would be acceptable to combine the two random data sets into a single random data set characterizing the entire site.

Another permutation for supplementing existing data would again involve subdividing the area into several subareas and assigning a predetermined number of sample locations to each subarea (predetermined number of samples per subarea is equal to the total samples divided by the number of subareas). The number of existing sample locations within each subarea would then be subtracted from the predetermined number, and the resulting value for each subarea would represent the number of locations remaining to be sampled.

Many methods are also available for determining random sample locations. One common method involves laying out $x$ and $y$ axes along the margins of a site. Sample locations would represent the intersection of two random-number values designating positions along the $x$ and $y$ axes. Another method involves dividing the site into a series of sequentially numbered blocks. Samples would be collected from within the blocks that were selected at random from the total number.

### *Systematic Random Sampling on a Linear Axis*

The systematic random sampling along a linear axis approach is a specialized sample design developed to facilitate random sampling of long, narrow areas such as pavement edges, drainage ditches, and pipelines. Like the stratified random sampling design, linear random sampling was used at several sites during the Phase I RI and was included in the Phase II RI/FS Draft Work Plan. The systematic random sampling along a linear axis design is used when:

- little or no information about a site is available and the objective is to conduct limited sampling to determine whether the site poses a risk (human health or ecological) that would necessitate further, more detailed investigation;
- existing data for the site are available and the objective of sampling is to define the extent of the problem;
- the volume of available random sample data is insufficient for conducting a risk assessment and the objective is to collect additional random data to satisfy risk assessment requirements; and
- existing data for a site are available and the objective of sampling is to confirm the existing data in support of any conclusions drawn from those data.

The systematic random sampling along a linear axis design is based upon the number of samples to be collected and the length of the linear feature being sampled. The length is divided by the number of sample locations to determine a base sample location spacing. Then, an initial starting location is randomly selected along the length of the feature. Once that point is established, the remaining sample locations are placed at fixed intervals at both sides of the point along the length of the feature using the sample location spacing value derived earlier. As with the stratified random sampling design, the systematic random sampling along a linear axis design could be applied to a new site or a subsection of a particular area or feature if existing coverage was satisfactory in part of the site but unsatisfactory in another.

### *Areal Systematic Random Sampling*

The final sampling design proposed for use during the Phase II RI/FS is areal systematic random sampling based on a grid. This type of sample design is typically used when:

- the objective is characterizing the nature and extent of a problem, whether or not existing information about the site is available; and
- the objective is to detect hot spots.

All areal systematic random sampling based on a grid designs involves two basic steps. The first step is to select an initial random starting location. This location is typically defined as the intersection of points randomly located along the *x* and *y* axes laid out at the perimeter of the site. The second step is to locate the remaining grid nodes. From the random starting location, a systematic square grid is constructed with each node (*x*/*y* coordinate) spaced at a predetermined, but fixed distance from the previous location. The grid is aligned along the *x* and *y* axes defined for step one. The grid is built outward progressively from the starting location in all directions until the entire area to be investigated has been covered.

Once the grid layout has been completed, the simplest design variation is to use the grid nodes as the sample locations (a similar variation would be placement of the sample location in the center of each grid block, which is defined by four grid nodes). The benefit of such design variations is that the individual sample locations are spaced at regular intervals. This type of design will be used for hot spot detection.

An additional degree of randomness will be added to the systematic grid in certain areas. This is accomplished by randomly positioning the sample locations within the grid cells (Gilbert 1987).

### 4.2.3.7 FIELD SAMPLING METHODS

The field sampling methods to collect samples of air, surface water, soils, groundwater, and sediment will provide the samples necessary for analysis and, eventually, the analytical results used in the decision-making process. Available sampling methods may have limitations that would also provide input to the decisions. The types of sampling methods are discussed in Section 5 of this WP and Section 6 of the FSP (BNI 1995a). Various sampling methods may include grab samples, soil borings, monitoring wells, ambient air collection devices, and soil gas probes.

### 4.2.3.8 ANALYTICAL METHODS

The overall objective of analytical methods is to provide analytical results for comparison to PRGs, background and ambient concentrations, and action levels. This comparison will allow rapid decision making during the field investigations.

#### *Field Measurements*

Field measurements provide qualitative results and are collected to characterize field conditions during sampling events. Field measurements will vary depending on the circumstances surrounding a specific sampling event, the type and anticipated concentration of the contaminants, and the media to be sampled. Field measurements to be taken may include pH, conductivity, temperature, VOCs using a flame ionization detector (FID) or photoionization detector (PID), product thickness, and depth to water. The physical measurements will be recorded with the greatest precision allowable by the instrument used.

### *Field Screening*

Field screening (qualitative and quantitative) will provide data that characterize sample conditions. Qualitative field screening devices will include handheld PID and/or FID, portable GC with PID, FID, or electron capture detector (ECD), and portable scintillometer. Immunoassay test kits and most laboratories will provide quantitative field screening measurements. Group- and/or compound-specific immunoassay test kits will be used to screen and identify PAH. Mobile laboratories equipped with a GC, a gas chromatograph/mass spectrometer (GC/MS), an inductively-coupled argon plasma (ICP) spectroscope, and an infrared (IR) spectrometer will also be used for field screening of VOCs, SVOCs, total petroleum hydrocarbons, total recoverable petroleum hydrocarbons, and metals. Methodologies and instrumentation are described in the Quality Assurance Protection Plan (QAPP) (BNI 1995b). Field screening instrumentation, thesis applications, and sensitivity levels are presented in Table 4-4.

All samples with detectable concentrations using these qualitative field sampling devices will be submitted to the on-site mobile laboratory or the field laboratory for further analysis and characterization. In addition to 100 percent of positive samples from qualitative field screening, a minimum of 5 percent of nondetects will be submitted for further analysis by an on-site mobile laboratory or a field laboratory.

A 20-percent rule was designed as the minimum member of field-screened samples submitted for confirmation by a state- and Naval Facilities Engineering Service Center (NFESC; formerly known as Naval Energy and Environmental Support Activity [NEESA])-certified laboratory using U.S. EPA CLP methodology. The 20-percent rule is defined as 20 percent of all field-screened samples at a particular site will be submitted to a fixed-base laboratory for confirmation. Of the 20 percent, two-thirds will be randomly selected from the positives (samples with detected results above the proposed detection limits) and one-third randomly selected from the nondetects. At some sites (OU-3), however, a predetermined number of samples for confirmation has been selected. Table 4-5 provides an overview of the proposed number of field-screened samples for further confirmation by the fixed-base laboratory.

### *Fixed-Base Laboratory Analysis*

NFESC has adopted three of the five analytical levels identified in CERCLA as quality control (QC) requirements. Levels C, D, and E correlate with Levels 3, 4, and 5 described in the Data Quality Objectives for Remedial Response Activities Development Process (U.S. EPA 1987). MCAS El Toro falls under Level D requirements because it is a NPL site. As a Level D site, U.S. EPA CLP methods must be followed whenever possible and must generate CLP deliverables. Quality Assurance (QA)/QC requirements are outlined by NFESC (NEESA 1988). Where U.S. EPA methods are not available, methods from other agencies and published methods that have undergone method validation must be used.

**Table 4-4**
**Field Screening Instruments and Sensitivity Levels**

| Instrument | Parameters | Applicable U.S. EPA[a] Method | Sensitivity Levels |
|---|---|---|---|
| | **Qualitative Field Screening** | | |
| **Handheld PID[b]** | VOCs[c] | NA[d] | 0.1 - 2,000 mg/kg[e] vapor |
| FID[f] | VOCs, TPH[g] (including methane) | NA | 0 - 10,000 mg/kg vapor |
| **Portable GC[h]** | | | |
| PID | VOCs | U.S. EPA 3810 | < 1.0 - 100 µg/L[i] vapor |
| ECD[j] | Chlorinated VOCs | NA | |
| FID | VOCs, TPH | NA | |
| **Portable Scintillation Counter** | Gross alpha/beta | NA | |
| | **Quantitative Field Screening** | | |
| **Immunoassay Kits** | PAH[k] - soil | | 10 - 500 µg/kg[l] |
| **Mobile Laboratory** | | | |
| GC-PID | aromatic VOCs | U.S. EPA 8020 | 0.5 - 50 µg/kg |
| GC-FID | TPH, VOCs | U.S. EPA 8015 | 10 - 10,000 mg/kg |
| GC-ELCD[m] | chlorinated VOCs | U.S. EPA 8010 | 0.1 - 50 µg/kg |
| GC/MS[n] | VOCs | U.S. EPA 8240 | 5 - 100 µg/kg |
| | SVOCs | U.S. EPA 8270 | 5 - 1,000 µg/kg |
| ICP[o] | metals | U.S. EPA 200 series | 0.02 - 100 µg/kg |
| IR[p] | TRPH[q] | U.S. EPA 418.1 | 10 - 10,000 mg/kg |

Notes:
[a] U.S. EPA – United States Environmental Protection Agency
[b] PID – photoionization detector
[c] VOC – volatile organic compound
[d] NA – not applicable
[e] mg/kg – milligrams per kilogram
[f] FID – flame ionization detector
[g] TPH – total petroleum hydrocarbons
[h] GC – gas chromatograph
[i] µg/L – micrograms per liter
[j] ECD – electron capture detector
[k] PAH – polynuclear aromatic hydrocarbons
[l] µg/kg – micrograms per kilogram
[m] ELCD – electrolytic conductivity detector
[n] MS – mass spectrometer
[o] ICP – inductively coupled argon plasma
[p] IR – infrared spectroscopy
[q] TRPH – total recoverable petroleum hydrocarbons

**Table 4-5**
**Field Screen/CLP Confirmation**

| Site Number | Unit Number | Number of Locations | Phase I Samples | Phase II Field Screen Samples | Phase II CLP Confirmation |
|---|---|---|---|---|---|
| Site 1 | Monitoring Wells | 3 | 0 | 45 | 8 |
| Site 2 | NA | 9 | 3 | 126 | 20% RULE* |
| Site 3 | Unit 1 - Landfill area | 3 | | 63 | 20% RULE* |
| | Unit 2 - Agua Chinon Wash | NA | | N/A | |
| | Unit 3 - Solvent spill | 2 | | 6 | 3 |
| | Unit 4 - Former Incinerator | 3 | | 9 | 3 |
| Site 4 | Unit 1 - Stained area | Removal Action | | | |
| | Unit 2 - Drainage ditch | Removal Action | | | |
| Site 5 | Unit 1 - Landfill area | 4 | | 112 | 20% RULE* |
| | Unit 2 - Stockpiled IDW | NA | | | |
| Site 6 | Unit 1 - Concrete apron edge | 2 | 8 | 6 | 6 |
| | Unit 2 - Drainage ditch | 3 | 8 | | 9 |
| | Unit 3 - Storage area | 3 | 8 | 9 | 3 |
| Site 7 | Unit 1 - North pavement edge | Removal Action | | | |
| | Unit 2 | Site 24 | 10 | | |
| | Unit 3 - New east pavement edge | Removal Action | | | |
| | Unit 4 - Drainage ditch | 3 | 5 | 9 | 6 |
| | Unit 5 - Open dirt area | 2 | 8 | 6 | 3 |
| Site 8 | Unit 1 - East storage yard | Removal Action | | | |
| | Unit 2 - West storage yard | 5 | 8 | 20 | 6 |
| | Unit 3 - Refuse pile | 4 | 10 | 16 | 4 |
| | Unit 4 - PCB spill area | Removal Action | | | |
| | Unit 5 - Old Salvage yard | 6 | 6 | 18 | 6 |
| Site 9 | Unit 1 - Pit area | 5 | 7 | 15 | 3 |
| | Unit 2 - Drainage area | 6 | 0 | 18 | 9 |
| Site 10 | Unit 1 - Aircraft matting | 8 | 11 | 24 | 5 |
| | Unit 2 - Concrete apron | 10 | 7 | 30 | 6 |
| | Unit 3 - Parking lot area | 12 | 0 | 36 | 9 |
| | Unit 4 - Parking (Bldg 1589) | 2 | 0 | 0 | 6 |
| Site 11 | Unit 1 - Concrete Pad | Removal Action | | | |
| | Unit 2 - Drainage ditch | Removal Action | | | |
| | Unit 3 - Storage yard | 6 | 0 | 0 | |
| Site 12 | Unit 1 - West sludge drying bed | 2 | 10 | 8 | 3 |

(table continues)

**Table 4-5** (continued)

| Site Number | Unit Number | Number of Locations | Phase I Samples | Phase II Field Screen Samples | Phase II CLP Confirmation |
|---|---|---|---|---|---|
| | Unit 2 - East sludge drying bed | 4 | 9 | 16 | 3 |
| | Unit 3 - Drainage ditch | Removal Action | | | |
| | Unit 4 - Former WWTP | 8 | 21 | 32 | 3 |
| Site 13 | Unit 1 - Area SE of tank farm | Removal Action | | | |
| | Unit 2 - Area SW of tank farm | Removal Action | | | |
| Site 14 | Unit 1 - Acid disposal area | Removal Action | | | |
| Site 15 | Unit 1 - Stained areas | Removal Action | | | |
| | Unit 2 - SWMU 273 | 6 | 7 | 18 | 4 |
| Site 16 | Unit 1 - Pits perimeter area | 3 | 7 | 9 | 3 |
| | Unit 2 - Fire-fighting pits | 4 | 10 | 16 | 3 |
| | Unit 3 - Drainage ditch | 3 | 8 | 0 | |
| Site 17 | Unit 1 - Landfill area | 5 | | 165 | 20% RULE* |
| Site 19 | Unit 1 - NE Stained area | Removal Action | | | |
| | Unit 2 - Excavated area | Removal Action | | | |
| | Unit 3 - Stained area | 6 | 9 | 18 | 5 |
| | Unit 4 - Pump station | 1 | 2 | 0 | 3 |
| Site 20 | Unit 1 - Drainage ditch | 1 | 9 | 2 | 2 |
| | Unit 2 - S Drainage ditch | Removal Action | | | |
| | Unit 3 - Stained area | Removal Action | | | |
| | Unit 4 - Courtyard | 3 | 7 | 12 | 3 |
| Site 21 | Unit 1 - Storage area | 2 | 9 | 6 | 3 |
| Site 22 | Unit 1 - Western area | 2 | 8 | 6 | 3 |
| | Unit 2 - Eastern area | 1 | 10 | 0 | 3 |
| Site 24 | | 33 | | 198 | 20 |
| Site 25 | Unit 1 - Agua Chinon | 3 | | 24 | 3 |
| | Unit 2 - Bee Canyon | 1 | | 6 | 3 |
| | TOTAL | | 225 | 1,158 | 189 |

Notes:

* TWENTY PERCENT RULE - 20% of all field screened samples will be submitted to a fixed-base laboratory for confirmation by U.S. EPA/CLP analytical methods. From this 20%, two-thirds will be randomly selected from the positive samples and one-third will be randomly selected from the nondetects.

Fixed-base laboratory analysis provides sample-specific data according to NFESC and U.S. EPA CLP requirements. The analytical technique chosen must have a detection limit well below the level of concern. Regardless of the specified method detection limit (MDL), the actual detection limit reported may be sample-specific, especially in the case of samples having complex matrices (i.e., samples containing numerous analytes at widely different concentration ranges). For parameters that have no regulatory or health-risk-based limits, standard U.S. EPA MDLs will be reported. The data measurement objective is to obtain data with detection limits adequate for risk-assessment purposes, because the primary purpose of a risk assessment is to establish and substantiate the level of concern or cleanup level for the site. Analytical methodologies and instrumentation are described briefly in Appendix A of the QAPP (BNI 1995a), and their respective detection limits for the COPCs are listed in Table 4-1. The project-required detection limits and the PRGs are derived from the Phase I data (Jacobs Engineering 1993c). The parameters listed are those for which the detection limits have been recommended by NEESA 2012-0478 (1988), U.S. EPA CLP, and the California Leaking Underground Fuel Tank (LUFT) Manual (LUFT 1989). Laboratory instrumentation and methodologies used to analyze for the suspected and known chemical families at MCAS El Toro are described in the QAPP (BNI 1995b, Appendix A).

### *Detection Limits*

Generally, there are several U.S. EPA analytical methodologies available for analysis of each chemical parameter. Analytical methodology and detection limits are based on regulatory limits, the acceptable level of risk, and analytical method limitations. Analytical methods for the Phase II RI/FS have been selected on the basis of their capability to meet detection levels required to characterize COPCs to U.S. EPA Region IX PRGs (1995) as presented in Table 4-1. The PRGs for the COPCs at MCAS El Toro include concentrations for residential and industrial land uses, ambient air, and tap water.

Estimated quantitation limits (EQLs) or estimated detection limits will be used for the CLP methods performed during the Phase II RI/FS as presented in Table 4-1. The practical quantitation limits (PQLs) are equivalent to the EQLs and are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Soil detection limits proposed for herbicides, pesticides, and metals are based upon PRGs and background concentrations. For certain COPCs, the listed detection limit does not satisfy the corresponding PRG. In this case, low-level standard will be analyzed daily to demonstrate the ability of the laboratory to detect these analytes at levels low enough to satisfy their PRG values. In all cases, the best available technology (BAT) with lowest possible detection/units obtainable will be implemented to satisfy PRGs for the COPCs. Alternative methods may be implemented by the laboratory provided that the compound list and performance criteria of the listed method is fully satisfied. A description of the alternative methods is presented in Section 3 of the QAPP. The RBCs and method selection are derived from the Phase I report (Jacobs Engineering 1993c).

***Confirmation Methods***

One goal of the Phase II RI is to use qualitative and quantitative field screening analytical methods to reduce the number of expensive and time-consuming fixed-base laboratory analyses. To accommodate this goal, a minimum of 20 percent of the field-screened samples will be submitted to state- and NFESC-certified fixed-base laboratories for Level D analysis. From this 20 percent, two-thirds of the positives (samples with detected results above the proposed detection limits) and one-third of the nondetects will be randomly selected for CLP confirmation by the fixed-base laboratory. For some sites (OU-3), the number of confirmation samples has been predetermined as presented in Table 3-2. The CLP results will then be used to confirm the field screening results.

Statistical comparisons will be used in the confirmation process and will compare the accuracy of the field screening results and the fixed-base results. The most appropriate statistical method will be selected, and it will be based on the type of distribution of the result values, the result value ranges, and the number of samples. Two commonly used methods are the Student's t-test, used for the comparison of the two population means, and the F test, based on the comparison of the two population variances. Statistical analyses will not be completed if the number of samples is insufficient.

### 4.2.3.9 FATE AND TRANSPORT MODELS

The types of fate and transports are numerous and models must be selected in consultation with the regulatory agencies before sampling is initiated because the various models have unique requirements for data. Numerical modeling may be used to predict the movement of contamination in soil and groundwater in the Phase II RI/FS. The potential of contaminant migration through the vadose zone will be modeled with a one-dimensional unsaturated zone flow and transport model (e.g., Vadose Zone Leaching [VLEACH], HYDRUS, or SESOIL models). The most appropriate model for each site will be selected based on data from the field investigation characterizing the nature of contamination and the material properties of the soil column. The model HELP will estimate the rate of recharge (deep percolation). A combination of the public domain codes MODFLOW and MT3D is proposed for flow and solute transport data, respectively, to replace the proprietary CFEST code used earlier for the site. Data from the calibrated CFEST model will be used. Codes will be in MODFLOW and MT3D. The public domain code MODPATH will also be used for particle tracking to identify advective migration pathways.

***Vadose Zone Modeling***

When subsurface soil contamination is present but does not extend to the water table (based on sampling results), the potential for contaminants to impact groundwater will be estimated using vadose zone modeling. Vadose zone models are used to simulate the downward movement of contaminants through the unsaturated zone to groundwater over time. The simulation estimates the contaminant mass loading to groundwater, and predicts the long-term risk to groundwater. Factors affecting potential impacts to groundwater from vadose zone contamination include distance to the water table and mobility of the contaminants.

VLEACH is a one-dimensional vadose zone fate-and-transport model. VLEACH was the Phase I RI/FS model application and is described in the Phase II RI Draft Work Plan (Jacobs Engineering 1993a) and in the program manual (U.S. EPA 1990). Its application to assess organic compound fate and transport in the vadose zone will be continued in the Phase II RI/FS.

Working input files (for each chemical constituent) and compiled executable versions of the computer code from the Phase I RI will be required from previous VLEACH model runs. Obtaining the original input files and compiled executable program (the exact version) will assure consistency and will reduce work hours for subsequent model simulations. If the current version of the VLEACH code has not been modified since the previous model simulation, the U.S. EPA public domain code can be used directly.

HYDRUS is a one-dimensional flow-and-transport-model for the unsaturated zone, accounting for different materials in the soil column, the relative hydraulic conductivity of the soil as a function, the moisture content, and root uptake (Kool and van Genuchten 1989). It solves the solute transport equation incorporating the effects of advection, dispersion, adsorption, and first-order decay reactions.

HELP was originally developed as a tool for the hydrologic evaluation of landfills (Schroeder et al. 1994). It is a hydrologic model that uses time series of meteorologic data to estimate the rate of deep percolation in landfills or other soils. It accounts for the soil properties, vegetation, and other surface conditions.

SESOIL is an integrated screening-level soil compartment model simulating water transport, sediment transport, and pollutant fate through the vadose zone (Bonazountas and Wagner 1984; Herrick et al. 1994). It incorporates a one-dimensional vertical transport code for the unsaturated soil zone. It is structured around three cycles: the hydrologic cycle, which accounts for precipitation, infiltration, soil moisture, surface runoff, and evapotranspiration; the sediment wash load cycle, which accounts for sediment transport by surface runoff; and the pollutant fate cycle, which accounts for transport through the vadose zone and partitioning in the soil between the gas, dissolved, and solid phases.

### *Groundwater Modeling*

This section describes the application of groundwater models in the Phase II RI/FS. Two IRP sites are known to have contaminated groundwater—Sites 2 and 24. Modeling at these two sites is proposed for the Phase II RI/FS using Phase I and Phase II results. Modeling of other sites may be performed during Phase II RI/FS for reasons discussed below.

**Site 2 Groundwater Modeling Applications.** Specifically, groundwater modeling will be required at Site 2 to evaluate alternative actions during the FS. In addition to capping the landfill, alternatives under this study could include a long-term RA. Potential long-term actions may include a groundwater pump-and-treat system or air sparging. Modeling would assist in evaluating both alternatives.

Evaluation of the pump-and-treat option would benefit from modeling the capture zone resulting from extraction well pumping and the effect of such pumping on the surrounding piezometric surface. This type of model simulation was performed by the Navy for the regional VOC groundwater plumes. The result of the simulation proved to be useful and suggested that extraction wells were necessary to contain the groundwater plumes.

**Other Groundwater Model Applications.** Previous regional groundwater modeling for VOC and benzene plumes provided solutions for predictive purposes and the selection of alternatives under expected scenarios (Jacobs Engineering 1994a). Further groundwater modeling or recalibration of previous model runs may be considered for one or more of the following reasons:

- **divergence in previous model solutions and model calibration**: where over time, previous model solutions diverge from model calibrations in predicted water levels (primary groundwater flow calibration) and in the nature and extent of chemical constituents (primary contaminant transport calibration), and these previous model solutions become technically questionable;
- **changes in empirical data sets:** where empirical data obtained in the Phase II RI/FS process indicates significant alteration of the site conceptual model; and/or
- **unanticipated applications:** unanticipated applications for groundwater modeling are possible and may become apparent during the Phase II RI/FS.

**Groundwater Model Selection.** The CFEST model was used during the OU-1 RI/FS (Gupta 1987). CFEST is a complex finite-element three-dimensional model. Because of applications anticipated (and previously described) for the Phase II RI/FS, the Navy is proposing MODFLOW, a simpler finite-difference groundwater model (McDonald and Harbaugh 1988).

MODFLOW is very flexible and will allow users to examine specific hydrogeologic features independently. The code has been used extensively and will perform applications required for groundwater modeling as previously described in this section.

MT3D (Zheng 1990) is a transport model intended to be used in conjunction with MODFLOW. It solves the solute transport equation accounting for advection, dispersion, adsorption, and decay, using the flow field generated by MODFLOW. It has a modular structure similar to that used in MODFLOW.

MODPATH (Pollock 1989) calculates and displays path lines based on the flow field calculated with the groundwater flow model MODFLOW. It can be used in a forward mode to follow contaminants originating from specific points, or in a backward mode to identify the origin of contaminants ending at specific points.

**Additional Data Requirements for Groundwater Modeling.** Groundwater model solution confidence will be improved by obtaining the following additional empirical data (if immediately available) during the Phase II RI/FS including:

- porosity,
- hydraulic conductivity,
- organic carbon,
- aquifer bulk density, and
- aquifer thickness.

Additional data for flow and transport modeling the vadose zone include hydrologic data and surface soil conditions (e.g., type, vegetation, cover, slope) to estimate the rate of deep percolation, relative hydraulic conductivity for the unsaturated soils, and contaminant concentration in the soils.

### 4.2.3.10 CLEANUP LEVELS

Cleanup levels (or RA objectives) consist of medium-specific or unit-specific goals for protecting human health and the environment. These are considered as inputs because the formulation of cleanup levels requires the collection of specific data. Cleanup levels are based on:

- the COPCs,
- ARARs,
- exposure route(s) and receptor(s),
- reuse,
- an acceptable contaminant level based on an acceptable level of risk, and
- BATs.

The acceptable exposure levels will be determined on the basis of the results of the baseline risk assessment and the evaluation of the various exposure scenarios (e.g., residential, industrial, or recreational) and associated risks for each alternative. Cleanup levels will be established by comparing contaminant levels in each media to these acceptable levels.

### 4.2.3.11 TECHNOLOGY IMPLEMENTABILITY, EFFECTIVENESS, AND COSTS

Potentially applicable cleanup technology types are considered as an input because these technologies have limitations and require specific types of information to select the appropriate technology. Technology types will be identified by drawing on a variety of sources, including references developed for application to Superfund sites, standard engineering texts, or presumptive remedies. Selection of technologies are based on implementability, effectiveness, and costs.

***Implementability***

Implementability encompasses both the technical and administrative feasibility of implementing a technology process. Technical implementability is used to eliminate those technologies that are clearly ineffective or unworkable at a site. The institutional aspect of implementability also needs to be considered (e.g., the ability to obtain necessary permits for off-site actions; the availability of treatment, storage, and disposal services [including capacity]; and the availability of necessary equipment and skilled workers to implement the technology).

***Effectiveness***

Specific technology processes are evaluated in terms of the following criteria: 1) the potential effectiveness of process options in handling the estimated areas or volumes of media and meeting the cleanup levels; 2) the potential impacts to human health and the environment during the construction and implementation phase; and 3) how proven and reliable the process is with respect to the contaminants and site conditions. Information needed to evaluate the effectiveness of technology for the different media includes contaminant type and concentration, the area or volume of contaminated media and, when appropriate, rates of collection of liquid or gaseous media.

***Cost***

The cost evaluation is made on the basis of engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type.

## 4.2.4 Step 4 – Define Study Boundaries

The inputs to defining the study boundaries are:

- temporal boundaries, and
- spatial boundaries.

For the Phase II RI/FS, temporal boundaries are generally not important, except for surface water and sediment sampling (because seasonal fluctuations in drainage flows may directly influence these samples). The Phase II spatial boundaries are based on existing information from the existing Phase I RI and modifications to these boundaries based on information compiled since the Phase I RI.

### 4.2.4.1 EXISTING INFORMATION

The spatial boundaries are shown in the existing Phase I RI (Jacobs Engineering 1993c). These boundaries are also shown on site plans in the attached appendices.

#### 4.2.4.2 MODIFICATIONS TO PHASE I REMEDIAL INVESTIGATION BOUNDARIES

Two basic modifications have been incorporated into the Phase II RI/FS. The first modification is designating the Phase II RI/FS sampling area as site units or "units." The second modification involves the addition of units or enlarging existing units because additional information has become available since the Phase I RI.

***Units***

During the Phase I RI, individual sites were sampled using a stratified random sampling program (Jacobs Engineering 1993c). Strata of each site consisted of an area in which similar historical activities and patterns of contamination occurred. Information used to form the strata included historical records and photographs. To satisfy the statistical analyses of the Phase I RI, a stratum was assumed to be an area within which there was an equal probability of detecting contaminants in a sample collected during the Phase I RI.

Because the Phase II RI/FS does not assume an equal probability of detecting contaminants in a stratum and does not exclusively employ unbiased sampling programs, the general area of the Phase I strata with modifications is defined as a site-specific sampling "unit" for the Phase II RI/FS. The physical limits of these units are generally the same as strata but also include the modifications discussed below. Each site unit will be sampled, when needed, with an optimized design resulting from this DQO process.

***Modifications to Study Boundaries***

Modifications to the areal extent of individual sites has been principally based on additional information that became available following the Phase I RI. Modifications are presented in Table 4-6 and are illustrated by site in appendices figures.

### 4.2.5 Step 5 – Decision Rules

Decision rules are required to explicitly state the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. The decisions will be made by comparing the analytical data from each unit in a site to PRGs and using U.S. EPA PRG risk-screening procedures (U.S. EPA 1995). The preliminary risk management decision should not be confused with a risk assessment, which will be conducted upon completion of the Phase II RI/FS field sampling activities. During the Phase II RI/FS field activities, the action levels (based on the U.S. EPA PRG risk-screening procedures) that will be used for decision making are the following:

- cumulative cancer risk of $10^{-6}$ in humans, and
- HI of 1.0 for chronic systemic toxicity in humans.

**Table 4-6**
**Modifications to Installation Restoration Program Site Boundaries**

| Site No. | Site Name | Modification |
|---|---|---|
| 1 | Explosives Ordnance Disposal Range | The overall site boundary remains unchanged, but the site itself has been divided into two units. The division was based upon the history of where most ordnance detonation or burning activities took place (primarily in the northern half of the site), and was supported by the results of the surface geophysical surveys (primarily the EM results) conducted at this site. |
| 2 | Magazine Road Landfill | The boundary of Site 2 has been modified to incorporate possible fill areas identified in aerial photographs. The entire northeast border has been expanded to include approximately 7.5 acres, and the western border was modified slightly. The portion of the Borrego Canyon Wash that is on the site has also been added to the investigation as a separate unit. |
| 3 | Original Landfill | The boundary of Site 3 has been expanded on the eastern boundary to incorporate possible fill areas identified in aerial photographs. The western boundary was unchanged; however, the location of the solvent spill (SWMU 300) is called out as a separate unit. |
| 5 | Perimeter Road Landfill | The boundary of Site 5 has been expanded to incorporate possible fill areas identified in aerial photographs and during employee interviews. |
| 6 | Drop Tank Drainage Area No. 1 | The boundaries of Unit 1 remain unchanged from the Phase I RI and the Phase II RI/FS Draft Work Plan. The area covered by Unit 2 (the Drainage Ditch) was expanded to include the western edge of an aircraft wash station (SWMU 204) plus the path of liquid drainage from SWMU 204 toward a liquid/stained area within the drainage ditch. Unit 3 (the Storage Area) was expanded to include an additional area where drop tanks were stored and an impoundment located southwest of the Phase I site boundary. |
| 9 | Crash Crew Pit No. 1 | The boundaries of Unit 1, the Pit Areas, remain unchanged from those used for the Phase I RI. However, a second unit was added at this site. Unit 2 (the Drainage Ditch) covers the area between the two pits and a linear drainage swale paralleling the taxiway immediately to the north. It extends from the edge of the steel matting on the east to a catch basin at the west end of the ditch. Unit 2 was created on the basis of aerial photo data, which indicated the flow paths of liquids extending from both pit areas into the drainage ditch. |
| 10 | Petroleum Disposal Area | The number of units at this site has been increased from two to four. The boundaries of the original two units, Unit 1 (Aircraft Matting) and Unit 2 (Concrete Apron) remain unchanged from those in the Phase I RI. The two additional units are designated as Unit 3 (Parking Lot Area) and Unit 4 (Building 1589). Unit 3 is currently an asphalt-paved parking lot, but historic aerial photographs indicate considerable staining, which suggests that dust-control measures may also have been applied to that area. Unit 3 extends from the edge of Unit 2 (Concrete Apron) southward to the end of the asphalt parking lot (just south of Buildings 655 and 388). The western boundary of Unit 3 bisects Building 655, and the eastern boundary is the edge of the parking lot, which parallels the concrete apron on the west side of Building 297. Unit 4 is an L-shaped area bordering the northwest and northeast sides of Building 1589 (west of Site 10), the former heavy equipment maintenance shop, which was the source of most liquids applied to Site 10 for dust control. This unit covers the area adjacent to Building 1589, where the wheel-mounted, 500-gallon temporary waste oil storage tanks ("buffaloes") were parked while being filled with waste oil, solvents, etc., generated in the maintenance shop. |

(table co 's)

Table 4-6 (continued)

| Site No. | Site Name | Modification |
|---|---|---|
| 11 | Transformer Storage Area | For the Phase II RI/FS, the number of units at this site has been increased from two to three. The boundaries of Unit 1 (Concrete Pad Edge) remain unchanged from those defined for the Phase I RI. The boundaries of Unit 2 (Drainage Ditch) were expanded to cover the entire length of the ditch (i.e., essentially the length of the Building 369 rear wall). The boundary of the new Unit 3 (Storage Yard) is the perimeter fence surrounding the area behind Building 369. This unit was created to address historic storage of transformers throughout the yard, not just on the concrete pad. |
| 12 | Sludge Drying Beds | The number of units at this site has been increased from three to four. The boundaries of Unit 1 (West Sludge Drying Beds) and Unit 3 (Drainage Ditch) remain unchanged from the Phase I RI. The boundary of Unit 2 (East Sludge Drying Beds) has been expanded to include a small rectangular area adjacent to the southeast corner of Unit 2. Historic aerial photographs indicate that this area was the former location of two small impoundments. Unit 4 (Former Wastewater Treatment Plant) was previously designated as SWMU/AOC 90. Its boundaries are the limits of the former treatment plant site (now a park), plus the adjacent (immediately southeast) small industrial wastewater treatment unit that operated briefly and treated plating shop wastes. |
| 14 | Battery Acid Disposal Area | The two units defined for the Phase I RI have been combined into a single unit for the Phase II RI/FS. This combined unit includes the two original units and the area between them. |
| 15 | Suspended Fuel Tanks | The number of units at this site has been increased from one to two. Unit 1 has the same boundaries as those used for the Phase I RI. Unit 2 is a new unit added to cover an area behind Building 31, including a drainage swale that parallels the building and extends southwestward to the fence line. |
| 16 | Crash Crew Pit No. 2 | The number of units at this site is unchanged from the Phase I RI. However, the boundaries of Units 1 and 2 have changed; those of Unit 3 (Drainage Ditch) remain unchanged. The boundary of Unit 1 (Disturbed Ground), which was reduced in size, still encompasses all three fire pits but now extends a shorter distance beyond them. Unit 2 (Fire Fighting Pits) formerly included only the main pit. The revised Unit 2 includes the main fire-fighting pit, the residual fluids pit, and the handheld fire-training pit. All three pits are located within the perimeter of Unit 1, described previously. |
| 17 | Communication Station Landfill | The boundary of Site 17 has been expanded to incorporate an approximate 30,000 square feet due to possible landfill, as identified in aerial photographs. The landfill area includes both areas defined in the Phase I RI, and the northeast boundary was modified to incorporate an area of less than one acre. |
| 19 | Aircraft Expeditionary Refueling (ACER) Site | This site now consists of four units. The boundaries of Units 1 through 3 remain unchanged from those identified in the Phase I RI. Unit 4 (Pump Station) was added to encompass the area of a fuel pump station (SWMU/AOC20) located immediately to the east end of Unit 3 (Stained Area Around Excavation). |
| 20 | Hobby Shop | The number of units at this site remains unchanged from the Phase I RI. However, the area covered by Unit 4 has been expanded to include the entire courtyard and the entry driveway/parking area. |

These action levels are based on residential scenario values. The residential scenario action levels were chosen because they are conservative estimates of risk and are more protective of human health than the estimates for recreational or industrial scenarios. Until the Navy makes a final determination regarding future land use at MCAS El Toro, the most conservative criteria will be adopted for any RI/FS activities to assure that additional work will not become necessary once a final land use decision is made.

To determine if action levels are exceeded, a transformation of the analytical data must be completed. Transformation of the analytical data and development of the preliminary risk management decision follows the step-wise process (detailed below), using U.S. EPA PRG risk screening procedures.

- Identify site contaminants in the U.S. EPA PRG table. Record the PRG concentrations for various media and note whether PRG is based on cancer risk or noncancer hazard. Segregate cancer PRGs from noncancer PRGs and exclude non-risk-based PRGs.

- For cancer risk estimates, take the site unit-specific concentration (maximum) and divide by the PRG concentrations that are designated for cancer evaluation. Multiply this ratio by $10^{-6}$ to estimate chemical-specific risk. For multiple pollutants, add the risk for each chemical:

$$Risk = [(\frac{conc_x}{PRG_x}) + (\frac{conc_y}{PRG_y}) + (\frac{conc_z}{PRG_z})] x 10^{-6}$$

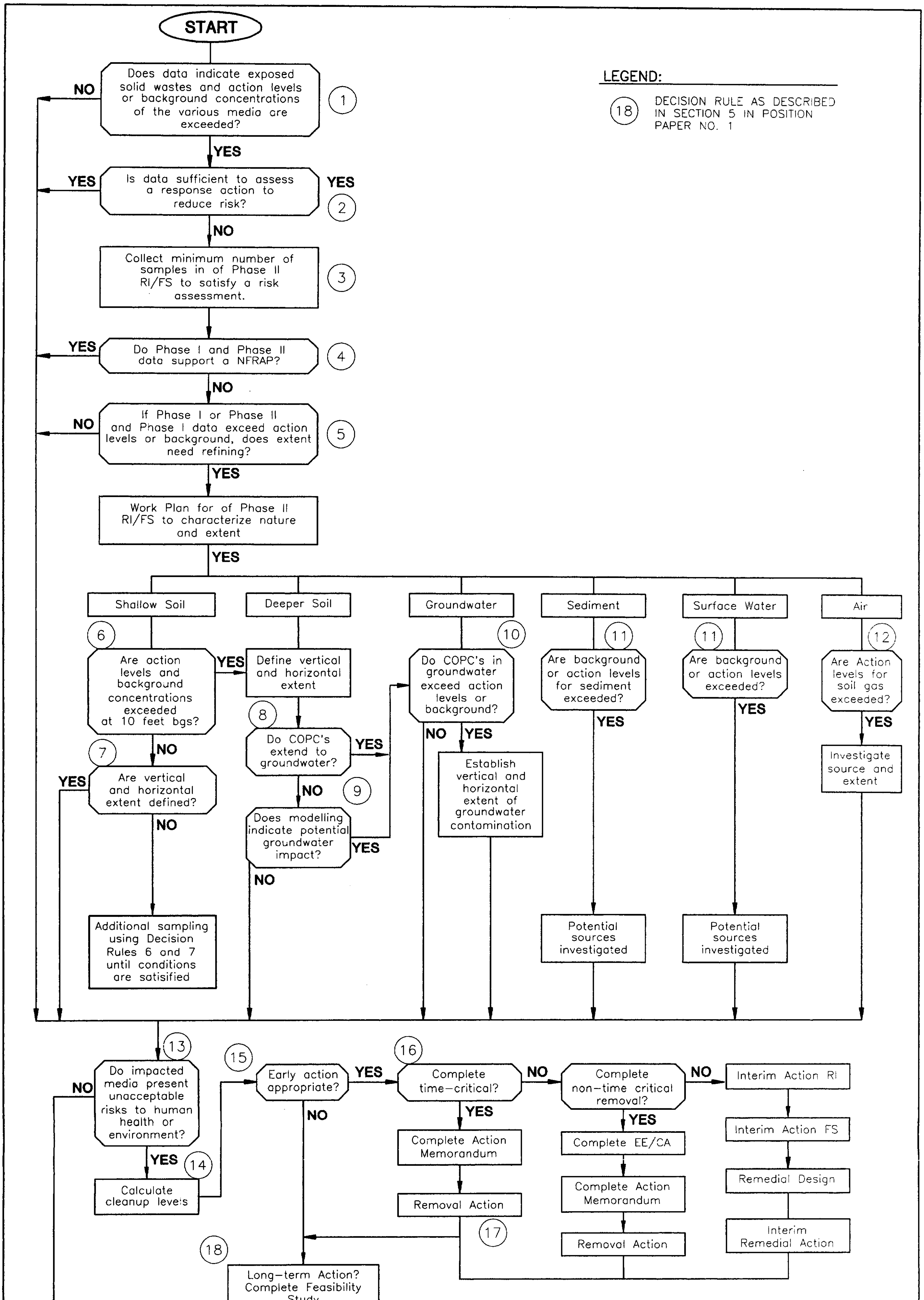
- For noncancer hazard estimates, divide the concentration term by its respective noncancer PRG and sum the ratios for multiple contaminants. (Note that carcinogens may also have an associated noncancer PRG that is not listed in the table; these will also need to be obtained in order to complete the noncancer evaluation.) The noncancer ratio represents an HI. An HI of 1 or less is generally considered safe. A ratio greater than 1 suggests further evaluation:

$$Hazard\ \ Index = [(\frac{conc_x}{PRG_x}) + (\frac{conc_y}{PRG_y}) + (\frac{conc_z}{PRG_z})]$$

The action levels for ecological protection are provided in Appendix A to the Risk Assessment Plan (BNI 1995d).

Specific decision rules that the BCT will use are described below and illustrated in Figure 4-2.

1. If Phase I data indicate that no solid wastes are exposed and the respective action levels or background/ambient concentrations for the various media of a site unit are not exceeded, then NFI is recommended.




**Work Plan**

**Figure 4-2**

**Decision Rules**

MCAS El Toro, California

CLEAN II Program

Date: 7/14/95
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2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units that exceed media action levels, or background/ambient concentrations, then cleanup levels and appropriate response action (Early Action, which includes removal actions or interim RAs, or Long-Term Action) will be determined.

3. If Phase I data are not sufficient to assess whether risks are unacceptable based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.

4. If Phase I data indicate that no solid wastes are exposed and the respective action levels and background/ambient concentrations for the various media of a site unit are not exceeded, then NFI is recommended.

5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background/ambient concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs do not exceed a potential response action.

6. If PRGs, action levels, or background/ambient concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.

7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum of 5-foot-depth separation) demonstrate that COPCs are not detected or are below background/ambient concentrations, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels. However, if subsurface geology and distribution of contaminants indicate that this general rule is not valid, a field meeting with the BCT will be held to discuss the recommendation.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - contract-required detection limit,
   - contract-required quantitation limit,
   - sample quantitation limit,
   - EQL,

- PQL,
- MDL, and
- instrument detection limit.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.
9. If COPCs are identified in subsurface soil below 10 feet bgs at concentrations above background/ambient or action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.
10. If it is determined that COPCs in subsurface soil have potentially impacted groundwater, then the vertical and horizontal extent of groundwater exceedance will be evaluated.
11. If action levels or background/ambient concentrations for surface water or sediment are exceeded, then potential sources (these will likely be nonpoint sources) will be investigated.
12. If action levels for air are exceeded, which are specified in SCAQMD Rule 1150.1 and 40 CFR Parts 258.23, then potential sources and extent will be investigated.
13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated (based on sample results, acceptable levels of risk, and potential land uses) to assess potential risks to human health and/or the environment.
14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be established as discussed in Section 4.2.3.10.
15. If cleanup levels in a given media are exceeded, the site meets at least one of the eight criteria for removal action described in 40 CFR 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected media are such that excess risk can be expediently reduced utilizing readily available technology, then the media at the site will be recommended for Early Action.
16. If an early removal action is selected, a non-time-critical EE/CA and AM will be completed for the Removal Action if more than 6 months of planning is available, or a time-critical AM if less than 6 months of planning is available, or an emergency removal will occur if risks present an imminent risk.
17. Once the Removal Action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be recommended.
18. If cleanup levels for a given media are exceeded and the site does not meet criteria for an Early Action, then the affected media will be recommended for long-term

RA as part of the RI/FS process. An FS will be completed followed by a proposed plan. These steps will be followed by an ROD, a Remedial Design, and an RA to clean up the site.

### 4.2.6 Step 6 – Acceptable Limits on Decision Errors

The purpose of Step 6 of the U.S. EPA DQO process is to establish acceptable limits on decision errors. These limits are used by the decision makers to establish performance goals for the data collection design. The objective of any data collection design is to obtain data that produce reliable estimates of site parameters and keep the probability of making a decision error below an acceptable limit.

Two types of data collection errors are typically associated with any sample collection effort: measurement errors and sampling design errors. The combination of these two error types yields the total study error. Measurement error is a combination of random and systematic errors, which are the result of inaccuracies that occur during sample collection, handling, preparation, and analysis, and data reduction and handling. Measurement error is closely related to the accuracy of the analytical method and the precision and accuracy of the instrumentation. Measurement errors are easier to control, and their contribution to the total study error is small. Sampling design errors occur when the sample data cannot capture the true variability of a parameter (e.g., concentration of arsenic) in the population of interest (e.g., soil). Sample data only provide an estimate of the true state of site conditions because it is neither physically practical nor cost effective to sample every location in a site or every grain of soil in a site. The sample design error is related to the complexity of the medium to be investigated and the number of COPCs to be analyzed, and it is the most challenging to control.

The magnitude of the total study error determines the probability of making a decision error. All measured data incorporate some degree of total study error, which means that the possibility of making a decision error cannot be eliminated completely. It is important to control the magnitude of the total study error in order to minimize potential decision errors to the extent possible on a cost-effective basis. By defining the allowable magnitude of each decision error, and the consequences associated with it, a sample collection design can be developed that achieves the acceptable decision error limits in a cost-effective manner. The probability of decision error can be controlled by adopting a statistical approach that controls decision errors through the use of statistical hypothesis testing. This approach consists of the following steps:

- identify the types of decision errors, define the null hypothesis and the alternative hypothesis, and assign the appropriate "false-positive" and "false-negative" terms to the decision errors;
- specify the allowable probability of error limits for each type of error;
- based upon the foregoing conditions, use a statistical formula to determine the sample size; and
- specify the criteria under which the sample size may be adjusted without adversely affecting the established acceptable limits on decision errors.

### 4.2.6.1 IDENTIFY THE DECISION ERRORS AND SPECIFY THE NULL HYPOTHESIS

Decision errors occur when sample analytical data lead to an incorrect conclusion regarding a particular COPC or group of similar COPCs. The following two decision errors could occur during the Phase II RI/FS at MCAS El Toro:

- the conclusion that the concentrations of a particular COPC or group of COPCs do not exceed PRGs or action levels when the concentrations are actually above PRGs or action levels, and conversely,
- the conclusion that the concentrations of a particular COPC or group of COPCs exceed PRGs or action levels when the concentrations are actually below PRGs or action levels.

The potential consequences associated with these decision errors are significantly different in terms of human health or ecological concerns, and costs. If the first decision error (the most severe one) is made, decision makers would erroneously conclude that the unit or site poses either no risk, or that the risk level is acceptable, when in fact the unit or site does pose an unacceptable risk. Potential consequences of such a decision would include adverse human health or ecological effects associated with inhalation, ingestion, or dermal contact with soil and possibly groundwater impacted by COPCs.

If the second decision error is made, investigators would erroneously conclude that the unit or site posed an unacceptable risk, when in fact the unit or site posed no risk or an acceptable risk. In this case, unnecessary remediation would be performed, representing an unnecessary cost burden.

The two decision errors only have significance when they are associated with a hypothesis describing the problem to be evaluated. The statistical formulation of the decision-making process consists of the test of two hypotheses, the null hypothesis and the alternative hypothesis. The null hypothesis is typically a true statement of the site conditions, or in the case of environmental investigations, the worst-case scenario of site conditions. Therefore, this statistical hypothesis to be tested is:

Null hypothesis: $H_0$: $\mu > C_a$

and the

Alternative hypothesis: $H_1$: $\mu \leq C_a$

where:

$\mu$ = population mean concentration, and
$C_a$ = acceptable concentration.

If $H_0$ is rejected, then it is concluded that the mean concentration of the COPC does not exceed the acceptable concentration, and consequently the site is not contaminated.

If $H_1$ is rejected, then it is concluded that the mean concentration of the COPC exceeds the acceptable concentration, and consequently the site is contaminated.

The following two types of statistical errors are related with the rejection of the null hypothesis.

Type I error (**false-positive error**). This error ($\alpha$) occurs if the null hypothesis is rejected when it is actually true (i.e., if it is concluded that a COPC does not exceed the acceptable level, when in reality it does). This type of conclusion may result in declaring a contaminated site as noncontaminated. The consequence of such an error is that no corrective action will be taken, and the site will continue to pose risks to human health and/or the environment. The *confidence level* ($1-\alpha$) of the hypothesis test is the probability of not making a false-positive error.

Type II error (**false-negative error**). This error ($\beta$) occurs when the null hypothesis is not rejected even though it is actually false (i.e., if it is concluded that a COPC exceeds the acceptable level, when in reality it does not). The consequences of this type of error are unnecessary further study and/or unnecessary cleanup of the site and, consequently, a waste of money and time. The probability of not making a false-negative error is the *power* ($1-\beta$) of the test of hypothesis.

### 4.2.6.2 DECISION ERROR LIMITS

The allowable probability limits designated for the two decision errors were specified by the Navy and reflect the concerns regarding the consequences of making false-positive and false-negative decisions errors. The allowable probability of making a false-positive decision error in Phase II RI/FS has been designated as 0.05 (5 percent). This corresponds to a confidence level of 95 percent. This means that the Navy will allow only a 5-percent probability that a unit or site is classified as having an acceptable risk, when, in reality, the risk is unacceptable. These values reflect concern about the severe consequences that could result from a false-positive decision error. The allowable probability of making a false-negative decision error has been set to 0.20 (20 percent). This corresponds to a power level of 80 percent.

### 4.2.6.3 CALCULATING THE NUMBER OF SAMPLES TO ESTIMATE RISK

The estimated risk (Table 3-1), the risk action level of $1 \times 10^{-6}$ for residential land use, and confidence and power values are established values used to determine whether the individual units within a site, or the entire site, represent an unacceptable risk, necessitating a response action. To make this determination, the number of samples needed to characterize risks must be estimated.

Preliminary risk calculations (using the Phase I RI data) provided the necessary assumptions for determining the number of samples within each unit at this site. Because of the large number of COPCs at MCAS El Toro, the Navy has chosen to use an estimated CV, representing the combined total of sample-specific risk for all COPCs stationwide as the basis for estimating the number of samples. The CV was estimated using Phase I risk estimates under the assumption of a lognormal distribution. The estimated value of the CV is 1.86, which is based on a variance equal to 1.499 (Jacobs Engineering 1993a).

The number of sample locations necessary to determine the unit or site risk with the specified confidence and power are based on a series of statistical evaluations.

The following formulas are traditionally used to estimate the number of samples per unit for a normal distribution.

For given values of $\alpha$, $\beta$, minimum detectable relative difference (*MDRD)*, and *CV*, the number of required soil samples ($n$) can be estimated using equation 1:

$$n_1 = \frac{(z_{1\text{-}\alpha} + z_{1\text{-}\beta})^2}{d^2} + 0.5^2 z_{1\text{-}\alpha} \qquad (1)$$

where:

$d = MDRD/CV$

$$MDRD = \frac{\text{(sample mean - population mean)}}{\text{population mean}}$$

$$CV = \frac{\text{standard deviation}}{\text{sample mean}}$$

$z$ = the standard normal deviate (Gilbert 1987)
$z_{1\text{-}\alpha}$ = the value of $z$ for which the confidence is equal to 1-$\alpha$.
$z_{1\text{-}\beta}$ = the value of z for which the power is equal to 1-$\beta$ (U.S. EPA 1992b).

Since the true standard deviation of every COPCs is not known with assurance, the $t$ distribution is used instead of the $z$ distribution to estimate the number of samples:

$$n_1 = \frac{(t_{1\text{-}\alpha,n-1} + t_{1\text{-}\beta,n-1})^2}{d^2} + 0.5^2 t_{1\text{-}\alpha,n-1} \qquad (2)$$

where:

$d = MDRD/CV$

$$\text{MDRD} = \frac{\text{(sample mean - population mean)}}{\text{population mean}}$$

$t_{1\text{-}\alpha,n\text{-}1}$ = the value of $t$ for which the confidence is equal to 1-$\alpha$ with a *n-1* degrees of freedom.

$t_{1\text{-}\beta,n\text{-}1}$ = the value of $t$ for which the power is equal to 1-$\beta$ with *n-1* degrees of freedom.

The degrees of freedom are required to define $t$. The degrees of freedom depend on the unknown $n$. An iterative procedure is used to estimate $n$. First $n_1$ is estimated using equation 1. Then $n_1$ is used to estimate the degrees of freedom needed to select the $t$ values for equation 2. A second value, $n_2$, for the number of samples will be estimated using equation 2. The estimated $n_2$ will be used to estimate $n_3$, and so on, until the value of $n$ is stabilized to its final value (no change between the previous $n_{i-1}$ and the last $n_i$). (Gilbert 1987).

Equations 1 and 2 can be replaced by equations 3 and 4:

$$n_1 = \frac{\sigma^2 (z_{1-\alpha} + z_{1-\beta})^2}{MDD^2} + 0.5^2 z_{1-\alpha} \qquad (3)$$

$$n_1 = \frac{\sigma^2 (t_{1-\alpha,n-1} + t_{1-\beta,n-1})^2}{MDD^2} + 0.5^2 t_{1-\alpha,n-1} \qquad (4)$$

where:

$MDD$ = minimum detectable difference (MDD) of sample mean - population mean
$\sigma$ = *the standard deviation of the population*

The distribution of the logarithms of the arithmetic values of a lognormal distribution is a normal distribution. Therefore, in the case of a lognormal distribution, $n$ can be estimated using equations 5 and 6:

$$n_1 = \frac{\sigma^2_{log} (z_{1-\alpha} + z_{1-\beta})^2}{MDD^2_{log}} + 0.5^2 z_{1-\alpha} \qquad (5)$$

$$n_1 = \frac{\sigma^2_{log} (t_{1-\alpha,n-1} + t_{1-\beta,n-1})^2}{MDD^2_{log}} + 0.5^2 t_{1-\alpha,n-1} \qquad (6)$$

where:

$\sigma^2 log$ = $log\,(1 + CV^2)$
$MDD_{log}$ = (sample mean - population mean)

First $n_1$ is estimated using equation 5. Then $n_1$ is used to estimate the degrees of freedom needed to select the $t$ values for equation 6. A second value $n_2$ for the number of samples will be estimated using equation 6. The estimated $n_2$ will be used to estimate $n_3$, and so on, until the value of $n$ will be stabilized to its final value (no change between the previous $n_{i-1}$ and the last $n_i$) (Gilbert 1987).

$MDD_{log}$ is related to the relative error of the geometric mean of the arithmetic values and:

$$(\text{sample mean}_{log} - \text{population mean}_{log}) = log \frac{\text{sample geometric mean}}{\text{population geometric mean}}$$

if the quantity in the right side of the equation is termed *RGM*, then:

$$MDD_{log} = log\ (RGM)$$

*RGM* stands for the ratio of geometric means, which is not a standard statistical term. It is introduced here to simplify the discussion. If *RGM* equals 1 (the true geometric mean is equal to the sample geometric mean), then $MDD_{log}$ is equal to 0 and an infinite number of samples is required. If *RGM* equals 2, the relative error of the geometric mean equals to one geometric mean. The number of samples can be used by setting a value for *RGM* instead of *MDRD*.

The number of samples were estimated for the Phase II RI/FS using an assumption of lognormal distribution and equations 5 and 6 and:

| | |
|---|---|
| Confidence: | $1-\alpha = 0.95$ |
| Power: | $1-\beta = 0.80$ |
| Ratio of geometric means: | *RGM* = variable |
| Variance: | $\sigma^2_{log} = 1.499$ |

Depending on the objectives of the investigation for a site or unit, an RGM value can be selected. Where the potential for a false-positive decision error is greater, the number of samples is large, as shown on Table 4-7. As the potential of a false-positive error decreases, progressively fewer samples are necessary.

**Table 4-7**
**Number of Sample Locations to Estimate Risk**

| Ratio of Geometric Means | Risk Range | Total Sample Locations | Total Number of Samples |
|---|---|---|---|
| 4 | $> 10^{-4}$ | 4 | 12 |
| 3 | $10^{-5}$ to $10^{-4}$ | 6 | 18 |
| 2 | $< 10^{-6}$ to $10^{-5}$ | 12 | 36 |

For each unit within the site, estimated risk values were calculated using the Phase I RI data (Table 4-8). The estimated cancer risk values computed for each unit were then compared to the risk ranges in Table 4-7 to identify the number of samples required to determine risk. This value is shown in Table 4-8. Where the existing sample data were insufficient to compute an estimated risk, or where the unit was newly designated for the Phase II RI/FS and no sample data were yet available, the estimated risk is given as unknown (Table 4-8). For these situations, a risk of $10^{-5}$ to $10^{-6}$ was arbitrarily assigned to the unit so that a conservatively large, but not excessive, number of samples would be collected. This approach was intended to assure that sufficient samples were collected for subsequent risk determination.

In general, the number of additional locations that must be sampled during the Phase II RI/FS to determine risk levels is the difference between the total number of sample locations and the number sampled during the Phase I RI. These values are also presented in the two aforementioned tables. There are some instances in which additional considerations have been factored into determining the number of sample locations. These factors are described in the following section.

#### 4.2.6.4 CRITERIA FOR MODIFYING THE NUMBER OF SAMPLE LOCATIONS

Based upon the procedure described in the previous section, the minimum of samples necessary to determine or confirm the risk at a particular unit or site was calculated (Table 4-7). For sites where the estimated risk ranged from less than $10^{-6}$ to $10^{-5}$, 12 sample locations were identified as the number necessary to confirm or determine the risk at a particular unit or site. For sites where the estimated risk was $10^{-5}$ to $10^{-4}$, a smaller number of sample locations (six) was identified as the number necessary to confirm or determine the risk at a particular unit or site. By using this procedure, a greater number of samples are collected at sites when a false-positive decision has the greatest consequence (i.e., making a decision at a site with low cumulative risks for additional investigation when NFI is actually acceptable). Conversely, when a site has a higher risk, a false-positive decision error has less of a consequence, because the investigation will likely recommend remediation of the contamination because it presents a significant risk.

If judgmental sampling is specified for a particular unit or site, the confidence and power limits do not apply because judgmental sampling is not designed to specifically address risk. Rather, judgmental sample locations are intended to answer a specific question regarding conditions at a specific location. Often, judgmental sampling locations are proposed because more information is known about the site conditions, and they are designed to answer a specific concern at a site.

Because the number of sample locations calculated for a risk range does not take into account the size of the unit or site, the standard area for risk assessment is the U.S. EPA 40- by 40-meter (approximately 0.5 acre) residential area (U.S. EPA 1995). This suggests that one sample would be sufficient to characterize the risk for an area of

**Table 4-8**
**Summary of Phase II Remedial Investigation/Feasibility Study Soil Sampling Strategies**

| Description | Unit Area | Phase I RI Cumulative Cancer Risk[a] | Total Number of Sample Locations[b] | Total Number of Samples[b] | Number of Phase I Sample Locations | Number of Phase I Samples | Number of Phase II Sample Locations[c] | Number of Phase II Samples[c] | Tier | Type of Sampling Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| Site 1–Explosive Ordnance Disposal Range | Unit 1–737,250 $ft^2$ | UNK | 12 | 36 | 4 | 4 | 12 | 36[d] | 1 | Areal systematic random |
| | Unit 2–721,600 $ft^2$ | UNK | 12 | 36 | 0 | 0 | 12 | 36 | 1 | Areal systematic random |
| Site 2–Magazine Road Landfill | Unit 1–22 acres | $< 1 \times 10^{-6}$ | | | 7 | 15 | 8 | 24 | | Judgmental |
| | Unit 2–4,000 linear ft | $< 1 \times 10^{-6}$ | | | 6 | 14 | 5 | 10 | | Judgmental |
| | Unit 3–NA (g.w.) | UNK | | | | UNK | | UNK | | Judgmental |
| Site 3–Original Landfill | Unit 1–20 acres | $< 1 \times 10^{-6}$ | | | 6 | 7 | 0 | | | Judgmental |
| | Unit 2–800 linear ft | $< 1 \times 10^{-6}$ | | | 3 | 7 | 4 | 8 | | Judgmental |
| | Unit 3–18,750 $ft^2$ | $< 1 \times 10^{-6}$ | | | 4 | 9 | 2 | 6 | | Judgmental |
| | Unit 4–600 $ft^2$ | $< 1 \times 10^{-6}$ | | | 3 | 5 | 3 | 9 | | Judgmental |
| Site 5–Perimeter Road Landfill | Unit 1–1.5 acres | $< 1 \times 10^{-6}$ | | | 7 | | 1 | 3 | | Judgmental |
| | Unit 2–22,500 $ft^2$ | $< 1 \times 10^{-6}$ | | | NA | | 0 | | | Judgmental |
| Site 6–Drop Tank Drainage Area No. 1 | Unit 1–1,254 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 4 | 10 | 2[e] | 6[e] | 1 | Stratified random: partial area |
| | Unit 2–26,970 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 3 | 6 | 3[e] | 9[e] | 1 | Systematic random on an axis |
| | Unit 3–94,370 $ft^2$ | $1 \times 10^{-6}$ (3) | 12 | 36 | 3 | 6 | 3[e] | 9[e] | 1 | Stratified random: partial area |
| Site 7–Drop Tank Drainage Area No. 2 | | | | | | | | | | |
| | Unit 4–27,950 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 3 | 6[f] | 3[e] | 9[e] | 1 | Systematic random on an axis |

(table continues)

**Table 4-8** (continued)

| Description | Unit Area | Phase I RI Cumulative Cancer Risk[a] | Total Number of Sample Locations[b] | Total Number of Samples[b] | Number of Phase I Sample Locations | Number of Phase I Samples | Number of Phase II Sample Locations[c] | Number of Phase II Samples[c] | Tier | Type of Sampling Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| | Unit 5–90,500 $ft^2$ | $10^{-5}$ (2) | 6 | 18 | 4 | 8[f] | 2 | 6 | 1 | Stratified random: partial area |
| Site 8–DRMO Storage Area Yard | | | | | | | | | | |
| | Unit 2–118,900 $ft^2$. | $< 10^{-6}$ | 12 | 36 | 3 | 7[f] | 5 | 20 | 1 | Areal systematic random |
| | Unit 3–3,710 $ft^2$ | $\sim 10^{-3}$ (4) | 4 | 12 | 4 | 10 | 4 | 16[g] | 1 | Areal systematic random |
| | Unit 5–104,160 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 3 | 6 | 6[e,h] | 18[e,h] | 1 | Areal systematic random |
| Site 9–Crash Crew Pit No. 1 | Unit 1–10,100 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 1 | 2[f] | 5[e] | 15[e] | 1 | Stratified random |
| | Unit 2–40,100 $ft^2$ | UNK | 12 | 36 | 0 | 0 | 6[e] | 18[e] | 1 | Systematic random on an axis |
| Site 10–Petroleum Disposal Area | Unit 1–537,800 $ft^2$ | $9 \times 10^{-6}$ | 12 | 36 | 4 | 11[f] | 8 | 24 | 1 | Areal systematic random |
| | Unit 2–405,600 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 4 | 8[f] | 10 | 30 | 1 | Areal systematic random |
| | Unit 3–266,200 $ft^2$ | UNK | 12 | 36 | 0 | 0 | 12 | 36 | 1 | Areal systematic random |
| | Unit 4–9,000 $ft^2$ | UNK | 2 | 6 | 0 | 0 | 2 | 6 | 1 | Judgmental-per regulators |
| Site 11–Transformer Storage Area | | | | | | | | | | |
| | Unit 3–27,800 $ft^2$ | UNK | 12 | 36 | 0 | 0 | 6[e] | 18[e] | 1 | Areal systematic random |
| Site 12–Sludge Drying Beds | Unit 1–63,800 $ft^2$ | $3 \times 10^{-5}$ | 6 | 18 | 4 | 10[f] | 2 | 8 | 1 | Stratified random: partial area |

(table continues)

## Table 4-8 (continued)

| Description | Unit Area | Phase I RI Cumulative Cancer Risk[a] | Total Number of Sample Locations[b] | Total Number of Samples[b] | Number of Phase I Sample Locations | Number of Phase I Samples | Number of Phase II Sample Locations[c] | Number of Phase II Samples[c] | Tier | Type of Sampling Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| | Unit 2–34,300 $ft^2$ | $3 \times 10^{-6}$ | 12 | 36 | 4 | 9[f] | 2[e] | 8[e] | 1 | Stratified random: partial area |
| | | | | | | | 2 | 8 | 1 | Judgmental–per regulators |
| | Unit 4–108,800 $ft^2$ | UNK | 8 | 24 | 9 | 18 | 8 | 32 | 1 | Judgmental–per regulators |
| | Unit 2–10,880 $ft^2$ | UNK | 12 | 36 | 0 | 0 | 6[e] | 18[e] | 1 | Areal systematic random |
| Site 16–Crash Crew Pit 2 | Unit 1–16,250 $ft^2$ | $< 10^{-6}$ (F) | 12 | 36 | 3[f] | 5 | 3[e] | 9[e] | 1 | Stratified random: partial area |
| | Unit 2–4,340 $ft^2$ | $< 10^{-6}$ (F) | 12 | 36 | 3 | 9 | 4[e] | 16[e] | 1 | Stratified random: 2/new pits |
| | Unit 3–10,200 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 3[f] | 8 | 3[e] | 9[e] | 1 | Systematic random on an axis |
| Site 17–Communication Station Landfill | Unit 1–34 acres | $< 1 \times 10^{-6}$-$1.1 \times 10^{-5}$ | | | 8 | 15 | 2 | 6 | | Judgmental |
| Site 19–Aircraft Expeditionary Site | | | | | | | | | | |
| | Unit 3–159,000 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 3 | 8 | 6[e] | 18[e] | 1 | Areal systematic random |
| | Unit 4–4,560 $ft^2$ | UNK | 1 | 3 | 0 | 0 | 1 | 3 | 1 | Judgmental–per regulators |
| Site 20–Hobby Shop | Unit 1–1,070 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 3 | 9 | 1[e] | 2[e,g] | 1 | Judgmental–per regulators |
| | Unit 4–19,260 $ft^2$ | $2 \times 10^{-6}$ (F) | 12 | 36 | 3 | 7 | 3[e] | 12[e,g] | 1 | Stratified random: w/replacement |
| Site 21–Materials Management | Unit 1–14,100 $ft^2$ | $< 10^{-6}$ | 12 | 36 | 4 | 9 | 2[e] | 6[e] | 1 | Stratified random: partial area |

(table continues)

**Table 4-8** (continued)

| Description | Unit Area | Phase I RI Cumulative Cancer Risk[a] | Total Number of Sample Locations[b] | Total Number of Samples[b] | Number of Phase I Sample Locations | Number of Phase I Samples | Number of Phase II Sample Locations[c] | Number of Phase II Samples[c] | Tier | Type of Sampling Strategy |
|---|---|---|---|---|---|---|---|---|---|---|
| Site 22–Tactical Air Fuel Dispensing System | Unit 1–28,700 $ft^2$ | $10^{-5}$ | 6 | 18 | 4[f] | 9 | 2 | 6 | 1 | Stratified random: partial area |
| | Unit 2–51,700 $ft^2$ | $< 10^{-6}$ | NFI | | 4 | 10 | 1 | 3 | 1 | Judgmental |
| Site 24–Potential Volatile Organic Compound Source Area | Unit 1–8,712.000 $ft^2$ | — | — | | | 286 | | 198 | 1 | Judgmental |
| Site 25–Major Drainages | Unit 1–19,000 linear ft | $< 1 \times 10^{-6*}$ | — | | | 26 | | 18 | | Judgmental |
| | Unit 2–1,000 linear ft | $1.6 \times 10^{-6*}$ | — | | | 13 | | 6 | | Judgmental |
| | Unit 3–8,000 linear ft | $1.5 \times 10^{-6*}$ | — | | | 13 | | 0 | | Judgmental |
| | Unit 4–16,000 linear ft | $1 \times 10^{-6*}$ | — | | | 14 | | 2 | | Judgmental |
| | Unit 5–7,000 linear ft | $1.4 \times 10^{-6*}$ | — | | | 4 | | 0 | | Judgmental |

Notes:

[a] These cumulative cancer risk values were developed using Phase I RI data and chemicals of potential concern-specific risk-based concentrations that were developed following completion of Phase I RI activities.

UNK – an unknown risk either because available sample data are insufficient or the unit is new and no samples have been collected; to be conservative, these unknowns were generally assigned an estimated risk of $10^{-5}$ to $10^{-6}$ to be confident of collecting sufficient samples.
Numbers in parentheses are the noncancer hazard index values that exceed the action level of 1.0.
(F) – indicates sites where the estimated risk may be low, but high residual fuel concentrations are present in soil.

[b] Number of sample locations and number of samples to estimate risks from Table 4-7.

NFI indicates units where no further sampling is proposed because "no further investigation" is the recommendation for this unit. The number of Phase II RI/FS shallow soil boring locations have been based on three samples per location.

Removal action indicates that the unit is planned for removal action rather than RI/FS activities.

[c] These numbers represent difference between number of locations and samples required to determine risk and the number collected as part of the Phase I RI except when noted.

[d] Samples from Phase I were taken outside that waste area and were only surface soil samples. Phase II samples are located using a random sampling design with samples taken at three depths.

[e] Where 12 sample locations were recommended to determine risk, the areas covered by these numbers of locations based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $ft^2$ for 12 sample locations.

(table continues)

**Table 4-8** (continued)

If the unit area is greater than this size limit, the maximum specified number of samples, minus the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of samples will represent a ratio of the unit area versus the sample area times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $ft^2$] x 12 locations = 9 locations needed–3 Phase I locations = 6 new Phase II RI/FS locations required). Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected.

At units where the ratio rule is applied, the total number of locations (Phase I and Phase II combined) will not be less than six, despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment are collected.

[f] Less than three samples were taken at each sample location.
[g] At Site 8 (Unit 3), Site 12 (Units 1, 2, 3, and 4), and Site 20 (Unit 3 and 4), four samples per location will be collected.
[h] Phase I samples taken in native soil beneath fill; Phase II samples to be taken in fill.

Special Cases: Where the number of Phase II RI/FS sample locations is specified as judgmental, per regulatory request, the values are not based on any calculated risk, power, or confidence values; the values are based solely on directions of regulatory agencies. Tier 2 samples, for extent definition, are randomly placed, but the number of locations and samples are based on professional judgment. At Site 8, Unit 3, soil has been removed since the Phase I RI as part of a paving project. For that reason, the residual risk is unknown, but it is assumed to be high based on original conditions. The number of sample locations needed to define current risk is based upon the original risk level.

approximately 17,220 square feet. Thus, a site requiring 12 sample locations and with a risk range of $10^{-6}$ to $10^{-5}$ would equate to an area of approximately 206,700 square feet. To characterize a site to less than $10^{-6}$ risk level, the same number of samples will be collected.

For units that require 12 samples and with a size less than 206,700 square feet, the number of samples to be collected will be determined by taking the ratio of the unit area divided by 206,700 square feet and multiplying that ratio times 12. In both cases of large and small sites, the site size is factored into the sample number issue.

A minimum of six Phase I and Phase II locations will be sampled within each unit regardless of the risk. Using six as a minimum number for sample locations will assure that at small sites where the estimated risk is near the action level and false-positive decision errors are most critical, the number of samples collected will at least equal the confidence and power limits established for the project.

#### 4.2.6.5 SAMPLING DESIGNS

Four types of sampling designs are used to determine the soil conditions at this site. These four sampling designs are:

- stratified random sampling – either whole or partial unit areas, with replacement where sample locations are closely spaced or overlap;
- systematic random sampling along an axis – with replacement if new and existing sample locations overlap or are closely spaced;
- areal systematic random sampling (grid); and
- judgmental sampling.

The first three sampling designs utilize some form of random positioning to produce an unbiased sample location configuration. The important consideration is that because they represent a random, unbiased sampling design, the uncertainty in the sample can be controlled, and the analytical results can be evaluated statistically.

The fourth sampling design to be used in the Phase II RI/FS is judgmental sampling. The use of judgmental sampling is not performed to address general issues such as risk. Rather, judgmental sampling is designed to provide answers to more specific questions or issues, such as providing samples in areas needing additional coverage or where sample locations are placed according to professional judgment. As such, the confidence and power limits associated with statistically based sampling designs do not apply. Decision errors must still be considered, but they cannot be evaluated statistically. This makes careful application of field and laboratory techniques more critical because corroborating data from multiple samples will not necessarily be available. To minimize decision errors, frequent meetings with the BCT will be held to discuss the results of judgmental sampling programs.

### 4.2.7 Step 7 – Optimization of Sampling Design

The objective of this effort is to identify the most resource-effective data collection design that satisfies DQO. The data needs of this step include:

- methods for testing the hypothesis,
- selecting optimal sample size, and
- select resource-effective data collection designs.

The methods for testing the hypothesis and selecting optimal sample size are discussed in preceding sections.

The Phase II RI/FS sampling strategies and types of media is summarized on Tables 4-8 and 4-9. Table 4-8 presents information on the site unit size, estimated risk for each unit from the Phase I RI, minimum number of samples required to characterize risks in the Phase II RI/FS, the number of additional samples that will need to be collected during the Phase II RI, and the type of sampling designs to be implemented at each unit. Table 4-9 summarizes the number and types of samples to be collected at each site during the Phase II RI/FS. The types of media samples and respective analysis are summarized in Tables 4-10, 4-11, 4-12, 4-13, and 4-14. Site-specific sampling locations are illustrated on figures presented in the appendices.

## Table 4-9
## Summary for Phase II Remedial Investigation/Feasibility Study Samples

| | GROUNDWATER SAMPLES | | | SHALLOW SOIL SAMPLES | | SUBSURFACE SOIL SAMPLES | | SEDIMENT AND SURFACE WATER SAMPLES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Proposed Monitoring Wells[a] | Existing Groundwater Wells[b] | Total | Soil Field Screening | Laboratory Analysis | Soil Field Screening[a] | Laboratory Analysis | Number of Sediment Samples | Number of Surface Water Samples | Air/Soil Gas Samples[a] |
| 1 | 3 | 2 | 5 | 72 | 72 | 18 | 18 | — | — | — |
| 2 | 9 | 4 | 13 | 27 | 3 | 18 | 2 | — | 4 | 208 |
| 3 | 0 | 4 | 4 | 15 | 2 | 2 | 1 | 3 | 3 | 81 |
| 5 | 1 | 4 | 5 | 3 | 1 | 4 | 1 | — | — | 38 |
| 6 | 0 | 0[c] | 0 | 24 | 24[d] | 0 | 0 | — | — | — |
| 7 | 0 | 0[c] | 0 | 15 | 9 | 0 | 0 | — | — | — |
| 8 | 0 | 0[c] | 0 | 54 | 16 | 0 | 0 | — | — | — |
| 9 | 0 | 0[c] | 0 | 33 | 12 | 0 | 0 | — | — | — |
| 10 | 0 | 0[c] | 0 | 96 | 21[d] | 0 | 0 | — | — | — |
| 11 | 0 | 0 | 0 | 24 | 24 | 0 | 0 | — | — | — |
| 12 | 0 | 0[c] | 0 | 56 | 9 | 0 | 0 | — | — | — |
| 15 | 0 | 0[c] | 0 | 18 | 4[d] | 0 | 0 | — | — | — |
| 16 | 0 | 0[c] | 0 | 34 | 12[d] | 15 | 9 | — | — | — |
| 17 | 2 | 1 | 3 | 0 | 0 | 165 | 33 | — | — | 31 |
| 19 | 0 | 0[c] | 0 | 21 | 8[d] | 0 | 0 | — | — | — |
| 20 | 0 | 0 | 0 | 14 | 0[d] | 0 | 0 | — | — | — |

(table continues)

**Table 4-9** (continued)

| | GROUNDWATER SAMPLES | | | SHALLOW SOIL SAMPLES | | SUBSURFACE SOIL SAMPLES | | SEDIMENT AND SURFACE WATER SAMPLES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Site No. | Proposed Monitoring Wells[a] | Existing Groundwater Wells[b] | Total | Soil Field Screening | Laboratory Analysis | Soil Field Screening[a] | Laboratory Analysis | Number of Sediment Samples | Number of Surface Water Samples | Air/Soil Gas Samples[a] |
| 21 | 0 | 0 | 0 | 6 | 3 | 0 | 0 | — | — | — |
| 22 | 0 | 0[c] | 0 | 9 | 6 | 0 | 0 | — | — | — |
| 24 | 24[e] | 6 | 30 | 16 | 3 | 182 | 17 | 0 | 0 | 200 |
| 25 | 0 | 0 | 0 | 6 | 2 | 22 | 4 | 2 | 12 | — |

Notes:

[a] Number may change depending on the results of initial Phase II RI/FS sampling.

[b] Groundwater monitoring wells were installed at most of the sites during the Phase I RI; however, most of these wells are only scheduled to be sampled as part of the basewide groundwater monitoring program.

[c] Not scheduled for sampling unless impacted media has potential to impact groundwater as indicated by Phase II RI/FS sampling or modeling.

[d] In addition to this number, for QA/QC support and verification, a minimum of 1 percent of the total number of positive, and a minimum of 5 percent of the total number of negative, field screening results will be analyzed by a fixed-base laboratory.

[e] Includes two air sparging wells.

## Table 4-10
## Summary for Phase II Remedial Investigation-Shallow Soil Samples and Analysis

| | | NUMBER OF SAMPLES | | ANALYSES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Number | Unit | Field Screening | Laboratory CLP[a] | VOC[b] | SVOC[c] | Pesticides/ PCBs[d] | Herbicides | TPH[e]-Gasoline | TPH-Diesel | Metals | Treatability Parameters | Other |
| 1 | 1 | 36 | 36 | | X | | | X | X | X | X | X |
| | 2 | 36 | 36 | | X | | | X | X | X | X | X |
| 2 | 1 | | | | | X | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | 27[f] | 3[g] | X | X | X | X | X | X | X | | |
| 3 | 1 | 63 | 13[g] | | | | | | | | | |
| | 2 | | | | | | | | | | | |
| | 3 | 6 | 3 | X | X | X | X | X | X | X | | |
| | 4 | 9 | 3 | X | X | X | X | X | X | X | | |
| 5 | 1 | 12 | 3 | X | X | X | X | X | X | X | | |
| | 2 | | | | | | | | | | | |
| 6 | 1 | 6 | 6 | X | X | | | X | X | X | | |
| | 2 | 9 | 6 | X | X | | | X | X | X | | |
| | 3 | 9 | 3 | X | X | | | X | X | X | X | |
| 7 | 2 | NFI[h] | | | | | | | | | | |
| | 4 | 9 | 6 | X | X | | | X | X | X | | |
| | 5 | 6 | 3 | X | X | X | | X | X | X | X | |
| 8 | 2 | 20 | 6 | X | X | X | X | X | X | X | X | X |
| | 3 | 16 | 4 | | X | X | | X | X | X | | |
| 8 | 5 | 18 | 6 | X | X | X | | X | X | X | | |
| 9 | 1 | 15 | 3 | X | X | | | X | X | X | | X |
| | 2 | 18 | 9 | X | X | | | X | X | X | | X |
| 10 | 1 | 24 | 5 | | X | | | X | X | | X | |
| | 2 | 30 | 6 | | X | | | X | X | | | |
| | 3 | 36 | 9 | | X | | | X | X | | X | |
| | 4 | 6 | 6 | | X | | | | | X | | |
| 11 | 3 | 24 | 24 | | | X | | | | | | |

(table continues)

**Table 4-10** (continued)

| Site Number | Unit | NUMBER OF SAMPLES Field Screening | Laboratory CLP[a] | ANALYSES VOC[b] | SVOC[c] | Pesticides/ PCBs[d] | Herbicides | TPH[e]- Gasoline | TPH- Diesel | Metals | Treatability Parameters | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 1 | 8 | 3 | | X | X | X | | | X | X | X |
| | 2 | 16 | 3 | | X | X | X | | | X | X | X |
| | 4 | 32 | 3 | | X | X | | | | X | X | X |
| 15 | 2 | 18 | 4 | | X | X | | X | X | X | | |
| 16 | 1 | 9 | 3 | X | X | | | X | X | X | | X |
| | 2 | 16 | 3 | X | X | | | X | X | X | X | X |
| | 3 | 9 | 6 | | X | | | X | X | X | | |
| 17 | 1 | 6[e] | 3 | X | X | X | X | X | X | X | | |
| 19 | 3 | 18 | 5 | | X | | | X | X | | | |
| | 4 | 3 | 3 | | X | | | X | X | | | |
| 20 | 1 | 2 | 2 | | X | | | | X | X | | |
| | 4 | 12 | 3 | X | X | | | X | X | X | | |
| 21 | 1 | 6 | 3 | X | X | | | X | X | | | |
| 22 | 1 | 6 | 3 | | X | | | X | X | | X | |
| | 2 | 3 | 3 | | X | | | X | X | | X | |
| 24 | NA[i] | 16 | 3 | X | | | | X | | | | |
| 25 | Agua Chinon | 3 | 1 | | X | | | X | X | | | X |
| | Bee Canyon | 3 | 1 | | X | | | X | X | | | X |
| | San Diego Creek | 0 | 0 | | | | | | | | | |

Notes:
- [a] CLP – U.S. EPA Contract Laboratory Program
- [b] VOC – volatile organic compound
- [c] SVOC – semivolatile organic compound
- [d] PCB – polychlorinated biphenyl
- [e] TPH – total petroleum hydrocarbons
- [f] Shallow soil samples will be collected in the groundwater monitoring well locations drilled off-site.
- [g] In addition to this number, for QA/QC support and verification, a minimum of 20 percent of the total number of field screened samples (2/3 are positive and 1/3 are nondetect).
- [h] NFI – no further investigation
- [i] NA – not applicable

## Table 4-11
## Summary for Phase II Remedial Investigation-Subsurface Soil Samples and Analysis

| | | NUMBER OF SAMPLES[a] | | ANALYSES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Number | Location | Field Screening | Laboratory CLP[b] | VOCs[c] | SVOCs[d] | Pesticides/ PCBs[e] | Herbicides | TPH[f]- Gasoline | TPH- Diesel | Metals | General Chemistry | Other |
| 1 | 1 | TBD[g] | TBD | X | X | | | X | X | X | | X |
| | 2 | TBD | TBD | X | X | | | X | X | X | | X |
| 2 | 3 | 18 | 2 | X | X | X | X | X | X | X | | X |
| 3 | 1 | 2 | 1 | X | X | X | X | X | X | X | | X |
| 5 | 1 | 4 | 1 | X | X | X | X | X | X | X | | |
| 16 | 2 | 15 | 9 | X | X | | | X | X | X | | X |
| 17 | 1 | 6 | 1 | X | X | X | X | X | X | X | | X |
| 19 | 2 | 10 | 6 | | X | | | X | X | | | |
| 22 | 1 | TBD | TBD | | X | | | X | X | | | |
| 24 | | 182 | 27 | X | | | | | | | | |
| 25 | Agua Chinon | TBD | 2 | | X | | | X | X | | | |
| 25 | Bee Canyon | TBD | 1 | | X | | | X | X | | | |

Notes:
- [a] number may change depending on the results of initial Phase II RI/FS sampling
- [b] CLP – U.S. EPA Contract Laboratory Program
- [c] VOC – volatile organic compound
- [d] SVOC – semivolatile organic compound
- [e] PCB – polychlorinated biphenyl
- [f] TPH – total petroleum hydrocarbons
- [g] TBD – to be determined

## Table 4-12
## Summary for Phase II Remedial Investigation-Groundwater Samples and Analysis

| | WELL STATUS | | | | ANALYSES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Number | Number of Wells | Existing | Proposed | Number of Samples | VOCs[a] | SVOCs[b] | Pesticides/ PCBs[c] | Herbicides | TPH[d]-Gasoline | TPH-Diesel | Metals | General Chemistry | Treatability Parameters | Other |
| 1 | 5 | 2 | 3 | 5 | X | X | | | X | X | X | X | | X |
| 2 | 13 | 4 | 9 | 19[e] | X | X | X | X | X | X | X | X | | X |
| 3 | 4 | 4 | TBD[f] | 4 | X | X | X | X | X | X | X | X | | X |
| 5 | 5 | 4 | 1 | 1 | X | X | X | X | X | X | X | X | | X |
| 17 | 3 | 1 | 2 | 2 | X | X | X | X | X | X | X | X | | X |
| 24 | 12 | 1 | 11 | 16 | X | X | X | | | | X | X | | |
| 25 | NA[g] | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Notes:
- [a] VOC – volatile organic compound
- [b] SVOC – semivolatile organic compound
- [c] PCB – polychlorinated biphenyl
- [d] TPH – total petroleum hydrocarbons
- [e] includes CPT groundwater samples
- [f] TBD – to be determined
- [g] NA – not applicable

**Table 4-13**
**Summary for Phase II Remedial Investigation-Soil Gas Samples and Analyses**

| Site Number | Unit | NUMBER OF SAMPLES Laboratory | Field Screening | ANALYSES VOCs[a] | TPH[b]-Gasoline | Other |
|---|---|---|---|---|---|---|
| 2 | 1 | 21 | 208 | | | X[c] |
| 3 | 1 | 4 | 41 | | | X[c] |
| | 2 | 1 | 4 | | | X[c] |
| | 3 | 3 | 30 | | | X[c] |
| | 4 | 1 | 6 | | | X[c] |
| 5 | 1 | 5 | 38 | | | — |
| 17 | 1 | 4 | 31 | | | X[c] |
| 24 | 1 | 200 | NA[d] | X | X | |

Notes:
[a] VOC – volatile organic compound
[b] TPH – total petroleum hydrocarbons
[c] Method TO-14 (modified to include methane)
[d] NA – not applicable

## Table 4-14
## Proposed Analyses for Phase II Remedial Investigation-Sediment and Surface Water Runoff Samples

| | | | ANALYSES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Number | No. of Locations | No. of Samples | VOCs[a] | SVOCs[b] | Pesticides/ PCBs[c] | Herbicides | TPH[d]- Gasoline | TPH- Diesel | Metals | General Chemistry |
| 2 (Surface Water) | 4 | 4 | X | X | X | X | X | X | X | X |
| 3 (Surface Water) | 3 | 3 | X | X | X | X | X | X | X | X |
| 3 (Sediment) | 3 | 3 | X | X | X | X | X | X | X | |
| 25 (Sediment) | 2 | 2 | | | X | | | | X | |
| 25 (Surface Water) | 12 | 12 | X | X | X | X | X | X | X | X |

Notes:
[a] VOC – volatile organic compound
[b] SVOC – semivolatile organic compound
[c] PCB – polychlorinated biphenyl
[d] TPH – total petroleum hydrocarbons

# SECTION 5

## REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

# Section 5
# REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

This section provides an outline of tasks associated with conducting the Phase II RI/FS at MCAS El Toro. The following subsections discuss project planning, community relations, remedial investigation activities, and the feasibility study. Detailed descriptions of the sampling activities are presented in the FSP (BNI 1995a).

## 5.1 PROJECT PLANNING

For the Phase II RI/FS, project planning activities that will occur after the WP and associated documents have been submitted and approved primarily will be related to procurement and permitting requirements for the Phase II RI/FS. Sources used to scope the Phase II RI/FS activities consisted of regulatory agency comments, the draft Phase II RI/FS WP, a series of meetings and position papers for the BCT, and the DQOs presented as appendices to this plan.

### 5.1.1 Procurement of Subcontractors

This subtask addresses the procurement of technical subcontractors to perform tasks associated with the RI/FS of MCAS El Toro. The process of selecting subcontractors occurs during the planning phase. Subcontractors will be selected and scheduled before the implementation of field activities. Selection of subcontractors will be made based on quality of work, cost of services, knowledge of the area, and availability and flexibility during the time of the field activities. Subcontractors may be acquired to perform the following tasks:

- analytical laboratory services (fixed-base laboratory),
- analytical laboratory services (mobile laboratory),
- geophysical fieldwork (borehole logging),
- geophysical survey (utility location),
- concrete cutting,
- drilling and well installation,
- cone penetrometer testing (CPT),
- soil gas sampling,
- backhoe contractor,
- land surveying,
- equipment vendors for treatability studies,
- general contractor for fencing, locks, and temporary storage area cleanup of investigation-derived waste, and
- hauling of on-site investigation-derived wastes.

During the field activities, an Environmental Site Manager will be responsible for the overall scheduling and direction of subcontractors involved with the RI/FS at MCAS El Toro.

### 5.1.2 Permitting for Fieldwork

One general well permit will be filed with the Orange County Health Agency. The information provided to the agency will include the approximate number and location of the borings and groundwater monitoring wells to be installed. Also included will be general information regarding the composition and materials used in well construction such as screening intervals and total depths. Information regarding boring backfill and monitoring well construction will also be provided. When the fieldwork is finished, a map will be submitted to the Orange County Health Agency that illustrates the locations of drilled borings and the permanent locations of monitoring wells, including the total number and depths of the borings and wells.

An air permit may be required from the SCAQMD for the proposed soil vapor extraction and air-sparging pilot tests. If subcontractors are used that have already obtained multiple-site permits for treating the discharged air, new permits will not be required.

## 5.2 COMMUNITY RELATIONS

A Community Relations Plan for the Phase II RI at MCAS El Toro will be prepared. This plan is required by SARA Section 117, which outlines the requirements for public participation prior to adoption of IRP plans by the Navy and Marine Corps. It will define the community relations program and will detail specific activities to support this RI/FS. The objectives of the community relations program are to:

- maintain open communication between MCAS El Toro and the regulatory agencies as well as local, state, and federal government agencies and officials; community leaders; environmental organizations; and other interested individuals or groups;
- encourage community involvement by providing residents, regulatory agencies, government officials, civic leaders, environmental organizations, and news media with accurate, timely information about the investigation and other important technical and administrative matters; and
- monitor community concerns, update the Community Relations Plan as necessary, and keep the structure, format, and schedule for community relations activities flexible to meet the changing needs of the local community.

Community relations activities will include the following tasks:

- identify public contacts at MCAS El Toro and the U.S. EPA who will provide information about site activities and will respond to community inquiries;
- conduct regular Restoration Advisory Board meetings to discuss cleanup issues and provide the community with the opportunity to review and comment on technical documents;

- publish fact sheets to inform the public about the environmental program underway at MCAS El Toro;
- conduct informal public meetings to provide current information about site activities and to respond to specific community concerns;
- maintain a mailing list of interested individuals, elected officials, civic leaders, and news media for mailing of information as it becomes available;
- maintain an Information Repository and Administrative Record; and
- issue public notices and news releases at key milestones during the RI process to announce scheduled public meetings, public comment periods, and other opportunities for public participation.

## 5.3 REMEDIAL INVESTIGATION

The Phase II RI activities at MCAS El Toro include:

- field investigations,
- data management and validation procedures,
- data evaluation methods,
- risk assessment,
- treatability and pilot testing, and
- RI report preparation.

### 5.3.1 Field Investigations

Field investigations planned for the Phase II RI include intrusive and nonintrusive methods. During the RI, data will be collected at each site to satisfy the DQOs and may include samples of the site soil, groundwater, air, surface water, or sediment.

#### 5.3.1.1 MOBILIZATION

Mobilization comprises the functions performed to prepare for field activities in preparation for the RI, including staking the field sampling locations, calibrating field instruments, and acquiring permits (Section 5.1.2). Also included is the coordination of subcontractors involved with the project. The Environmental Site Manager will manage interactions with subcontractors. Further discussion of these activities is provided in Section 6 of the FSP (BNI 1995a).

#### 5.3.1.2 UTILITY CLEARANCE

At each location where drilling, driving of soil gas sampling points, direct-push soil sampling, backhoe trenching, or other intrusive investigations are to be conducted, utility clearance procedures will be completed to avoid damaging existing utilities.

After each appropriate sampling location has been selected and located in the field, utility maps obtained from the MCAS El Toro engineering department will be used to determine the approximate location of nearby buried utilities. Geophysical surveys, including GPR, magnetic surveys, and electromagnetic methods, as appropriate, will be used to locate and mark the locations of subsurface utilities in the field. Prior to drilling or driving of sampling equipment, a hole will be hand augered to a depth of 5 feet to assure that subsurface utilities are not present. In case of utility emergency, the Facilities Management Department will be immediately telephoned, and the incident will be reported.

#### 5.3.1.3 SOIL SAMPLING AND DRILLING

Drilling methods to be used during the Phase II RI include hollow-stem auger, direct-push using a CPT rig, air rotary, and mud rotary. The drilling methods listed below include a brief description of their intended purpose, and method(s) of soil sampling. The number and types of shallow soil (samples taken from depths of less than 10 feet) and subsurface soil are summarized in Tables 4-10 and 4-11, respectively. Soil sampling and drilling procedures are described in more detail in the FSP (BNI 1995a).

Hollow-stem auger drilling will be used for investigating the nature and extent of subsurface soil contamination. These borings may be used as pilot holes for deep soil gas sampling if the CPT rig is not capable of reaching the water table. Soil vapor extraction wells/piezometers will be installed in the borings as appropriate. If feasible, hollow-stem auger drilling will be used to complete the proposed water table wells (estimated to be 90 to 150 feet bgs). Soil samples will be collected at intervals with modified California samplers using the drive method, or samples will be collected and continuously cored using the Central Mining Equipment 5-foot core barrel.

Direct-push soil samples will be obtained using the CPT rig. These samples will be taken in conjunction with the soil gas investigation. In this way, soil and soil gas VOC concentrations can be correlated from a specific sampling location.

Air-rotary/casing hammer drilling will be used to complete the deep monitoring wells and water table wells (if hollow-stem auger drilling is not feasible). The air-rotary/casing hammer method was selected because the conductor casing helps provide assurance that contamination from the water table is not transmitted to deeper zones. Soil samples will be collected with modified California samplers using the drive method.

Mud-rotary drilling will be selected to facilitate downhole geophysical logging. Soil samples will be collected using the Christiansen 94-millimeter, 10-foot core barrel. Mud-rotary drilling will be used as the final option in constructing monitoring wells (i.e., since both hollow-stem auger and air-rotary drilling are not considered to be feasible). The BCT will be consulted before monitoring well borings are drilled using the mud-rotary method. No samples would be taken for chemical analysis in mud-rotary borings.

Samples will also be taken from sediment in the major drainages. Surface soil samples will be taken in the upper 6 inches bgs. Shallow soil samples (up to 10 feet bgs) will be taken with hand-augered borings. The borings will be logged according to the Unified Soil Classification System. Section 6 of the FSP details the drilling and soil sampling methods and how they will be applied to the Phase II RI (BNI 1995a).

#### 5.3.1.4 HYDROGEOLOGICAL INVESTIGATIONS

The hydrogeological investigations will include drilling and logging of well borings, and the installation and development of groundwater monitoring wells. The wells will be installed to determine and monitor (through time) the horizontal and vertical groundwater quality on the Station. Groundwater samples will be collected from monitoring wells (permanent sampling locations) and from direct-push or push-in samplers. The number and types of groundwater samples are summarized in Table 4-12.

Specific information on well depths at individual sites, monitoring well installation techniques, and construction materials are outlined in Section 6 of the FSP (BNI 1995a). Similar information regarding air sparging wells is also included in Section 6 of the FSP (BNI 1995a).

Wells will be developed as soon as practical after completion, but no sooner than 72 hours after the well seal has been installed. Well development procedures, groundwater sampling, and monitoring procedures are described in the FSP (BNI 1995a).

#### 5.3.1.5 SOIL GAS

VOCs may be present in the unsaturated zone in four separate phases. If a free-liquid-phase VOC enters the subsurface (e.g., from waste solvent disposal), it will partition, in whole or part, into the sorbed, dissolved, and vapor phases. If a VOC enters the soil in the dissolved phase (e.g., mixed with water from aircraft washing) it will partition, in part, into the sorbed and vapor phases. In general, the organic carbon fraction of a soil controls the degree to which a VOC is sorbed. Organic carbon concentrations are generally higher in finer-grained soil than in sandy soil. Soil samples analyzed from MCAS El Toro have demonstrated very low organic carbon and, therefore, should only weakly sorb VOCs. In soils with very low organic carbon concentrations, most of the VOCs partition to the dissolved and vapor phases. Generally, VOCs are slightly soluble in water and have high vapor pressures, so they partition readily to the vapor phase. These are favorable conditions for using a soil gas investigation to estimate the horizontal and vertical extent of VOC contamination.

Soil gas investigations will be conducted at Site 24, the VOC Source Area, and at the Station landfills, Sites 2, 3, 5, and 17 (Table 4-13). The goal at the VOC Source Area is to define the nature and extent of VOC-contaminated soil gas. Understanding the nature and extent of the soil gas plume beneath Site 24 will permit correlation with the groundwater plume and will facilitate selection of a remedial alternative. The purpose of the soil gas investigations at the Station landfills is to identify potential hot spots and assess production of landfill gases. This soil gas information will be used during the evaluation of the landfill presumptive remedy (capping).

The soil gas investigations will follow "Requirements for Active Soil Gas Investigation," produced by the RWQCB, Los Angeles Region (RWQCB 1994). These guidelines recommended a 10- to 20-foot grid pattern and 5- to 10-foot vertical spacing for samples in soil gas hot spots. A 100-foot or less grid pattern is recommended for the remainder of the site. This effort would require considerable expenditure of time for the Phase II RI/FS at MCAS El Toro. The horizontal and vertical sampling plans for soil gas surveys were discussed with the BCT and incorporated into site-specific sampling plans for Sites 2, 3, 5, 17, and 24. Other procedures discussed in the guidelines will be followed. This document is appended to the QAPP (BNI 1995b).

The soil gas samples will be collected using a CPT rig to hydraulically advance the sample probe to the desired depth. Sampling depths will be determined after analyzing CPT lithologic logs, and the soil and geophysical logs from the proposed mud-rotary borings. Relatively permeable soils will be targeted for soil gas sampling. In the event that the desired soil gas sampling depth cannot be reached using the CPT rig, a hollow-stem auger boring will be advanced to no less than 10 feet above the sample point, and the CPT unit will be used to take the sample.

#### 5.3.1.6 AIR SAMPLING

Sampling of surface emission of vapors from the subsurface into the air is a significant component of the landfill investigations. Field investigations will use various air-sampling methods, including instantaneous sampling, integrated surface sampling, isolation flux chamber, and ambient air sampling. The primary goals of this air sampling are to collect data to determine whether off-gassing from the landfills is a risk to human health and the environment, and to assess whether gas-collection systems will be required for the landfills. Explanations and standardized procedures for these methods are outlined in Section 6 of the FSP (BNI 1995a).

#### 5.3.1.7 SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediment sampling are primarily used to assess risks associated with contaminants in the major drainages (Site 25). However, additional samples will be collected at Sites 2 and 3. Table 4-14 summarizes the types and locations of sediment and surface water samples. Samples of the surface water and sediment in the drainages will be collected and analyzed for contaminants. The field procedures are outlined in Section 6 of the FSP (BNI 1995a).

#### 5.3.1.8 GEOPHYSICS

Surface geophysical surveys, GPR, electromagnetics, and use of a magnetometer will primarily be used in the RI as a tool to define the limits of the landfill IRP sites.

#### 5.3.1.9 LAND SURVEYING

The horizontal and vertical locations and elevations of soil borings, test pits, soil sample locations, mud-rotary borings, CPT holes, groundwater monitoring wells, and other features of importance will be surveyed by a professional land surveyor. The horizontal and vertical locations will be determined by the California Plane Coordinate System (NAD 83, Lambert Zones 1 through 6) with northings and eastings calculated the nearest 0.1 foot. The top of well casings will be determined to the nearest 0.01 foot from a vertical reference of MSL.

Surveyors will be on-site only at predetermined times that have been coordinated with MCAS El Toro. Each point to be surveyed will be marked on the ground with paint or a stake and marked on field maps supplied to the survey crew. Surveying of monitoring wells will occur after complete installation and will be designated by the station identification number, which will be marked on the casing or the surface completion apparatus. For a sampling location remote from permanent structures, a global positioning system (GPS) survey may be used to locate the proposed sampling location that will be surveyed after sampling using theodolites.

For those sites that will require grids for sampling strategies, datum points used to establish the grid lines will also be surveyed along two perpendicular control lines designed to provide the rectangular alignment for each initial grid. Once these lines have been defined, the screening grid will be laid out across each site; and tapes, survey chains, or GPS will be used to define the grid node locations. Each node will be identified by a paint mark (on pavement areas) or a paint mark and stake (in soil areas). Secondary grids will be developed and deep boring locations will be identified; and the initial grid nodes will be used for control points.

The results of the field investigations and available documentation provided by any topography searches will be entered into a digital terrain computer database, and those results will be overlaid with the survey data collected. The data will include the date that the horizontal and vertical datum was established. This database will be used to calculate volumes of landfill areas, which will aid in estimating gas and leachate generation potential.

Surveys will be conducted during more than one field session. Survey field notes will be recorded in a survey logbook. Final survey data will be incorporated in the Phase II RI/FS.

### 5.3.1.10 DECONTAMINATION

This section describes decontamination process for all material and equipment that is used directly or indirectly for sample collection during the Phase II field investigation. It does not include personnel decontamination, which is described in the Health and Safety Plan. Additional information regarding decontamination is provided in Section 6 of the FSP (BNI 1995a).

Decontamination is the process of neutralizing, washing, rinsing, and removing contaminants from the exposed surfaces of equipment to reduce the potential for contaminant migration or cross-contamination. All sampling equipment should be decontaminated before it is used at the site and before it leaves the site.

MCAS El Toro has two constructed, concrete-lined decontamination areas with containment sumps for decontamination wastes. Any decontamination activity that requires a large amount of wash and rinse water will be conducted on one of these pads, including all steam cleaning of vehicles and equipment. This will facilitate the collection and treatment of decontamination solutions.

Small sampling equipment that is submersible can be washed at the sampling location. If needed, the waste storage area will be used as an alternate decontamination location. Equipment used for surface water sampling, soil sampling, well development, pump testing, and slug testing will be hand-washed using the wash-and-rinse method. The specific procedure for the wash-and-rinse method is detailed in Section 6 in the FSP (BNI 1995a). Wastes generated during decontamination will be drummed and appropriately labeled for transport to the waste staging area. The water generated during decontamination will be pumped to a Baker tank by a sump pump and then treated by the on-site carbon system. The treated water can be used to irrigate the golf course.

Vehicles and other large equipment used at the drilling location will be cleaned with a steam cleaner or high-pressure hot water cleaner before drilling operations and between borings. Monitoring well casings, screens, and fittings will be delivered to the site in clean condition or will be cleaned in the manner described below, prior to moving them to the drilling location.

The wipe method of decontamination (Section 6 of the FSP, BNI 1995a) will be used at the sampling location for cleaning items that will be washed and rinsed in the field or will be subjected to steam cleaning at the decontamination pad. These items include steel tapes, electric sounders, transducers, and geophysical and video logging equipment.

Depending upon the type of analysis, additional chemical rinses may be used in decontamination procedures. For example, U.S. EPA Region IX recommends a 0.1N nitric acid rinse, where metal contamination is of concern, and a pesticide-grade solvent rinse, where SVOC and nonvolatile organic contamination may be present.

Decontamination procedures will be documented in the field logbook. The information recorded will include date and time of operation, sampling location at which the items became contaminated, method of decontamination, person completing and witnessing the decontamination procedure, and items decontaminated (identified by license, rig number, or serial number).

#### 5.3.1.11 INVESTIGATION-DERIVED WASTE HANDLING

The investigation-derived wastes will be handled according to the MCAS El Toro Phase II RI/FS IDWMP (BNI 1995e). Arrangement for transportation of solid waste from the sampling location, waste sampling, waste classification, and waste disposal will be the responsibility of the waste manager, who will follow the guidance in the IDWMP.

### 5.3.1.12 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Specific procedures regarding sample containers, sample labeling and numbering, sample custody, sample handling in the field, and sample packaging and shipping have been outlined for field staff to follow. Detailed information regarding these procedures is provided in the QAPP (BNI 1995b) and in Section 6 of the FSP (BNI 1995a).

With the exception of subsurface soil samples collected in sampler tube sleeves (liners), the analytical laboratory shall provide the sample containers to be used. The type and size of containers used for aqueous and soil samples will vary depending on the type of analysis to be performed on the sample. Where applicable, preservatives may be placed in the containers prior to their arrival at the field site.

Certificates of cleanliness for glassware, including bottle lot numbers, will be cross-referenced to provide ample identification in the field logbooks. Information regarding whether preservatives were added at the laboratory or by the sample manager, will be recorded with the sample identification.

Sample numbers will be assigned on the basis of a code system that provides blind samples to the laboratory, with no duplication of numbers. Sample labels convey information unique to each sample container. Labels also relay specific information about sample conditions at the time of sampling. Each sample label will have the project, site, and job number. Sample labels will also contain the name or initials of the sampler, sample identification number, sample depth below the ground surface (if applicable), analysis required, preservatives added, date of sampling, and local standard time of sample collection using 24-hour notation.

The information recorded on the sample labels will also be recorded in the field logbook, chain-of-custody (COC) record, and boring logs. Additional information to be recorded in the field logbook includes sample location (e.g., distances to nearest fixed reference points), sample matrix, sample appearance, volume of sample collected, field measurements (if applicable), type of sampling equipment used, type and number of sample containers used per sampling site, designation of quality control samples (e.g., blanks, splits, or duplicates), and significant events and observations. At the end of the daily logbook narrative, the field sampler's signature and date of sample collection must be recorded.

The field sampler shall fill out a COC record as each sample is collected. The purpose of the COC record is to physically record sample possession from the time of collection to ultimate sample disposition. The COC record must move with the samples. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the record. The times of relinquishment and receipt will be identical to avoid breaking the custody chain. The following information will be recorded on the COC record:

- project name and site of sample collection,
- job number,

- names of field samplers,
- sample ID number,
- date of sampling,
- local standard time of sample collection using 24-hour notation,
- sample matrix,
- description of the sample location and depth (bgs), if applicable,
- analyses requested,
- preservatives added (if applicable),
- means of transmittal to the analytical laboratory or storage facility (including carrier and airbill number, if applicable), and
- any general comments, instructions to the analytical laboratory or unusual circumstances, including possible splits of particular samples with an owner, operator, or government agency, instructions to spike a sample, or problems encountered during an attempt to transfer a sample.

Custody seals are to be used on each sample to show that the sample was not disturbed during transportation. When a sample has been collected, labeled, and the appropriate information has been entered into the field logbook, and entered on the COC record, a signed and dated custody seal shall be affixed to the container in such a way that it is necessary to break the seal in order to open the sample container. Two or more custody seals shall be affixed to the outside of the shipping container or cooler prior to shipment through an overnight carrier.

The final responsibilities of the field sampling team will be to assure that each sample is properly packaged and shipped to the appropriate laboratory and that a record of that shipment is available. Specific protocol regarding sample packaging and shipping is outlined in Section 6 of the FSP (BNI 1995a) and in the QAPP (BNI 1995b).

## 5.4 DATA MANAGEMENT AND VALIDATION

The data collected for this project will consist of field logbooks, field measurements, field screening laboratory results, and fixed-base CLP laboratory results. Site data requirements for this RI/FS will be governed by the specific type of data and the DQOs. Unique data type combinations will be available to accommodate the specific data collection and reporting needs for this project.

Primary data management activities include the following:

- the establishment of sampling design;
- the collection, encoding, verification, and validation of data;
- the performance of a QA/QC evaluation of data; and

- the sharing of responsibility for high-quality products between the data management staff and the RI/FS staff.

Data management will be implemented for this CTO as described in the Phase II RI/FS Data Management Plan (BNI 1994c).

Data validation will be performed by subcontractors to the CLEAN II Program organization and will be consistent with CERCLA requirements. Raw data collected from Phase II RI/FS sampling tasks and used in project reports will be appropriately evaluated and will be included in the Phase II RI/FS report. The purpose of data verification and validation is to help assure that the following standards are met:

- the data meet the DQOs outlined in the QAPP (BNI 1995b); and
- the data can be used as a basis for remediation action decisions at MCAS El Toro.

Data validation is described in the QAPP (BNI 1995b).

## 5.5 DATA EVALUATION

Data evaluation will be performed throughout the Phase II RI. Analyses of the data will focus primarily on meeting DQOs. The Phase II DQOs designate site-specific objectives and types of data needed to satisfy these objectives. Phase II objectives include:

- characterizing the risks associated with the contamination at each site,
- characterizing the extent of contamination,
- determining ambient levels of organics and background levels of inorganics at the Station,
- developing models of contaminant fate and transport, and
- developing data required to evaluate removal or remedial actions, if necessary.

For IRP sites that have common boundaries or that overlap, site-specific efforts are coordinated to maximize data and avoid redundancy of fieldwork. (e.g., the Site 24 relation to Sites 7, 8, 9, 10, 11, and 22).

## 5.6 RISK ASSESSMENT

At MCAS El Toro, the risk assessment will be conducted to estimate the risks to human health and the environment in accordance with the Phase II RI/FS Risk Assessment Plan (BNI 1994d). The following sections summarize the risk assessment process for the Phase II RI/FS.

### 5.6.1 Human Health Risk Assessments

Human health risk assessments performed on IRP sites will be baseline or streamlined risk assessments. The objective of a baseline risk assessment is to estimate the risks associated with the site in the absence of any remedial action and thereby provide decision makers information useful in identifying the most appropriate Remedial Action alternative. A streamlined risk assessment is as an evaluation that is intermediate in scope between a baseline risk assessment and a screening risk assessment. It is used to justify a removal action. Streamlined risk assessments focus on the particular medium that is the object of the removal action for chemicals that present a significant risk and do not necessarily deal with all of the COPCs, as with a baseline risk assessment.

Streamlined risk assessments performed to justify an removal action will be performed in accordance with interim guidelines developed by SWDIV (SWDIV 1994). Those guidelines are based on U.S. EPA guidance provided in Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA (U.S. EPA 1993a). The assessment will:

- summarize risk assessments that have already been performed on a site,
- identify documented exposure pathways or potential exposure pathways,
- identify sensitive populations,
- compare measured chemical concentrations with health and ecologically based standards or criteria or with PRGs when standards or criteria are unavailable, and
- identify concentrations that might be used as cleanup goals.

The general elements of either assessment of risk to human health from chemicals released to the environment consist of the following:

- data evaluation,
- toxicity assessment,
- exposure assessment, and
- risk characterization.

The data evaluation process is the critical review of the results of the chemical analyses performed on samples collected from a site to:

- determine if U.S. EPA requirements for chemical analysis have been met,
- identify chemicals that may have entered the samples after collection,
- characterize background levels of naturally occurring chemicals, such as metals, and
- select the COPCs to be evaluated in the risk assessment.

Once the chemicals to be evaluated are selected, the toxicity of each chemical is assessed. For most of the chemicals, the toxicity assessment involves assembling toxicity criteria developed by regulatory agencies for use in risk assessments. These criteria are used to characterize risk numerically and reflect the toxic potencies of the chemicals. The criterion for assessing noncancer risk are the reference dose (RfD) or reference concentration. The criterion for assessing cancer risk is called a cancer slope factor, cancer potency factor, or unit risk factor. When a chemical with no toxicity criterion is encountered, a criterion may be developed using one of several approaches. Alternately, the risk posed by the chemical may be qualitatively assessed.

The exposure assessment can be performed in parallel with the toxicity assessment, since neither is dependent on the other for completion. The exposure assessment involves:

- characterizing the individuals or populations at risk,
- selecting reasonable hypothetical exposure scenarios,
- identifying exposure pathways and routes associated with each scenario, and
- calculating the exposure level or dose associated with each exposure route.

Exposure scenarios used in a risk assessment depend on existing and future land uses for both the site and the surrounding areas. Residential use is considered to be the highest-risk scenario. When appropriate, an industrial or occupational scenario is used alone or in combination with the residential scenario.

With each scenario, risk is based on exposure of a hypothetical person under what the U.S. EPA calls reasonable maximum exposure conditions. Upper-bound estimates of chemical concentrations, exposure times, and intake rates are used to estimate risk. This deliberate attempt to overestimate risk is made in the interest of public protection. When the assessment of the site indicates that the risk is acceptable, one can be reasonably assured that it is. When the assessment indicates that risk is not acceptable, the question remains as to whether the risk might be lower if better estimates of exposure conditions were used. In such cases, refined risk assessments may be performed. Such assessments often require collecting additional data, including information on the behavior of the individuals or population at risk.

The final step in assessing risk consists of quantifying the risk associated with each chemical and exposure pathway for each exposure scenario, assessing the accuracy of the risk estimates, and evaluating noncancer risk and cancer risk separately. Noncancer risk is expressed as the ratio of the estimated dose and the RfD (the ratio is called a hazard quotient). Cancer risk is expressed as the probability that an individual will develop cancer as the result of exposure to the carcinogens evaluated. Population burden (the number of people in the population at risk expected to develop cancer) may also be calculated if the hypothetical individual(s) at risk represents a real population and the number of people in the population is known.

The accuracy of the risk estimates can be appraised qualitatively or quantitatively by conducting an uncertainty analysis. The analysis estimates the degree to which each of the major factors affecting risk overestimates or underestimates risk. The analysis is usually qualitative.

### 5.6.2 Ecological Risk Assessment

In general, ecological risk assessments quantitatively or qualitatively evaluate the potential adverse effects of hazardous waste sites on an ecosystem. Under the Phase II RI for MCAS El Toro, a predictive ecological risk assessment will be used to address current and potential impacts to plants and wildlife that may be exposed to COPECs present in soils, surface water, and sediments. The major ecological concern at MCAS El Toro is the potential effects of metals and organic compounds adsorbed to and migrating from soil and sediment particles and gases migrating upward from landfills. Therefore, a specific goal of the predictive ecological risk assessment for MCAS El Toro is to identify concentrations of these chemicals in sediment, soil, and soil gas that might be associated with adverse ecological effects at the site.

The predictive ecological risk assessment is a process by which measured or predicted concentrations or doses of chemicals in environmental samples (i.e., soils, sediments, water, animal tissues) are compared with criteria considered protective of ecological receptors to determine an HI. Thus, the risk assessment will evaluate whether the chemical concentrations at the site pose a threat to ecological receptors or components. Information on potential impacts to ecological receptors will be subsequently used in risk management decision that are protective of the environment.

An ecological risk assessment differs from a human health risk assessment in that assessment endpoints do not necessarily focus on the individual, as with humans, but on populations and communities, with a final goal of evaluating the ecosystem. Thus, a certain degree of impact to individuals and species is considered within the context of impacts at higher ecological organization. The ecological risk assessment will be used in conjunction with the human health risk assessment to assess total risks at the site and to review alternative remedial actions.

The predictive ecological risk assessment will evaluate the risks to nonhuman organisms resulting from exposure to chemicals associated with current and past activities at the base. The current ecological risk assessment guidance follows similar guidance by the U.S. EPA Risk Assessment Forum for assessing stressor (i.e., chemical and nonchemical) risks to the environment (U.S. EPA 1992b,c,d) in that both are adapted from the four-step methodology developed by the National Academy of Sciences for assessing human health risks (NRC 1983).

The most current ecological risk assessment guidelines will be used to evaluate environmental impacts at the base. These guidelines are presented in the following reference documents: Ecological Assessment at Hazardous Waste Sites: A Field and Laboratory Reference (U.S. EPA 1989b), Ecological Assessment of Superfund Sites: An Overview (U.S. EPA 1991b), Eco Updates (U.S. EPA 1991b, 1992d) which supersede earlier guidance for conducting environmental evaluations for the baseline risk assessment (U.S. EPA 1989a), Framework for Ecological Risk Assessment (U.S. EPA 1992e), Draft Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities, Part A: Overview (DTSC 1994a), Draft Guidance for Ecological Risk Assessment at Hazardous Wastes Sites and Permitted Facilities, Part B: Scoping (DTSC 1994b), and Wildlife Exposure Factors Handbook (U.S. EPA 1993b). Additional reference documents will be consulted regarding habitat and species found in California and include California Department of Forestry and Fire Protection: A Guide to Wildlife

Habitats of California (Mayer and Laudenslayer 1988), and California Department of Fish and Game: Volume 1, Amphibians and Reptiles (Zeiner et al. 1988), Volume 2, Birds (Zeiner et al. 1990a), and Volume 3, Mammals (Zeiner et al. 1990b).

The Phase II RI/FS predictive ecological risk assessment will involve collecting additional information on potentially contaminated media and potential ecological receptors based on the data gaps identified above. The Phase II predictive ecological risk assessment will involve additional surveys of the plants and animals within or near each RI site identified on MCAS El Toro to better identify ecological resources and potential impacts to those resources. Because some COPECs are known to bioaccumulate in plants and animals, it may be necessary to analyze tissues to evaluate potential effects on higher trophic level organisms. Information generated in the Phase I RI ecological risk assessment will be incorporated to the information that will be generated in the Phase II. Information collected during all phases will be used to help make decisions about potential remediation and to evaluate remedial alternatives.

## 5.7 TREATABILITY AND PILOT TESTING

Three types of pilot tests have been identified to support the Phase II feasibility study. Remedial alternatives to be tested at the site include soil vapor extraction (SVE) for VOC-contaminated soil, air sparging for VOC-contaminated groundwater, and aquifer pump testing. Based on the findings of the Phase I and Phase II RI, other treatability studies or pilot tests may be identified to evaluate specific remedial alternatives. Treatability requirements have been reviewed, and if the need for additional testing is identified, a WP for the treatability studies/pilot testing will be developed as a separate document from this Phase II WP.

### 5.7.1 Soil Vapor Extraction Pilot Testing

An SVE pilot test will be conducted in areas where elevated concentrations of VOCs are present in the soil gas. Results of soil gas sampling will be presented to the BCT, and specific SVE pilot test locations will be recommended by the CLEAN II team. The tests will be conducted with a portable vacuum blower and generator. A description of SVE pilot test methods is included in Section 6 of the FSP (BNI 1995a).

Information obtained from the SVE pilot test that will be used in the FS include the following:

- effective radius of influence,
- significant preferential flow paths, if any,
- extraction air-flow rate versus applied vacuum,
- VOC concentrations in the extracted air, and
- VOC mass removal rate.

### 5.7.2 Air-Sparging Pilot Testing

An air-sparging pilot test will be conducted in the area of monitoring well 09_DBMW45. This area has been identified as the VOC groundwater plume hot spot. The air-sparging pilot test will be conducted in conjunction with an SVE pilot test, so VOCs removed as vapor from the aquifer will be captured by an SVE network. A description of the air-sparging pilot test methods is included in Section 6 of the FSP (BNI 1995a).

Information obtained from the air-sparging pilot test that will be used in the FS include the following:

- effective radius of influence,
- significant preferential flow paths, if any,
- SVE extraction air-flow rate versus applied vacuum,
- air-sparging flow rate,
- VOC concentrations in the extracted air (before and after sparging), and
- VOC mass removal rate (soil and groundwater).

### 5.7.3 Aquifer Pump Testing

Aquifer pump testing will be performed on three wells on Site 24. The data from these tests will enable the hydrogeologist to estimate the radius of influence and the capture zone of the pumping well, as well as to calculate parameters necessary for groundwater modeling such as hydraulic conductivity and storativity. A description of aquifer pump testing methods is included in Section 6 of the FSP (BNI 1995a).

## 5.8 REMEDIAL INVESTIGATION REPORTS

An RI report will be prepared summarizing the RI work. This report will briefly review analytical results and site characterization. The RI report will be signed by a California Registered Geologist, if geologic interpretations are included, and a California Professional Engineer, if surveys or designs are presented. Table 5-1 presents the outline of the RI report as required by the FFA (FFA 1990).

## 5.9 RESPONSE ACTIONS

Following the risk assessment, the appropriate response action will be determined if an unacceptable risk is present. The DON encourages the use of the SACM, which is intended to make cleanup more timely and efficient (U.S. EPA 1992a). Because the only response authorities under CERCLA are removal and remedial, the SACM suggests that these authorities be used under the NCP to achieve prompt risk reduction (early action) or to conduct more complex, time-consuming remediations (long-term action).

**Table 5-1**
**Outline of Remedial Investigation Report**

## REMEDIAL INVESTIGATION REPORT

**SUMMARY**

**1 INTRODUCTION**

1.1 Purpose of Report

1.2 Site Background

1.2.1 Site Description
1.2.2 Site History
1.2.3 Previous Investigations

1.3 Report Organization

**2 STUDY AREA INVESTIGATION**

2.1 Includes field activities associated with site characterization. These may include physical and chemical monitoring of some, but not necessarily all, of the following:

2.1.2 Surface Features (topographic mapping, etc.) (natural and man-made features)
2.1.3 Contaminant Source Investigations
2.1.4 Surface Water and Sediment Investigations
2.1.5 Geologic Investigations
2.1.6 Soil and Vadose Zone Investigations
2.1.7 Groundwater Investigations
2.1.9 Ecological Investigations

2.2 If technical memoranda documenting field activities were prepared, they may be included in an appendix and summarized in this chapter.

**3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA**

3.1 Includes results of field activities to determine physical characteristics. These may include some, but not necessarily all, of the following:

3.1.1 Surface Features
3.1.2 Meteorology
3.1.3 Surface Water Hydrology

(table continues)

**Table 5-1** (continued)

3.1.4 Geology
3.1.5 Soils
3.1.6 Hydrogeology
3.1.7 Demography and Land Use
3.1.8 Ecology

**4 NATURE AND EXTENT OF CONTAMINATION**

4.1 Presents the results of site characterization, both natural chemical components and contaminants in the following:

4.1.1 Sources
4.1.2 Soils and Vadose Zone
4.1.3 Groundwater
4.1.4 Surface Water and Sediments
4.1.5 Air
4.1.6 Biota
4.1.7 Fish and Wildlife

**5 CONTAMINANT FATE AND TRANSPORT**

5.1 Potential Routes of Migration (i.e., air, groundwater)

5.2 Contaminant Persistence

5.2.1 If they are applicable (i.e., for organic contaminants), describes the estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.

5.3 Contaminant Migration

5.3.1 Discusses factors affecting contaminant migration for the media of importance (e.g., sorption onto soils, solubility in water, movement of groundwater)
5.3.2 Discusses modeling methods and results, if applicable.

**6 BASELINE RISK ASSESSMENT**

6.1 Human Health Evaluation

6.1.1 Exposure Assessment
6.1.2 Toxicity Assessment

(table continues)

**Table 5-1** (continued)

| | | | |
|---|---|---|---|
| | | 6.1.3 | Risk Characterization |
| | 6.2 | Environmental Evaluation | |
| **7** | **SUMMARY AND CONCLUSIONS** | | |
| | 7.1 | Summary | |
| | | 7.1.1 | Nature and Extent of Contamination |
| | | 7.1.2 | Fate and Transport |
| | | 7.1.3 | Risk Assessment |
| | 7.2 | Conclusions | |
| | | 7.2.1 | Data Limitations and Recommendations for Further Work |
| | | 7.2.3 | Recommended RAOs |

Early actions are responses performed under removal or remedial authority to eliminate or reduce human health or environmental threats from the release of hazardous substances or wastes (U.S. EPA 1992a). These risk-reduction activities can be conducted as emergency or time-critical removals (where quick response is necessary) or as non-time-critical removals and early removal actions in less urgent situations. The NCP has special requirements for non-time-critical removals, including the need to prepare an EE/CA. An EE/CA is a study to identify and assess non-time-critical removal action alternatives.

Long-term actions are usually taken when there is extensive site characterization, cleanup costs are high, and duration cleanup may take more than 5 years to complete. An FS is usually completed for long-term removal actions.

Based on the information acquired from evaluating and cleaning up sites since Superfund inception in 1980, the U.S. EPA has also developed presumptive remedies to accelerate future cleanups. The objective of the presumptive remedies is to use past experience to streamline site investigations and speed up the selection of remedial alternatives. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances (U.S. EPA 1993c). Guidance documents for feasibility analysis using the presumptive remedy approach include Presumptive Remedy for CERCLA Municipal Landfill Sites (U.S. EPA 1993d), and Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites With Volatile Organic Compounds (U.S. EPA 1993e).

### 5.9.1 Removal Action

Following any release that presents a threat to public health, welfare, or the environment, a Removal Action may be taken to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release. The following are potential RAOs based upon the factors specified in Section 300.415(b)(2) of the NCP:

- prevention or abatement of actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants, or contaminants;
- prevention or abatement of actual or potential contamination of drinking water supplies or sensitive ecosystems;
- stabilization or elimination of hazardous substances in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release;
- treatment or elimination of high levels of hazardous substances, pollutants, or contaminants in soils largely at or near the surface that may migrate;
- minimization or elimination of the effects of weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or to be released;
- elimination of threat of fire or explosion;
- mitigation or abatement of other situations or factors that may pose threats to public health, welfare, or the environment; and
- cost of less than $2 million and completion within 12 months.

The following sections discuss the subjects to be incorporated in an EE/CA that will satisfy the above objectives.

#### 5.9.1.1 DETERMINATION OF REMOVAL SCOPE

The EE/CA will define specific objectives of the removal action. The scope of the action may vary considerably from total site cleanup, site stabilization, or surface cleanup of hazardous substances pursuant to Section 104(c)(1) of CERCLA. When a non-time-critical removal action will be the only or last action taken to clean up an NPL site, the EE/CA will consider whether the alternatives can achieve cleanup levels consistent with remedial standards.

#### 5.9.1.2 DETERMINATION OF REMOVAL SCHEDULE

The general schedule for removal activities will be included in the EE/CA. The schedule will include both the start and completion dates, and will also reflect influences by negotiations, weather, nature of threat, and statutory limits.

#### 5.9.1.3 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Based on the analysis of the nature and extent of contamination, and on the cleanup objectives developed previously, a limited number of alternatives will be assessed that are appropriate for addressing the cleanup objectives. Using specific objectives for the action, obviously irrelevant alternatives will be eliminated, thus avoiding a screening step. Only the most qualified technologies that apply to the media or source of contamination will be discussed in the EE/CA. The use of presumptive remedies can, in many cases, provide an immediate focus to the discussion and selection of alternatives, limiting the universe of effective alternatives.

#### *Implementability*

A limited number of alternatives, including any identified presumptive remedies, will be selected for detailed analysis. The set of potentially applicable alternatives and processes can be evaluated with respect to their technical implementability. This is accomplished by using readily available information from the site characterization phase on the nature and extent of contamination at the site.

#### *Effectiveness*

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the removal action. Each alternative will be evaluated against the scope of the removal action and against each of the specific objectives for final disposition of the wastes and the level of cleanup desired. These objectives will be discussed in terms of protectiveness of public health and the environment.

In addition, this evaluation criterion will be used to determine whether each alternative will meet federal and state ARARs that have been identified. Section 300.415(I) of the NCP requires removal actions attain ARARs under federal and state environmental laws to the extent practicable, considering the exigencies of the situation. At certain sites, ARARs form the basis of the removal-specific objectives.

#### *Cost*

Each removal action alternative will be evaluated to determine its projected costs. The cost analysis includes a capital cost comparison for each alternative. The present worth of alternatives that will last longer than 12 months should be calculated. In certain cases, a sensitivity analysis of the present worth calculations may be conducted.

### 5.9.1.4 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on the comparative analysis, the EE/CA will make a determination of the recommended action and should describe the reasons for the recommendation. Following public comment, the EE/CA summary may be used in the AM, which selects the removal action alternative. This section increases public involvement opportunities. Since the recommendation from the EE/CA is open to public comment and evaluation, however, it is possible that the recommended alternative may not be the final choice selected in the AM. In such a case, the AM and an administrative record should provide a sufficient degree of detail to justify the selection of an alternate technology for the response action.

## 5.9.2 Feasibility Study

The FS will more generally be used in the Long-Term Action process where final site cleanup is a complex, lengthy process. The following sections discuss the FS process.

### 5.9.2.1 ALTERNATIVE DEVELOPMENT PROCESS

The alternative development process is a series of analytical steps that involve making successively more specific definitions of potential remedial activities. These steps are described below.

***Develop Remedial Action Objectives***

RAOs consist of medium-specific or unit-specific goals for protecting human health and the environment. The objectives will be as specific as possible but not so specific that the range of possible alternatives is unduly limited. RAOs aimed at protecting human health and the environment specify:

- the COPCs,
- exposure route(s) and receptor(s), and
- an acceptable contaminant level based on an acceptable level of risk.

The acceptable exposure levels will be determined on the basis of the results of the baseline risk assessment and the evaluation of the expected exposures and associated risks for each alternative. Contaminant levels in each media will be compared with these acceptable levels and include an evaluation of the following factors:

- whether the remediation goals for all carcinogens of concern, including those with goals set at the chemical-specific ARAR level, provide protection within the risk range of $10^{-4}$ to $10^{-6}$;
- whether the remediation goals set for all noncarcinogens of concern, including those with goals set at the chemical-specific ARAR levels, are sufficiently protective at the site;
- whether environmental effects (in addition to human health effects) are adequately addressed; and
- whether the exposure analysis conducted as part of the risk assessment adequately addresses each significant pathway of human exposure identified in the baseline risk assessment (e.g., if the exposure from the ingestion of fish and drinking water are both significant pathways of exposure, goals set by considering only one of these exposure pathways may not be adequately protective).

***Develop General Remedial Actions***

General remedial actions are those actions that will satisfy the RAOs. General remedial actions may include treatment, containment, excavation, extraction, disposal, institutional actions, or a combination of these. RAOs are medium-specific. In developing alternatives, combinations of general remedial actions may be identified, particularly when disposal methods primarily depend on whether the medium has been previously treated.

### *Identify Volumes or Areas of Media*

During the development of alternatives, an initial determination is made of areas or volumes of media to which general response actions might be applied. This initial determination is made for each medium of interest at a site. Estimating the areas or volumes of media will include a consideration of not only acceptable exposure levels and potential exposure routes, but also site conditions and the nature and extent of contamination.

### *Identify and Screen Remedial Technologies and Process Options*

In this step, the scope of potentially applicable technology types and process options is reduced by evaluating the options with respect to technical implementability. Technology types and process options will be identified by consulting a variety of sources, including references developed for application to Superfund sites and standard engineering texts. During this screening step, process options and technology types are eliminated from further consideration on the basis of technical implementability. Two factors that commonly influence technology screening are the presence of inorganic contaminants, which limit the applicability of many types of treatment processes, and the subsurface conditions, such as depth to impervious formations, which can limit many types of containment and groundwater collection technologies.

### *Effectiveness Evaluation*

Specific technology processes that have been identified will be evaluated further on their effectiveness relative to other processes within the same technology type. This evaluation should focus on 1) the potential effectiveness of process options in handling the estimated areas or volumes of media and meeting the remediation goals identified in the RAOs, 2) the potential impacts to human health and the environment during the construction and implementation phase, and 3) how proven and reliable the process is with respect to the contaminants and conditions at the site. Information needed to evaluate the effectiveness of technology for the different media includes contaminant type and concentration, the area or volume of contaminated media and, when appropriate, rates of collection of liquid or gaseous media.

If modeling of transport processes is undertaken during the alternative development and screening phases of the FS to evaluate removal or collection technologies, and if many contaminants are present at the site, it may be necessary to identify indicator chemicals (as is often done for the baseline risk assessments) to simplify the analysis. Typically, indicator chemicals are selected on the basis of their usefulness in evaluating potential effects on human health and the environment. Commonly, selected indicator chemicals include those that are highly mobile and highly toxic.

### *Implementability Evaluation*

Implementability encompasses both the technical and administrative feasibility of implementing a technology process. Technical implementability is used as a initial screen of technology options to eliminate those that are clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options requires greater emphasis on the institutional aspect of implementability, such as the ability to obtain necessary permits for off-site actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of necessary equipment and skilled workers to implement the technology.

***Cost Evaluation***

The cost analysis is made on the basis of engineering judgment. Each process is evaluated as to whether costs are high, low, or medium relative to other process options in the same technology type.

#### 5.9.2.2 ALTERNATIVE SCREENING PROCESS

Alternatives are initially developed and assembled to meet a set of RAOs for each medium of interest and volume of media. During screening, the assembled alternatives will be evaluated to assure that they protect human health and the environment from each potential pathway of concern at the site or those areas of the site being addressed as part of an OU. If more than one pathway is present, such as inhalation of airborne contaminants and ingestion of contaminants in groundwater, the overall risk level to receptors should be evaluated. If it is found that an alternative is not fully protective, a reduction in exposure levels for one or more media will need to be made to attain an acceptable risk level.

After the alternatives have been refined with respect to RAOs and volumes or media, the technology process options must be defined more fully with respect to their effectiveness, implementability, and cost in order to identify differences among alternatives. The following information will be developed, as appropriate, for the various technology processes used in an alternative:

- size and configuration of on-site extraction and treatment systems or containment structures;
- time frame in which treatment, containment, or removal goals can be achieved;
- rates or flows of treatment;
- spatial requirements for constructing treatment or containment technologies or for staging construction materials or excavated soil or waste;
- distances for disposal technologies; and
- required permits for off-site actions and imposed limitations.

A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment. Each alternative should be evaluated as to its effectiveness in providing protection and the reductions in toxicity, mobility, or volume that it will achieve. Both short- and long-term components of effectiveness should be evaluated; short-term refers to the construction and implementation period, and long-term refers to the period after the remedial action is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the hazardous substances or contaminated media by the use of treatment that decreases the inherent threats or risks associated with the hazardous material.

Implementability, as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative, is used during screening to evaluate the combinations of process options with respect to conditions at a specific site. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete. It also includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, into the future after the remedial action is complete. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies; the availability of treatment, storage, and disposal services and capacity; and the requirements for and availability of specific equipment and technical specialists.

Typically, alternatives are defined before screening, and estimates of cost are available for comparisons among alternatives. The procedures used to develop cost estimates for alternative screening are similar to those used for the detailed analysis; the only differences are the degree of alternative refinement and the degree to which cost components are developed.

Alternatives with the most favorable composite evaluation of all factors will be retained for further consideration during the detailed analysis. Alternatives selected for further evaluation will, where practicable, preserve the range of treatment and containment technologies initially developed.

The alternatives recommended for further consideration will be presented to the BCT. Unselected alternatives may be reconsidered at a later step in the detailed analysis, if similar retained alternatives continue to be evaluated favorably, or if information is developed that identifies an additional advantage not previously apparent.

#### 5.9.2.3 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, STANDARDS, OR CONSTRAINTS

Identification of ARARs, standards, or constraints will be conducted and may be categorized as chemical-specific, location-specific, and action-specific requirements. Potential chemical- and location-specific ARARs are identified on the basis of the compilation and evaluation of existing site data. The evaluation of action-specific ARARs will assess the feasibility of remedial technologies. In addition to federal ARARs, state and local ARARs will be identified. ARARs may define acceptable exposure levels and, thereby, establish cleanup goals. The assistance of regulatory agencies will be sought in identifying and confirming applicability or relevance and appropriateness. The following waivers of ARARs are authorized under CERCLA:

- Interim Measure – The remedial action selected is only part of a total remedial action that will attain ARARs when completed.
- Greater Risk to Human Health and the Environment – Compliance with the ARAR will result in greater risk to human health and the environment than alternative options.
- Technical Impracticability – Compliance with the ARAR is technically impracticable from an engineering standpoint.
- Equivalent Standard of Performance – The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criterion, or limitation through use of another method or approach.
- Inconsistent Application of State Requirements – With respect to a state standard, requirement, criterion, or limitation, the state has not consistently applied (or demonstrated the intention to apply consistently) the standard, requirement, criterion, or limitation in similar circumstances for other remedial actions.

#### 5.9.2.4 DETAILED ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives follows the development and screening of alternatives, and it precedes the actual selection of a remedy. The extent to which alternatives are analyzed during the detailed analysis is influenced by the available data, the number and types of alternatives being analyzed, and the degree to which alternatives were previously analyzed during their development and screening.

The evaluations conducted during the detailed analysis phase build on previous evaluations conducted during the development and screening of alternatives. This phase also incorporates any treatability study data and additional site characterization information that may have been collected during the RI.

The results of the detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed plan. Upon completion of the detailed analysis, the FS report and the proposed plan (and the RI report if not previously released) are submitted for public review and comment. The results of the detailed analysis supports the final selection of a remedial action and the foundation for the ROD.

A detailed analysis of alternatives consists of the following components:

- further definition of each alternative, if necessary, with respect to the volumes or areas of contaminated media to be addressed, the technologies to be used, and any performance requirements associated with those technologies;
- an assessment and a summary profile of each alternative against the evaluation criteria; and
- a comparative analysis among the alternatives to assess the relative performance of each alternative with respect to each evaluation criterion.

The specific statutory requirements for remedial actions that must be addressed in the ROD and supported by the FS report are listed below. RAs must:

- be protective of human health and the environment;
- attain ARARs (or provide grounds for invoking a waiver);
- be cost-effective;
- utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
- satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element or provide an explanation in the ROD as to why it does not.

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternative remedial actions (Section 121[b][1][A]). These statutory considerations include:

- the long-term uncertainties associated with land disposal;
- the goals, objectives, and requirements of the Solid Waste Disposal Act;
- the persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;
- short- and long-term potential for adverse health effects from human exposure;
- long-term maintenance costs;
- the potential for future remedial action costs if the alternative remedial action in question were to fail; and
- the potential threat to human health and the environment associated with excavation, transportation, and redisposal or containment.

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations listed above, and to address the additional technical and policy considerations that are important for selecting among remedial alternatives. These evaluation criteria serve as the basis for conducting the detailed analyses during the FS and for subsequently selecting an appropriate remedial action. The evaluation criteria with the associated statutory considerations are:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume;
- short-term effectiveness;
- implementability;
- cost;

- state acceptance; and
- community acceptance.

### 5.9.2.5 FEASIBILITY STUDY REPORT

The purpose of the FS is to develop corrective actions or sets of actions for MCAS El Toro that will protect human health and the environment. Information reported in the RI will be summarized briefly in the FS report. This information will include the conclusions of the RI field investigations and pilot testing. Potential corrective actions needed to protect human health and the environment will be developed and evaluated against the nine criteria listed in Section 5.9.2.4, and the recommended remedial actions will be described. The FS report will be signed by a California Professional Engineer, if designs are presented, and by a California Registered Geologist, if geologic interpretations are presented. Table 5-2 presents an outline of the FS report as required by the FFA (FFA 1990).

**Table 5-2**
**Outline for Feasibility Study Report**

# FEASIBILITY STUDY REPORT

## SUMMARY

## 1 INTRODUCTION

1.1 Purpose and Organization of Report

1.2 Background Information (Summarized from RI)

- 1.2.1 Site Description
- 1.2.2 Site History
- 1.2.3 Nature and Extent of Contamination
- 1.2.4 Contaminant Fate and Transport
- 1.2.5 Baseline Risk Assessment

## 2 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Introduction

2.2 RAOs – Presents the development of RAOs for each medium of interest (e.g., groundwater, soil, surface water, air, ecological). For each medium, the following should be discussed:

- 2.2.1 Contaminants of Interest
- 2.2.2 Allowable Exposure Based on Risk Assessment (including ARARs)
- 2.2.3 Development of Remediation Goals

2.3 General Response Actions – For each medium of interest, describes the estimation of areas or volumes to which treatment, containment, or disposal technologies may be applied.

2.4 Identification and Screening of Technology Types and Process Options – For each medium of interest, describes:

- 2.4.1 Identification and Screening of Technologies
- 2.4.2 Evaluation of Technologies and Selection of Representative Technologies

(table continues)

**Table 5-2** (continued)

## 3 DEVELOPMENT AND SCREENING OF ALTERNATIVES

3.1 Development of Alternatives – Describes rationale for combination of technologies/media into alternatives. Note: This discussion may be by medium or for the site as a whole.

3.2 Screening of Alternatives (if conducted)

- 3.2.1 Introduction
- 3.2.2 Alternative 1
  - 3.2.2.1 Description
  - 3.2.2.2 Evaluation of effectiveness, implementability, and cost
- 3.2.3 Alternative 2
  - 3.2.3.1 Description
  - 3.2.3.2 Evaluation
- 3.2.4 Alternative 3

## 4 DETAILED ANALYSIS OF ALTERNATIVES

4.1 Introduction

4.2 Individual Analysis of Alternatives

- 4.2.1 Alternative 1
  - 4.2.1.1 Description
  - 4.2.1.2 Assessment of:
    - – overall protection
    - – compliance with ARARs
    - – long-term effectiveness and permanence
    - – reduction of toxicity, mobility, or volume through treatment
    - – short-term effectiveness
    - – implementability
    - – cost
    - – state acceptance
    - – community acceptance
- 4.2.2 Alternative 2
  - 4.2.2.1 Description
  - 4.2.2.2 Assessment

(table continues)

**Table 5-2** (continued)

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# SECTION 6

## SCHEDULE

# Section 6
# SCHEDULE

The schedule of Phase II RI activities for the sites at MCAS El Toro is based on a March 1995 revision to the FFA and is illustrated on Figure 6-1. Key milestone dates for the separate RI/FS efforts from Figure 6-1 are summarized below.

## 6.1 OU-2 A VOLATILE ORGANIC COMPOUND SOURCE AREA INVESTIGATION

Milestone dates related to the VOC Source Area Investigation are listed below:

| | |
|---|---|
| Initiate VOC Field Investigations | July 10, 1995 |
| Issue Draft VOC RI Report | February 20, 1996 |
| Issue Draft VOC FS Report | June 19, 1996 |
| Draft Record of Decision | January 22, 1997 |

## 6.2 OU-2 B AND C LANDFILLS INVESTIGATION

Milestone dates related to the landfills sites RI/FS are listed below (when Removal Actions are not implemented):

| | |
|---|---|
| Initiate Field Investigations | July 10, 1995 |
| Issue Draft RI Report | March 19, 1996 |
| Issue Draft FS Report | July 19, 1996 |
| Draft Record of Decision | February 19, 1997 |

## 6.3 OU-3 INVESTIGATIONS

Milestone dates related to the OU-3 RI/FS are listed below (when Removal Actions are not implemented):

| | |
|---|---|
| Initiate Field Investigations | July 10, 1996 |
| Issue Draft RI Report | November 20, 1996 |
| Issue Draft FS Report | March 19, 1997 |
| Draft Record of Decision | October 21, 1997 |

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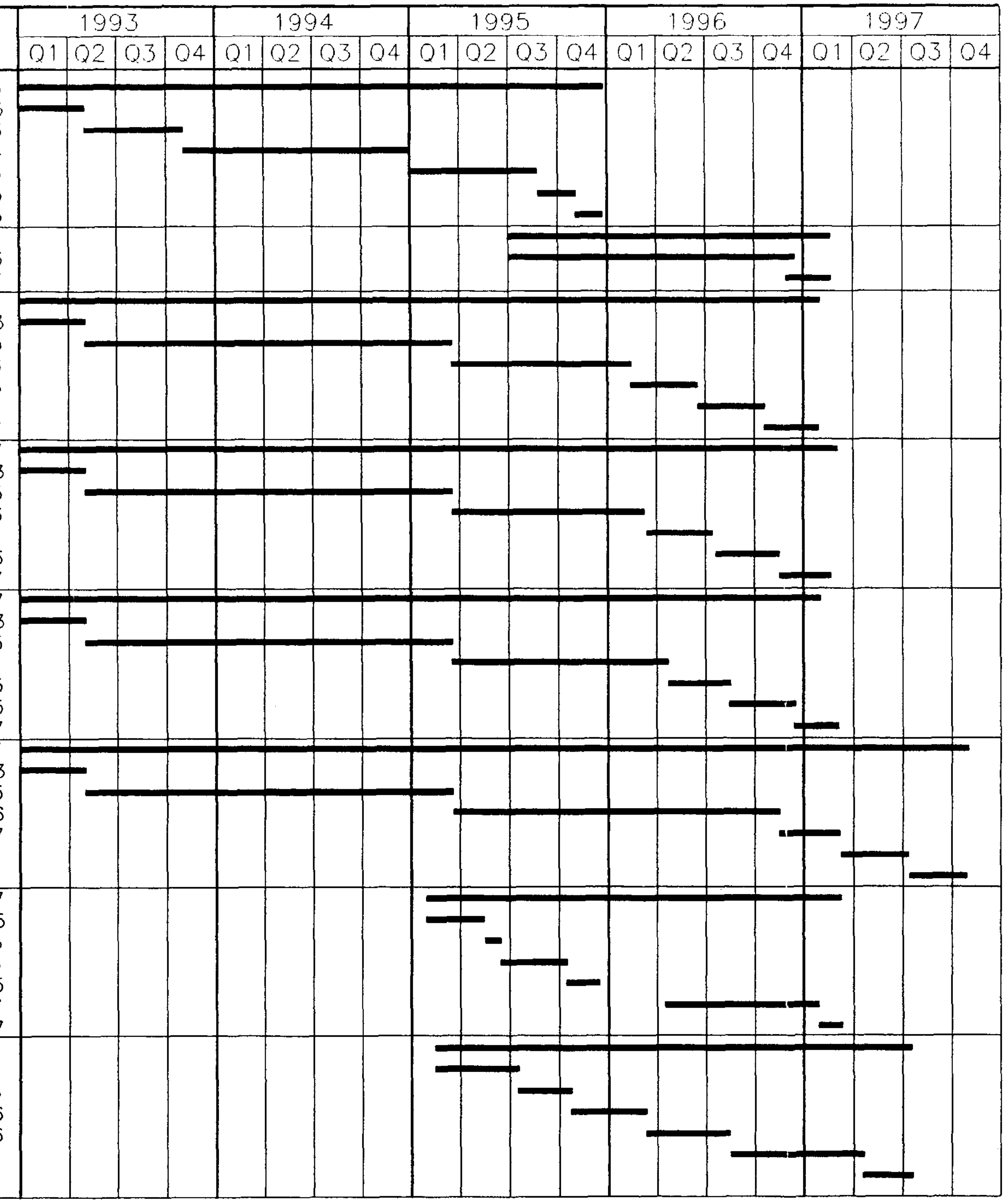
## PROPOSED SCHEDULE[1]

| Task Name | Start | End |
|---|---|---|
| **OU-1** | 04/Jan/93 | 20/Dec/95 |
| Phase I Technical Memo | 04/Jan/93 | 07/May/93 |
| Draft Phase II Work Plan | 10/May/93 | 09/Nov/93 |
| Draft RI Report | 10/Nov/93 | 30/Dec/94 |
| Re-Draft FS Report | 02/Jan/95 | 30/Aug/95 |
| Draft Proposed Plan | 31/Aug/95 | 22/Nov/95 |
| Draft Record of Decision | 24/Nov/95 | 29/Dec/95 |
| **Groundwater Monitoring Plan** | 05/Jul/95 | 21/Feb/97 |
| 4 Rounds of Sampling | 05/Jul/95 | 20/Dec/96 |
| Draft Longterm GWM Work Plan | 20/Nov/96 | 21/Feb/97 |
| **OU-2A Site 24, 25 VOC Source Area** | 04/Jan/93 | 22/Jan/97 |
| Phase I Technical Memo | 04/Jan/93 | 07/May/93 |
| Draft Phase II Work Plan | 10/May/93 | 20/Mar/95 |
| Draft RI Report | 21/Mar/95 | 20/Feb/96 |
| Draft FS Report | 21/Feb/96 | 19/Jun/96 |
| Draft Proposed Plan | 19/Jun/96 | 18/Oct/96 |
| Draft Record of Decision | 21/Oct/96 | 22/Jan/97 |
| **OU-2B Site 2, 17 Alton Parkway** | 04/Jan/93 | 19/Feb/97 |
| Phase I Technical Memo | 04/Jan/93 | 07/May/93 |
| Draft Phase II Work Plan | 10/May/93 | 20/Mar/95 |
| Draft RI Report | 21/Mar/95 | 19/Mar/96 |
| Draft FS Report | 20/Mar/96 | 19/Jul/96 |
| Draft Proposed Plan | 22/Jul/96 | 20/Nov/96 |
| Draft Record of Decision | 21/Nov/96 | 19/Feb/97 |
| **OU-2C Site 3, 5 Landfills** | 04/Jan/93 | 17/Mar/97 |
| Phase I Technical Memo | 04/Jan/93 | 07/May/93 |
| Draft Phase II Work Plan | 10/May/93 | 20/Mar/95 |
| Draft RI Report | 20/Mar/95 | 19/Apr/96 |
| Draft FS Report | 19/Apr/95 | 20/Aug/95 |
| Draft Proposed Plan | 20/Aug/96 | 20/Dec/95 |
| Draft Record of Decision | 23/Dec/96 | 17/Mar/97 |
| **OU-3A All other Sites** | 04/Jan/93 | 21/Oct/97 |
| Phase I Technical Memo | 04/Jan/93 | 07/May/93 |
| Draft Phase II Work Plan | 10/May/93 | 30/Mar/95 |
| Draft RI Report | 16/Mar/95 | 20/Nov/96 |
| Draft FS Report | 21/Nov/96 | 19/Mar/97 |
| Draft Proposed Plan | 20/Mar/97 | 18/Jul/97 |
| Draft Record of Decision | 21/Jul/97 | 21/Oct/97 |
| **EE/CA Sites 4, 13** | 13/Feb/95 | 19/Mar/97 |
| Issue Draft EE/CA | 13/Feb/95 | 22/May/95 |
| Prepare Action Memos | 22/May/95 | 21/Jun/95 |
| Issue Final Action Memos | 22/Jun/95 | 19/Oct/95 |
| Issue Final EE/CA | 20/Oct/95 | 19/Dec/95 |
| Field Work | 19/Apr/96 | 22/Jan/97 |
| Phase III Work Plan | 22/Jan/97 | 19/Mar/97 |
| **EE/CA Sites 7, 11, 14, 19, 20** | 13/Feb/95 | 17/Jul/97 |
| Issue Draft EE/CA | 13/Feb/95 | 18/Jul/95 |
| Prepare Action Memos | 17/Jul/95 | 20/Oct/95 |
| Issue Final Action Memos | 23/Oct/95 | 19/Mar/96 |
| Issue Final EE/CA | 20/Mar/96 | 21/Aug/96 |
| Field Work | 21/Aug/96 | 21/Apr/97 |
| Phase III Work Plan | 21/Apr/97 | 17/Jul/97 |




[1] Based on available funding

**Work Plan**

**Figure 6-1**
**Schedule of Phase II RI Activities**

MCAS El Toro, El Toro, California

CLEAN II Program

Date: 7/10/95
File No. invstcht
Job No. 22214

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# SECTION 7

# PROJECT MANAGEMENT

# Section 7
# PROJECT MANAGEMENT

## 7.1 IDENTIFICATION OF STAFF

Figure 7-1 identifies the Navy and BCT organization, CLEAN II Program management organization, and the Field Operations and Technical Staff organization and responsibilities. The roles of the Navy and BCT are as follows.

Mr. Jason Ashman is the Navy Remedial Project Manager (RPM). He is responsible for coordination among all parties including the CLEAN II contractors, the MCAS El Toro and other Marine Corps representatives, and the regulatory agencies as well as his management at SWDIV.

Ms. Bonnie Arthur (U.S. EPA), Mr. Juan Jiminez (Cal/EPA), and Mr. Larry Vitale (RWQCB, Santa Ana Region) are the oversight agency RPMs. They will be involved in overseeing and monitoring the progress of the RI/FS and its conformance with the requirements of the FFA.

Mr. Joseph Joyce is the BEC, which chairs the BCT and is responsible for coordinating the various environmental restoration and compliance programs at MCAS El Toro.

## 7.2 COORDINATION AMONG PARTIES

It has been agreed that the BCT will schedule and conduct RPM meetings at regular intervals throughout the performance of the RI/FS. Intermediate meetings will also be held if warranted. At a minimum, representatives from the Marine Corps (including the CLEAN II contractor), along with U.S. EPA, Cal/EPA, and RWQCB, Santa Ana Region will be present. Meeting minutes will be recorded and provided to all attendees by the CLEAN II Team. U.S. EPA, Cal/EPA, and RWQCB, Santa Ana Region representatives have indicated that they, in turn, will share information with other interested agencies.

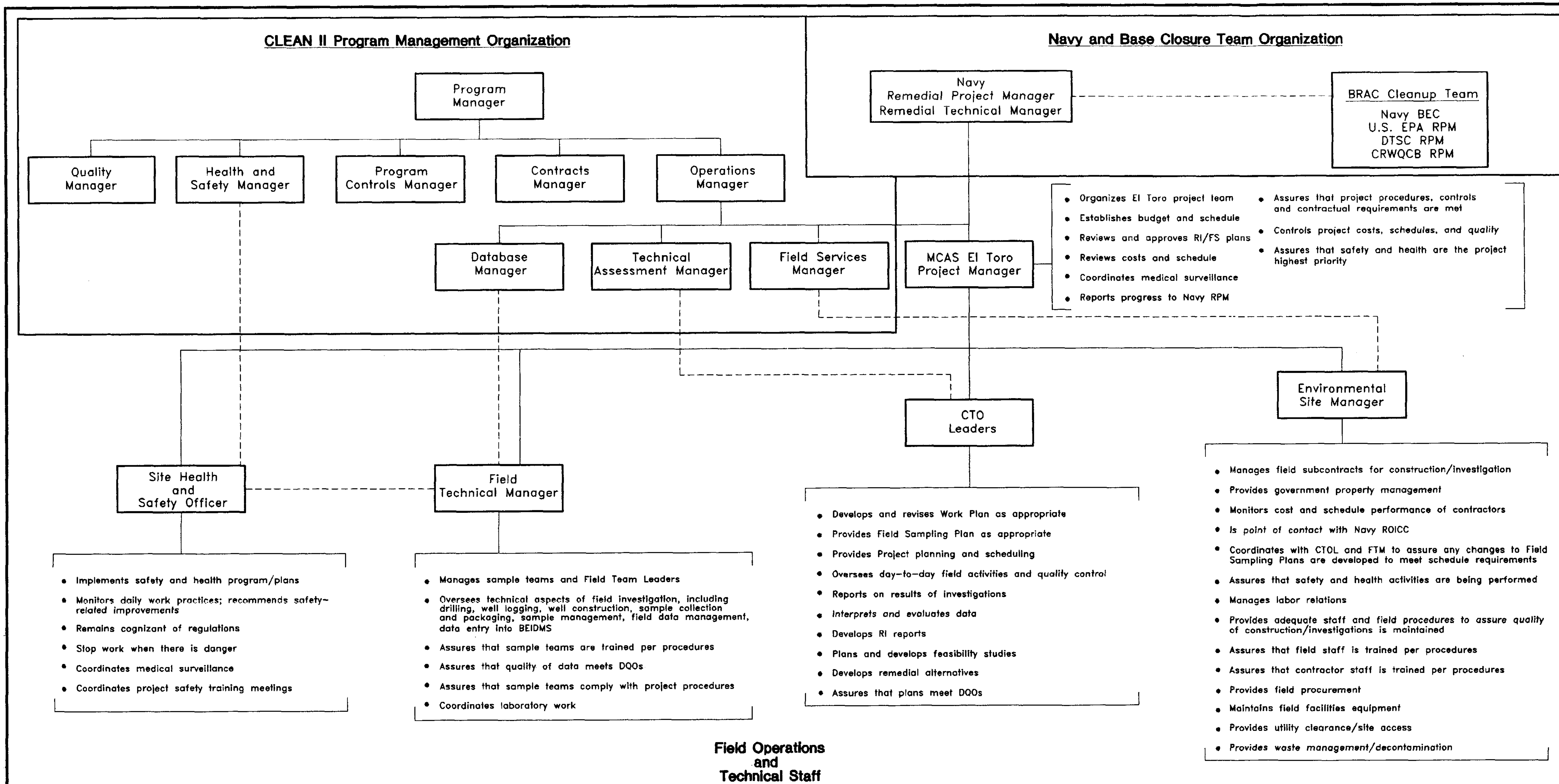
## 7.3 COORDINATION OF SUBCONTRACTORS

The CLEAN II contractor will be responsible for oversight and management of its subcontractors (drillers, labs), including health and safety requirements and responsibilities. All other parties (Marine Corps, U.S. EPA) will be responsible for their subcontractors, including all health and safety requirements and responsibilities.

## 7.4 COST/SCHEDULE CONTROL

Each CLEAN II work assignment has a project controls engineer assigned specifically to the project. Work progress and cost of the work will be tracked to identify areas of delay or overrun based on the target schedule and baseline budget. Progress of the work will be tracked using earned-value techniques. Overall project financial and schedule status reports are provided to the Marine Corps on a monthly basis. The reports include a summary of progress during the previous month and activities planned for the next month as well as action items and deliverable status. Potential problems and recommended solutions are also discussed.

Notification of changes and limitation of cost will be handled in a timely manner to reduce delays in the work.




LEGEND:

-------- COMMUNICATION

———— LINE OF DIRECT REPORTING

**Work Plan**

**Figure 7-1**

**Project Organization**

**MCAS El Toro, California**

**CLEAN II Program**

Date: 7/10/95
File No. org-wp
Job No. 22214-059

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# SECTION 8

## REFERENCES

## Section 8
# REFERENCES

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# WORK PLAN APPENDIX A

## DATA QUALITY OBJECTIVES
## OPERABLE UNIT 3 –
## SITE 1 – EXPLOSIVE ORDNANCE DISPOSAL RANGE

# SUMMARY

## STEP 1 – STATE THE PROBLEM

Site 1, the Explosive Ordnance Disposal Range, is an active military and civilian explosives/munitions disposal site. The site may be adversely impacted by chemical constituents derived from the burning/detonation of military ordnance and civilian explosives. The Explosive Ordnance Disposal Range will be investigated to estimate the human health and ecological risks, and to recommend either a No Further Investigation or an appropriate remedial alternative if the site poses unacceptable risks.

## STEP 2 – IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decisions to be considered at Site 1 are as follows: Do chemicals of potential concern in the shallow soil at Site 1 present an unacceptable risk to human health and the environment? Are chemicals of potential concern present in subsurface soil (greater than 10 feet below ground surface), and if so, do they present an unacceptable risk to groundwater? The possible decision outcomes are recommendations for No Further Investigation, Early Action, or Long-Term Action.

## STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions include a list of chemicals of potential concern; the extent of impacted media; the background (ambient) concentrations of metals, herbicides, and pesticides; and the action levels for protection of human health and the environment.

## STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to the geographic area of Site 1, which comprises two subareas: 1) the Northern Explosive Ordnance Disposal Range (approximately 737,250 square feet) where a majority of the recent military ordnance disposal has occurred, and 2) the Southern Explosive Ordnance Disposal Range (approximately 721,600 square feet) where ordnance disposal by the Orange County Sheriff Department and federal agencies has occurred.

## STEP 5 – DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of $10^{-6}$ in humans; and a hazard index of 1.0 for chronic systemic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

## STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

## STEP 7 – OPTIMIZE THE DESIGN

A shallow-soil sampling program has been designed for Site 1 for the Phase II Remedial Investigation/Feasibility Study; however, since Site 1 is active, implementation of this plan must be postponed. As an interim measure, three groundwater monitoring wells will be installed to monitor conditions beneath the site.

# ACRONYMS/ABBREVIATIONS

| | |
|---|---|
| ARAR | applicable or relevant and appropriate requirement |
| BCT | BRAC Cleanup Team |
| bgs | below ground surface |
| BRAC | Base Realignment and Closure |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| COPC | chemical of potential concern |
| CRDL | contract-required detection limit |
| DQO | data quality objective |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EM | electromagnetic |
| EOD | Explosive Ordnance Disposal |
| FS | Feasibility Study |
| FS smoke | sulfur trioxide chlorosulfonic acid |
| FSP | Field Sampling Plan |
| GPR | ground-penetrating radar |
| HMX | octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine |
| IDL | instrument detection limit |
| LUFT | (California) Leaking Underground Fuel Tank (Field Manual) |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| MCAS | Marine Corps Air Station |
| MCL | maximum contaminant level |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| NEESA | Naval Energy and Environmental Support Activity |
| NFESC | Naval Facilities Engineering Service Center |
| NFI | No Further Investigation |
| PAH | polynuclear aromatic hydrocarbons |
| pCi/L | picocuries per liter |
| PRG | (U.S. EPA Region IX) Preliminary Remediation Goal |

## ACRONYMS/ABBREVIATIONS (continued)

| | |
|---|---|
| QA/QC | quality assurance/quality control |
| RA | Remedial Action |
| RDX | hexahydro-1,3,5-trinitro-1,3,5-triazine |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| SAIC | Science Applications International Corporation |
| SVOC | semivolatile organic compound |
| TAL | target analyte list |
| TFH | total fuel hydrocarbons |
| TNT | 2,4,6-trinitrotoluene |
| TPH | total petroleum hydrocarbons |
| TRPH | total recoverable petroleum hydrocarbons |
| U.S. EPA | United States Environmental Protection Agency |
| VOC | volatile organic compound |

## Appendix A
# SITE 1 – EXPLOSIVE ORDNANCE DISPOSAL RANGE

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use (U.S. EPA 1993).

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 1 – Explosive Ordnance Disposal (EOD) Range.

## STEP 1 – STATE THE PROBLEM

Site 1 is an active military and civilian ordnance disposal site. Soil at the site may be impacted by chemical constituents derived from the burning of small arms ammunition and the detonation of hand grenades, land mines, cluster bombs, smoke bombs, rocket warheads, and rocket motors; as well as dynamite and gelatinous explosives. Metallic bomb fragments, drums, and bombed-out vehicles are also buried at the site. Unexploded ordnance and partially burned drums containing FS smoke (the military designation for sulfur trioxide chlorosulfonic acid) may be present beneath the site, further complicating potential Remedial Investigation (RI)/Feasibility Study (FS) activities and remedial actions. The impact on groundwater beneath the site from 40 years of ordnance disposal activities is unknown.

## Site Description

Site 1, the EOD Range, is located in the northeast portion of Marine Corps Air Station (MCAS) El Toro in the foothills of the Santa Ana Mountains (Figure A-1). The site is situated within a tributary canyon to Borrego Canyon Wash at an elevation of about 625 feet mean sea level (MSL). Site boundaries for MCAS El Toro Phase I RI were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together into sites based on common historical activities, aerial photograph review, and their respective locations to each other.

Disposal and detonation of munitions have been conducted at this site since 1952. Military ordnance disposed at the site has included hand grenades, land mines, cluster bombs, smoke bombs, and rocket warheads. Civilian and commercial explosives, such as 2,4,6-trinitrotoluene (TNT), dynamite, and plastic and gelatinous explosives, were also disposed at the EOD Range.

In 1982, approximately 2,000 gallons of drummed FS smoke was burned in trenches located at the northern end of the site (Figure A-2). The disposal method consisted of partially burying the drums containing FS smoke and rupturing them with a small explosive charge. It is not known if petroleum fuel was used to facilitate the burning of the drums.

Sources of potential contaminants include disposed ordnance (exploded and unexploded) and petroleum fuels (gasoline, kerosene, and diesel fuel) used in the disposal process. An estimated 30,000 tons of munitions and explosives have been disposed at this site. In addition, an estimated 300,000 gallons of petroleum fuels were used in burning these disposed materials (Jacobs Engineering 1993a).

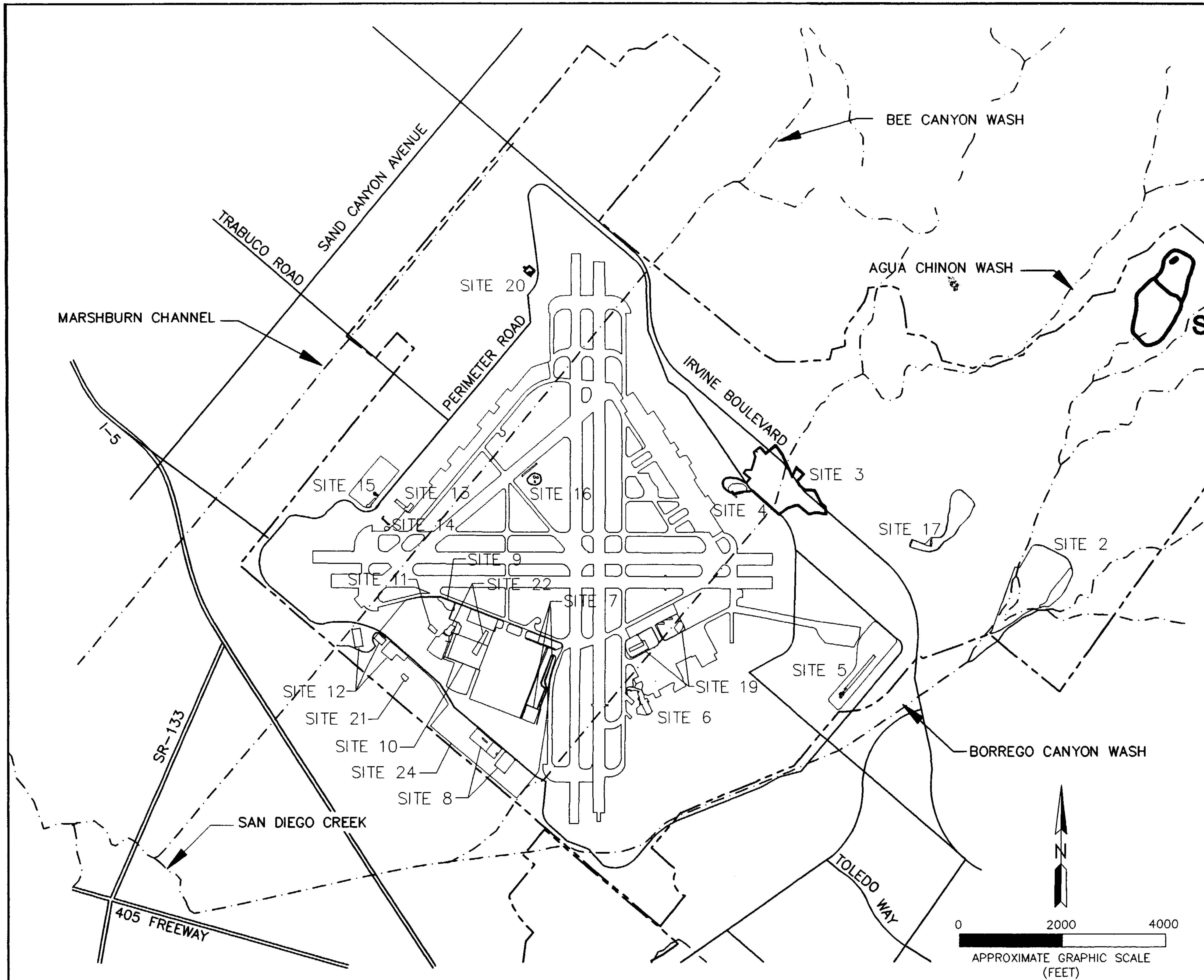
The EOD Range continues to operate. Munitions are detonated in trenches and pits that are continually filled with soil and reexcavated. The top soil is frequently disked for weed control, which mixes the shallow soils and removes identifiable site features. Undetonated explosives or drums may still be present at the EOD Range, buried beneath the soil.

## Previous Investigations

Previous investigations at Site 1 are the geophysical survey, Phase I RI, aerial photograph surveys, and employee interviews. The sections below provide a summary of these investigations.

### GEOPHYSICAL SURVEY

A surface geophysical survey was conducted at Site 1 in 1991 to facilitate the identification of subareas within the site where disposal activities had occurred and where buried material (drums, vehicles, etc.) may be present (Jacobs Engineering 1991). The surveys were conducted by making a series of linear traverses across the site at equally spaced intervals. Two types of surveys were conducted: ground-penetrating radar (GPR)




**Work Plan Appendix A**
**Figure A-1**
**Site Location**
**Site 1 - Explosive Ordnance Disposal**

MCAS El Toro, California

CLEAN II Program

Date: 5/23/95
File No. slocr-1
Job No. 22214-059

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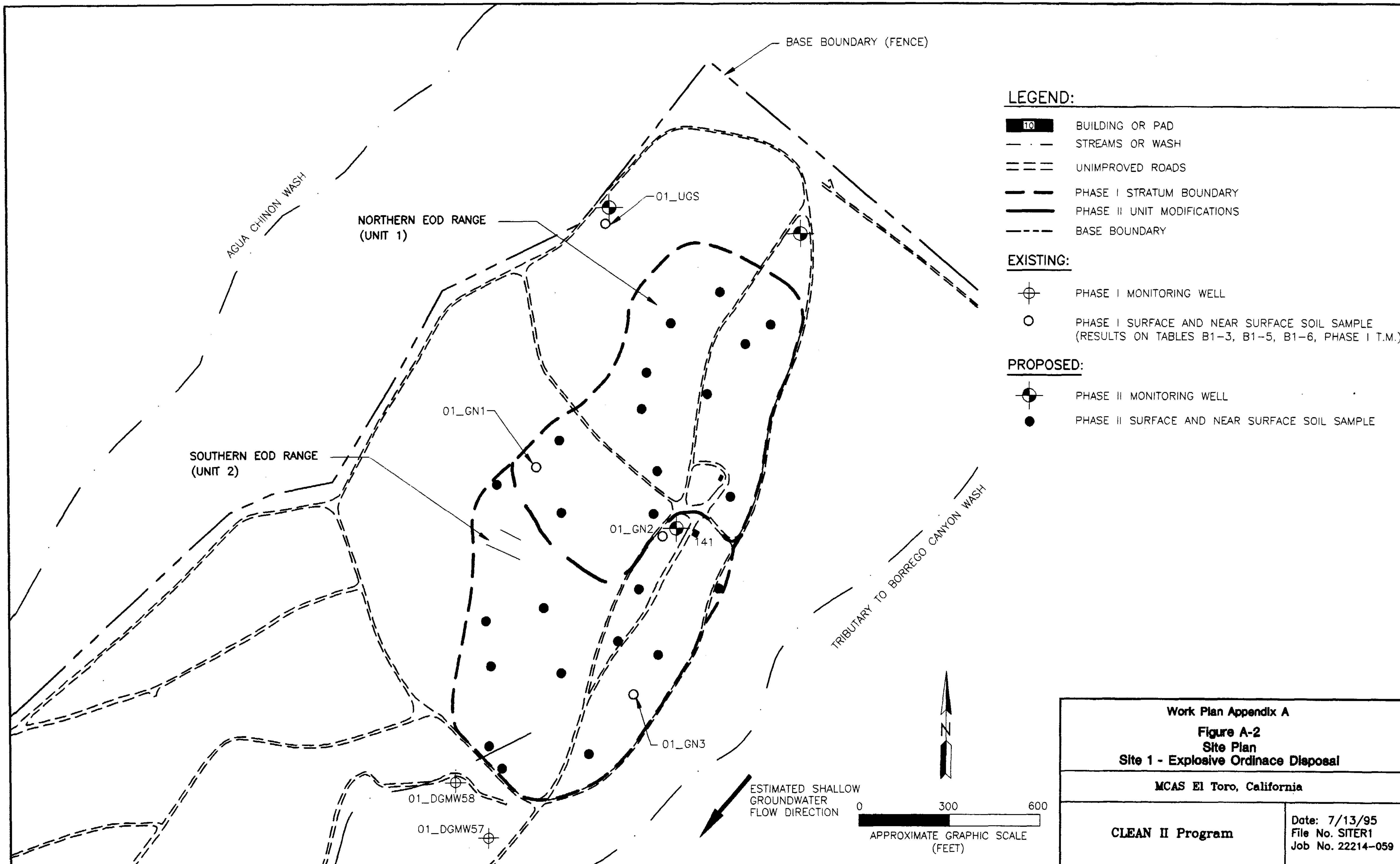
BASE BOUNDARY (FENCE)
LEGEND:
BUILDING OR PAD
STREAMS OR WASH
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
BASE BOUNDARY
EXISTING:
PHASE I MONITORING WELL
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLES B1-3, B1-5, B1-6, PHASE I T.M.)
PROPOSED:
PHASE II MONITORING WELL
PHASE II SURFACE AND NEAR SURFACE SOIL SAMPLE
AGUA CHINON WASH
NORTHERN EOD RANGE (UNIT 1)
SOUTHERN EOD RANGE (UNIT 2)
01_UGS
01_GN1
01_GN2
01_GN3
141
01_DGMW58
01_DGMW57
TRIBUTARY TO BORREGO CANYON WASH
ESTIMATED SHALLOW GROUNDWATER FLOW DIRECTION
0
300
600
APPROXIMATE GRAPHIC SCALE (FEET)
N
Work Plan Appendix A
Figure A-2
Site Plan
Site 1 - Explosive Ordinace Disposal
MCAS El Toro, California
CLEAN II Program
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File No. SITER1
Job No. 22214-059

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and electromagnetic (EM). The GPR survey results did not provide usable data for interpretation. The EM survey data provided useful data on the location of historic disposal operations (trenches, craters, etc.) and buried metallic objects (drums, vehicles, etc.).

## PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/FS, subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

In the Phase I RI, the entire site was represented by a single stratum. However, the FS smoke disposal area or known detonation pits were not sampled. The following field investigation activities were conducted as part of Phase I RI (Jacobs Engineering 1993b):

- four surface (0 to 6 inches below ground surface [bgs]) soil samples were collected (one soil sample from upgradient of the site and three within the EOD Range);
- two downgradient monitoring wells (01_DGMW57 and 58) were drilled and installed, and subsurface soil and groundwater were sampled;
- soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), total fuel hydrocarbons (TFH), target analyte list (TAL) metals, general chemistry, dioxins and furans; and
- groundwater samples were analyzed for VOCs, SVOCs, TRPH, TFH, TAL metals, pesticides/polychlorinated biphenyls, general chemistry, dioxins and furans, and gross alpha and beta.

A summary of the ranges of analyte concentrations detected during the Phase I RI (sample identification of the highest concentration is provided), including recent groundwater monitoring data, is presented below. All chemicals of potential concern (COPCs) that exceed human health U.S. EPA Region IX Preliminary Remediation Goals PRGs) or ecological screening criteria in shallow soil, and all COPCs that exceed PRGs or federal and/or California drinking water maximum contaminant levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the U.S. EPA Contract Laboratory Program detection limit. Sample locations are shown on Figure A-2. A complete listing of all detected chemicals is included in the Phase I RI technical memorandum, Appendix B-1, Tables B1-2 through B1-7 (Jacobs Engineering 1993b), and in the Groundwater Quality Data Report (Jacobs Engineering 1994a). TAL metals that were analyzed during the Phase I RI are aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

***Shallow Soil (less than 10 feet below ground surface)***

- metals: 16 of 23 TAL metals;
- VOC: toluene (< 10 to 6J micrograms per kilogram [μg/kg] [01_GN1 at 0 feet and 01_GN2 at 0 feet]), carbon tetrachloride (< 10 to 2J μg/kg [01_GN1 at 0 feet]);
- general chemistry: ammonia-N (5.94 to 9.75J milligrams per kilogram [mg/kg] [01_GN3 at 0 feet]), nitrate-N (0.65 to 1.53 mg/kg [01_GN1 at 0 feet]), total Kjeldahl nitrogen (359 to 874 mg/kg [01_GN1 at 0 feet]); and
- fuel and petroleum hydrocarbons: TFH-gasoline (< 0.05 to 0.22 mg/kg [01_UGS at 0 feet]), TFH-diesel (19.4 to 61.6 mg/kg [01_UGS at 0 feet]), TRPH (< 20 to 147 mg/kg [01_GN3 at 0 feet]).

***Subsurface Soil (off-site) (greater than 10 feet below ground surface)***

- VOC: 2-butanone (2J to 4J μg/kg [01_DGMW57 at 40 feet and 01_DGMW58 at 60 feet]).

***Groundwater (01_DGMW57 AND 58 downgradient)***

- general chemistry: nitrate/nitrite-N (1.66 to 7.66 milligrams per liter [mg/L] [01_DGMW58]), total dissolved solids (TDS) (429 to 808 mg/L [01_DGMW57]);
- metals: arsenic (< 1.4 to 1.4B micrograms per liter [μg/L] [01_DGMW58]), nickel (12.6B to 110 μg/L [01_DGMW58]), manganese (2.4B to 74.7 μg/L [01_DGMW57]);
- VOC: chloromethane (< 2 to 0.7J μg/L [01_DGMW57 and 58]);
- SVOC: bis(2-ethylhexyl) phthalate (< 10 to 49 μg/L [01_DGMW57]); and
- gross alpha and gross beta: gross alpha (5.8 to 7.5 picocuries per liter [pCi/L] [01_DGMW57]), gross beta (6.6 to 12.2 pCi/L [01_DGMW58]).

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than or equal to the instrument detection limit (IDL) (inorganic parameters).

The concentrations of COPCs detected in shallow soil were compared to PRGs and ecological screening criteria. No COPCs detected in shallow soil (upgradient and within the site) exceeded PRGs or ecological screening criteria.

COPCs detected in groundwater samples were compared to PRGs and MCLs:

- arsenic (1.4B μg/L) and nitrate-N (7.66 mg/L) exceeded PRGs; and
- nickel (110 μg/L), manganese (74.7 μg/L), and TDS (808 mg/L) exceeded MCLs.

Petroleum hydrocarbons detected in shallow soil samples were compared to California Leaking Underground Fuel Tank (LUFT) Field Manual (LUFT 1989) guidelines to evaluate potential hydrocarbons migration to groundwater. Based on LUFT guidelines, petroleum hydrocarbons characterized by shallow soil sample analytical data do not appear to pose a threat to groundwater at this site. Additional sampling and analysis is proposed in Step 7 (Optimize the Design) of this DQO to confirm this hypothesis.

### U.S. EPA AERIAL PHOTOGRAPH SURVEY

According to the U.S. EPA aerial photographic survey, trenches and stains at this site were first observed on the 1952 photograph in the southern section of the EOD Range. Additional features identified include craters, mounded material, and stains. From 1981 through 1991, photographs show an impoundment containing surface water at the northern end of the site. All observed features except the impoundment are located within the unvegetated, graded area of the EOD Range (Jacobs Engineering 1993c).

### SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The aerial photographic survey conducted by Science Applications International Corporation in 1993 confirmed the site boundaries established from the U.S. EPA survey. All identified features were observed within the existing site boundaries (SAIC 1993).

### EMPLOYEE INTERVIEWS

Active and retired MCAS El Toro employees were interviewed by members of the Base Realignment and Closure (BRAC) Cleanup Team (BCT) on 26 May 1994. Civilian employees of MCAS El Toro had no knowledge of the EOD Range activities because the EOD Range is operated by the Marines (Jacobs Engineering 1994b).

During a site visit in October 1994, Staff Sergeant G. Mullett (Explosive Ordnance Disposal Team, MCAS El Toro) stated that Site 1 remains in use approximately two to three times a week for destruction of small arms ordnance (mostly 50 caliber or less). He also indicated that the Orange County Sheriff Department and federal agencies use the southern area of the EOD Range for emergency explosives disposal, and for explosives training activities.

## Geology

A review of the Phase I RI boring logs for Site 1 indicates that the subsurface geology is characterized by sandy soil, with some silt and clay overlying bedrock at variable depths. Bedrock was encountered at a depth of 70 feet bgs in monitoring well boring 01_DGMW57, and at 21 feet bgs in well boring 01_DGMW58 (Jacobs Engineering 1993b).

## Hydrogeology

The EOD Range is situated within a tributary canyon to Borrego Canyon Wash. A small impoundment has been constructed near the upstream end of Site 1 to contain storm runoff. The depth to groundwater is approximately 45 to 65 feet bgs in the downgradient wells. The site is characterized by fairly rapid groundwater recharge in response to storm events (Jacobs Engineering 1993b). After the above-average January 1993 rainfall, groundwater levels rose approximately 8 to 11 feet (Jacobs Engineering 1994a). Groundwater beneath Site 1 has been estimated to flow in a southerly direction along the axis of the canyon.

## Conceptual Model

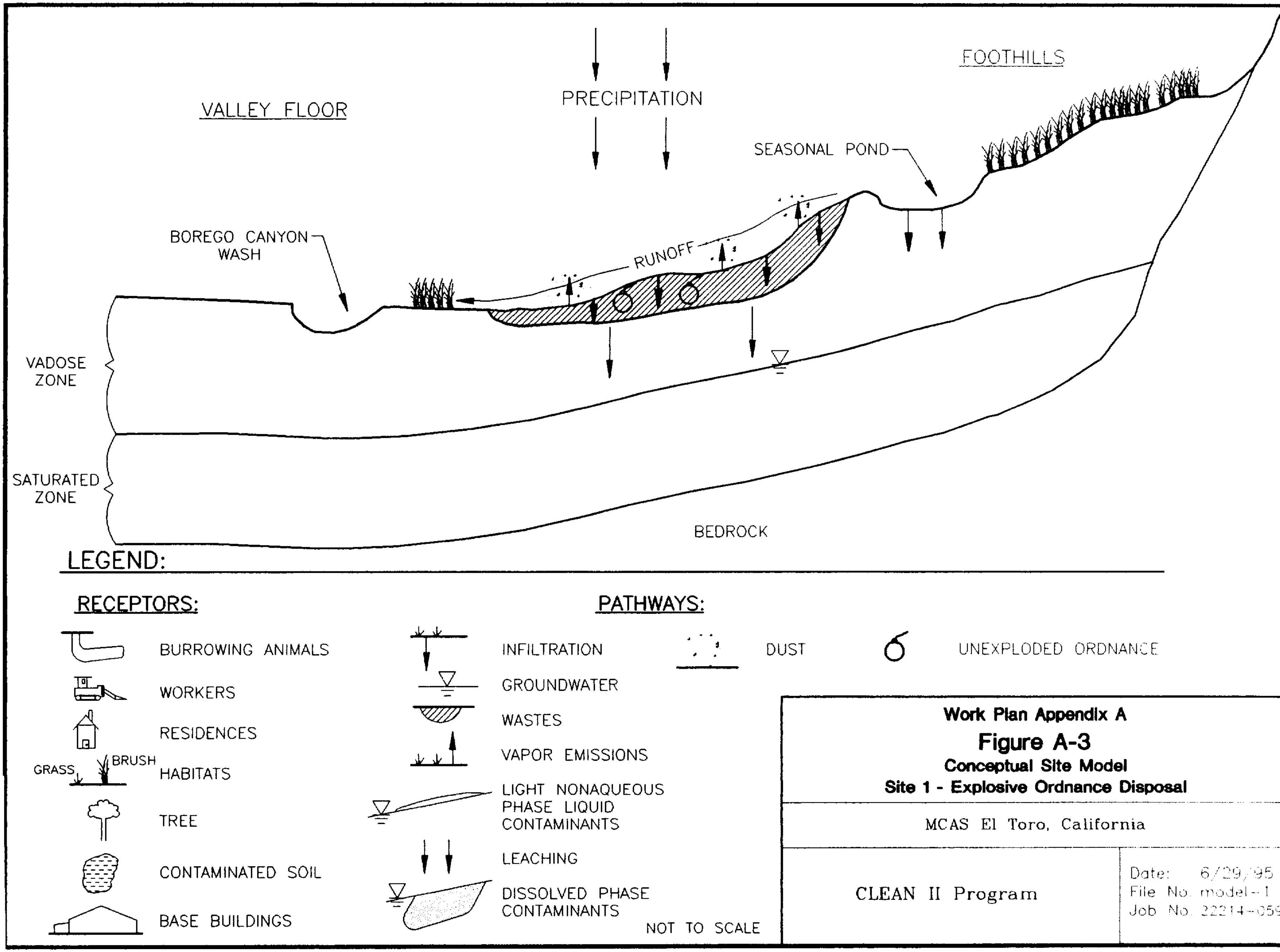
In the process of developing a conceptual site model, release mechanisms or potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure A-3 illustrates the conceptual site model developed for Site 1. Figure A-4 depicts the potential exposure routes and pathways for human and ecological receptors.

The primary release mechanism is the contaminants that are released to shallow soil from disposal activities at this site. Eventually under gravity, contaminants present in shallow soil may move downward with soil moisture (in dissolved phase) or in liquid phase. The depth of groundwater is recorded to be about 50 feet bgs.

The secondary source of contaminants is the surrounding soil that is impacted by disposal activities. One secondary release mechanism is the dust produced by explosion and burning activities. The fine particles of dust may contain all potential contaminants. Storm water runoff may form another secondary release mechanism. Storm water carries contaminants in dissolved forms, colloidal forms, or in forms associated with suspended soil particles.

The potential pathways are air, groundwater, and surface water. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather conditions. Typically, winds at MCAS El Toro are from west/southwest at less than 10 knots. Transportation of airborne contaminants through volatilization is expected to be unimportant at this site. Surface water is affected by the amount of rainfall, type of contaminant, surface soil properties, and topography of the area. The mean annual rainfall at MCAS El Toro is about 14 inches; most of it occurs from November through April.

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in disposal activities in addition to plants and animals. Workers and animals are potential receptors to surface and subsurface soils via ingestion and dermal contact exposure routes. Infiltration of contaminated water through the vadose zone into




**Work Plan Appendix A**

**Figure A-3**

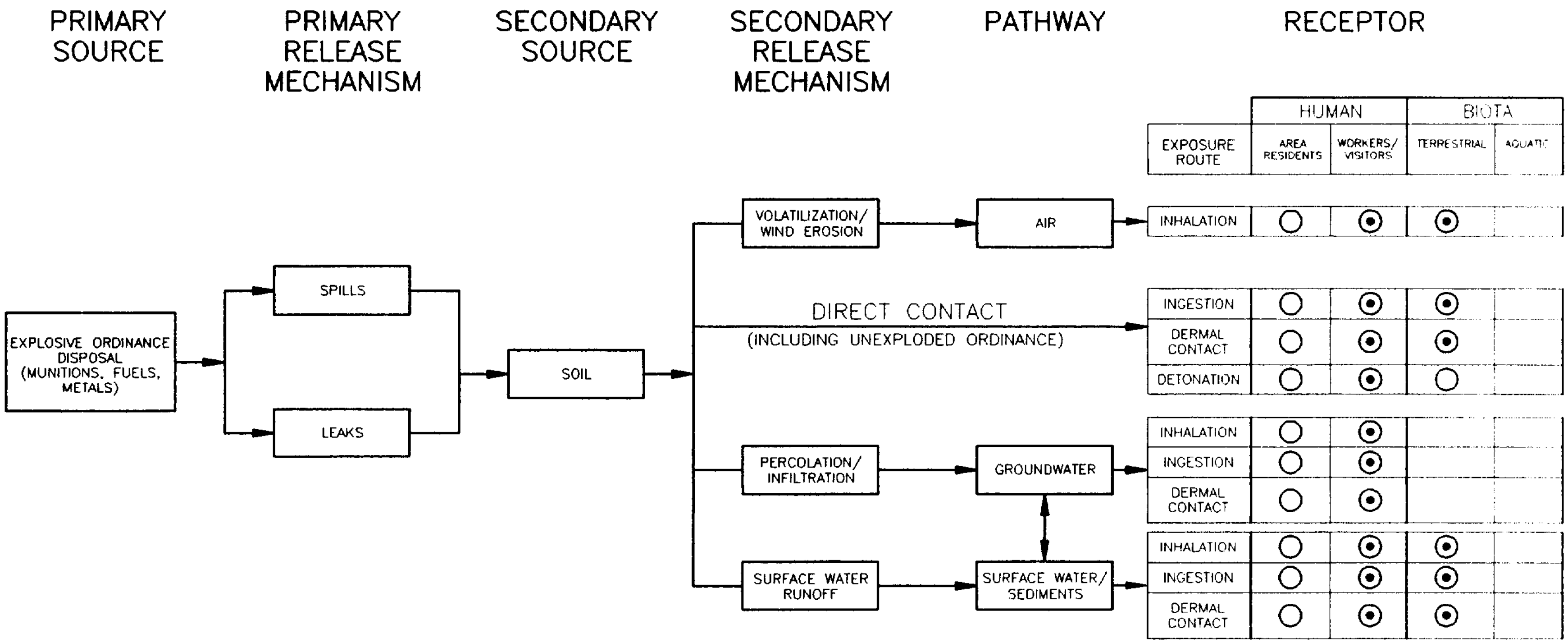
**Conceptual Site Model**

**Site 1 - Explosive Ordnance Disposal**

MCAS El Toro, California

CLEAN II Program

Date: 6/29/95
File No. model-1
Job No. 22214-059




LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

**Work Plan Appendix A**

**Figure A-4**

**Exposure Routes and Receptors**
**Site 1 - Explosive Ordinance Disposal**

**MCAS El Toro, California**

CLEAN II Program

Date: 6/28/95
File No. mod1
Job No. 22214-059

groundwater is possible because subsurface soil is mainly sands with some silts and clays. However, current exposure of workers and animals is unlikely via inhalation groundwater at this site.

Terrestrial wildlife could be exposed to chemicals in on-site surface soil, and in dust and vapors through ingestion, dermal absorption, or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. Aquatic organisms, including plants, could be exposed to chemicals in surface water (through ingestion and bioaccumulation) or in sediment (through plant uptake). Species occurring at this site include mourning doves and other foraging birds, California ground squirrels, southwestern pocket gophers, the desert cottontail, and other burrowing mammals. The site is also used by predatory birds and mammals such as foxes, hawks, and owls. Special-status species observed on or near this site include the California gnatcatcher, orange throated whiptail lizard, and coastal horned lizard.

### Statement of Phase II RI/FS Problem

Site 1, the EOD Range, is located in the northeast portion of MCAS El Toro in the foothills of the Santa Ana Mountains. The site is situated within a tributary canyon to Borrego Canyon Wash. The problems associated with this site are the following:

- even though no COPCs exceed PRGs or ecological screening criteria, the three surface samples collected from the site are not sufficient to characterize potential risk associated with waste disposal activities;
- based on LUFT guidelines, the petroleum hydrocarbons identified in shallow soil samples do not appear to pose a threat to groundwater at the site;
- it is not known if the COPCs in groundwater identified in downgradient monitoring wells are related to ordnance disposal at Site 1;
- the impact to groundwater from site activities remains unknown;
- the site remains in operation; and
- additional data are necessary to calculate a cumulative excess cancer risk and hazard index for the site.

## STEP 2 – IDENTIFY THE DECISION

This step describes the decisions that will be considered during the DQO process for Site 1. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure A-5. For Site 1, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

If uncertain, collect additional soil samples to determine risk.

If no, recommend the unit for No Further Investigation (NFI).

2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an Engineering Evaluation/Cost Analysis (EE/CA).

   If no, recommend unit for a remedial response as part of the RI/FS process.

## STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below.

### Inputs for No Further Investigation

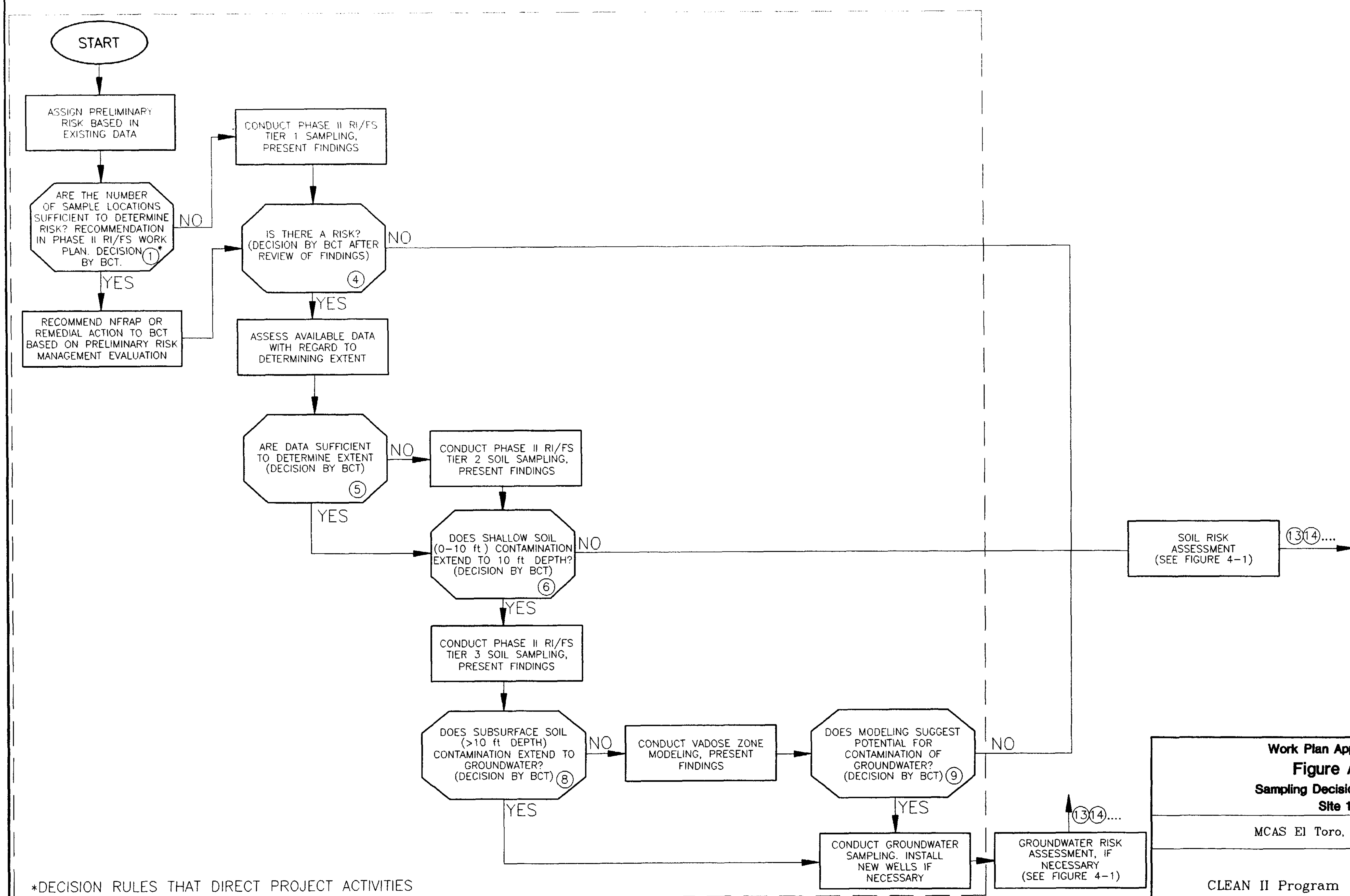
Input information required to support an NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the site; and
- action levels for the protection of human health and the environment.

### Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support an Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;




**Work Plan Appendix A**

**Figure A-5**

**Sampling Decision Process**

**Site 1**

MCAS El Toro, California

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- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

## Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

## Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

### CHEMICALS OF POTENTIAL CONCERN

The COPCs for Site 1 include all chemicals detected in the Phase I RI for each medium and stratum, with the exception of metals in shallow (0 to 10 feet bgs) soil. COPCs include chemicals associated with munitions such as toluene, TNT, hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX).

Degradation intermediates of munitions chemicals may be present and include para-hydroxytoluene, 2,4,6-trihydroxytoluene, nitrates, and phosphates. The formation of dioxins and dibenzofurans may occur during ordnance burning and detonation.

COPCs for Site 1 are listed (by chemical class and media) below:

#### *Shallow Soil (less than 10 feet below ground surface)*

- metals: aluminum, arsenic, barium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, zinc;
- general chemistry: nitrate/nitrite-N, phosphate, sulfate;
- explosives: TNT, RDX, HMX, para-hydroxytoluene, 2,4,6-trihydroxytoluene;
- VOC: carbon tetrachloride, toluene;
- dibenzofurans/dioxins: dibenzofuran, octachlorodibenzo-p-dioxins; and
- fuel and petroleum hydrocarbons: TFH-diesel, TFH-gasoline, TRPH.

***Subsurface soil (greater than 10 feet below ground surface)***

- metals: aluminum, arsenic, barium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, zinc;
- general chemistry: nitrate/nitrite-N, phosphate, sulfate;
- explosives: TNT, RDX, HMX, para-hydroxytoluene, 2,4,6-trihydroxytoluene;
- VOC: 2-butanone, carbon tetrachloride, toluene; and
- dibenzofurans/dioxins: dibenzofuran, octachlorodibenzo-p-dioxins.

***Groundwater***

- metals: aluminum, arsenic, barium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, zinc;
- explosives: TNT, RDX, HMX, para-hydroxytoluene, 2,4,6-trihydroxytoluene;
- VOC: chloromethane;
- SVOC: bis(2-ethylhexyl) phthalate;
- general chemistry: nitrate/nitrite-N, phosphate, sulfate; and
- gross alpha and beta: gross alpha, gross beta.

## THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

## BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Phase II RI/FS Work Plan.

## DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

### APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARARs will be prepared as necessary. In addition, any ARARs already developed for the OU-3 sites will be utilized where appropriate.

### SITE/UNIT CLEANUP IN FIVE YEARS

If the site/unit cleanup is estimated to be accomplished in a period of more than five years, the site/unit will be addressed as a Long-Term Action site.

### IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

### CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remediate the site, if necessary.

## STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

- Unit 1 – the Northern EOD Range (approximately 737,250 $feet^2$ where the majority of recent military disposal has taken place).
- Unit 2 – the Southern EOD Range (approximately 721,600 $feet^2$ where ordnance disposal from the Orange County Sheriff Department and federal agencies has taken place).

Site 1 was represented by a single stratum in the Phase I RI. The combined areas of Phase II RI/FS Units 1 and 2 have the same boundary as Stratum 1 of the Phase I RI. The map of Site 1 (Figure A-2) includes the locations of Units 1 and 2.

Most of the Phase II RI/FS field activities for Site 1 will be initiated after Station closure unless the EOD Range remains active as a civilian munitions disposal site. If this site remains active after Station closure, only the proposed Phase II RI/FS activities related to the investigation of groundwater will be conducted. All of the Phase II RI/FS sampling will be conducted during a single field activities period spanning approximately six months.

Continue



## STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules (as numbered from the Work Plan) that will be followed to determine an action are described below.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units that exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.
3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results. This will assure that the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.
4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.
5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.
6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.
7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - CRDL
   - contract-required quantitation limit,
   - sample quantitation limit,