Comprehensive Long-Term Environmental Action Navy (CLEAN) II
Contract No. N62742-94-D-0048
Contract Task Order No. 0078

Work Plan

Aquifer Test

IRP Site 2, Magazine Road Landfill
Former Marine Corps Air Station, El Toro, California

Prepared for:

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

Prepared by:

Earth Tech, Inc.
700 Bishop Street, Suite 900
Honolulu, Hawaii 96813

March 2002

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

DOCUMENT TRANSMITTAL

Contract No. N62742-94-D-0048

To: Remedial Project Manager
Naval Facilities Engineering Command
Southwest Division
Gordon Brown
1230 Columbia Street, Suite 870
San Diego, CA 92101-8517

DATE: April 4, 2002
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FROM: Crispin G. Wanyoike

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Work Plan
Aquifer Test
IRP Site 2, Magazine Road Landfill
MCAS El Toro, California

Contract No. N62742-94-D-0048
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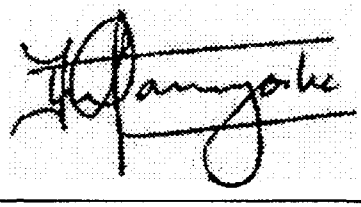
Reviews and Approvals:



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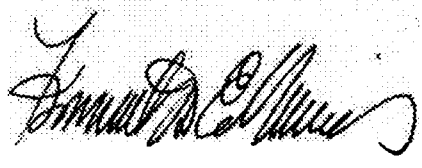

Ken Vinson, P.E.
Program Quality Manager
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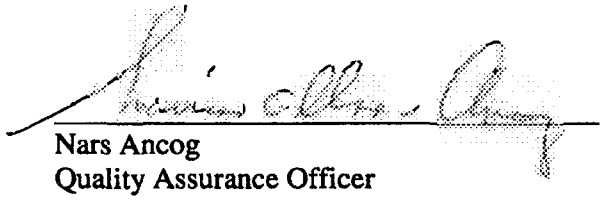

Nars Ancog
Quality Assurance Officer
U.S. Naval Facilities Engineering Service Command
Southwest Division
(Review and Approval by QAO is pertinent to the Field Sampling Plan and Quality Assurance Project Plan sections of this work plan document).

Date: 3/7/02

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ADDENDUM 1
TO THE HEALTH AND SAFETY PLAN (PRE-DESIGN INVESTIGATION FOR REMEDIAL DESIGN) FOR AQUIFER TEST IRP SITE 2, MAGAZINE ROAD LANDFILL

DATED 29 MARCH 2002

IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **M60050.002616**

CONTENTS

APPENDIXES

FIGURES

TABLES

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
µg/L	microgram per liter
µmho	micro mhos
1,1,2-TCA	1,1,2-trichloroethane
1,2-DCA	1,2-dichloroethane
BCT	BRAC Cleanup Team
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
Cal/EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COC	chain of custody
COPC	chemical of potential concern
CPT	cone penetrometer testing
CRWQCB	California Regional Water Quality Control Board
CTO	contract task order
DOT	Department of Transportation
DQO	data quality objective
DTSC	Department of Toxic Substances Control
Earth Tech	Earth Tech, Inc.
EDD	electronic data deliverable
EPA	Environmental Protection Agency
EWI	environmental work instructions
FS	feasibility study
ft^2/day	square feet per day
GAC	granular activated carbon
gpm	gallons per minute
HCl	hydrochloric acid
HSP	health and safety plan
ID	identification
IDW	investigation-derived waste
IR CDQM	Navy Installation Restoration Chemical Data Quality Manual
IRP	Installation Restoration Program
JEG	Jacobs Engineering Group
L	liter
LCS	laboratory control sample
LPGAC	liquid-phase granular activated carbon
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
mg/L	milligram per liter
ML	milliliter
MS	matrix spike
MSA	master services agreement
MSD	matrix spike duplicate
MSL	mean sea level

mV	millivolt
NCP	National (Oil and Hazardous Substances Pollution) Contingency Plan
NEDTS	Naval Environmental Data Transfer System
NFESC	Naval Facilities Engineering Service Center
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
ORP	oxidation-reduction potential
PACNAVFACENGCOM	Pacific Division, Naval Facilities Engineering Command
PCE	tetrachloroethene
pH	negative log of the hydrogen ion concentration
PPE	personal protective equipment
ppm	parts per million
PRG	preliminary remediation goal
psig	pounds per square inch-gauge
PVC	polyvinyl chloride
QA	quality assurance
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
%R	percent recovery
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RPD	relative percentage of difference
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act
SOP	standard operating procedure
SOW	statement of work
SWAT	solid waste assessment test
SWDIV	Naval Facilities Engineering Command, Southwest Division
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	total organic carbon
U.S.	United States
VOC	volatile organic compound
WDR	waste discharge requirement

1. INTRODUCTION

This work plan details the objectives and procedures to conduct a long-term aquifer test to evaluate aquifer properties within the trichloroethene (TCE) and tetrachloroethene (PCE) groundwater plumes at Installation Restoration Program (IRP) Site 2, the Magazine Road Landfill at Former Marine Corps Air Station (MCAS), El Toro, California. In addition, the extents of the TCE and PCE plumes and the potential of natural attenuation will be evaluated. Aquifer analysis and sampling results will be used to evaluate mass-removal rates and design a response strategy for the volatile organic compound (VOC) plumes.

This work plan was prepared for the Southwest Division, Naval Facilities Engineering Command (SWDIV) as authorized by the U.S. Navy, Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM) under contract task order (CTO) no. 0078 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) II program, contract number N62742-94-D-0048. It complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) in Title 40 of the Code of Federal Regulations (CFR), Part 300.

This work plan presents the elements of the quality assurance project plan (QAPP) as recommended in U.S. Environmental Protection Agency (EPA) *Requirements for Quality Assurance Project Plans for Environmental Data Operations, QA/R-5* (EPA 2001).

1.1 SITE DESCRIPTION

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

IRP Site 2, the Magazine Road Landfill, is located in the foothills of the Santa Ana Mountains in the eastern portion of MCAS El Toro. IRP Site 2 occupies approximately 27 acres between Borrego Canyon Wash and one of its tributaries. A man-made drainage channel that trends northeast-southwest bisects the site. IRP Site 2 is bounded on the west by Magazine Road and on the south and east by a dirt road.

1.2 SITE BACKGROUND

The former operational landfill, shown as areas A and B on Figure 1-2, was used from the late 1950s until about 1980. Intermittent, unauthorized disposal occurred at Areas C1, C2, and D2. The landfill is no longer in use. Portions of the landfill serve as habitat for the California gnatcatcher, a federally listed threatened species.

All solid waste generated at MCAS El Toro and a portion of the solid waste from MCAS Tustin was disposed of in the operational landfill at IRP Site 2. The suspected types of waste include construction debris, municipal waste, batteries, waste oil, hydraulic fluid, paint residue, transformers, and waste solvents (BNI 1996).

1.3 PREVIOUS INVESTIGATIONS

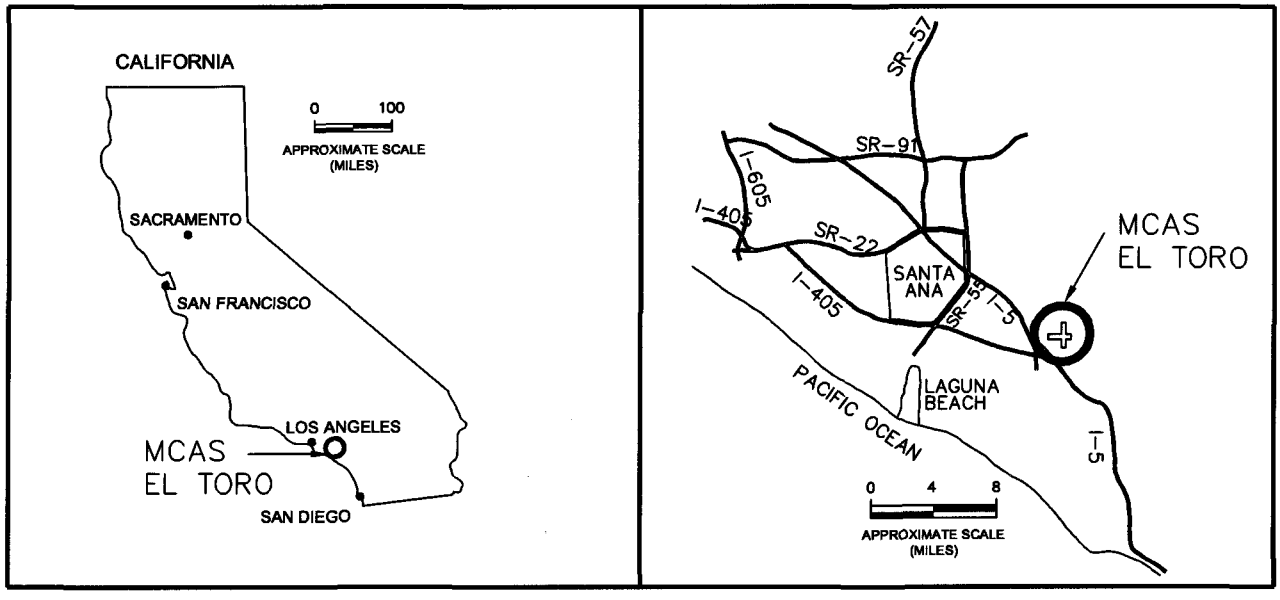
Previous investigations at IRP Site 2 include the solid waste air quality assessment test (SWAT) (Strata 1991), a Phase I remedial investigation (RI) (JEG 1993), a Phase II RI (BNI 1996), and an investigation to verify the VOCs detected in groundwater (Earth Tech 2000). The Air SWAT results indicated the emission of low concentrations of VOCs from the landfill. The Phase I RI identified chemicals of potential concern (COPCs) based upon the analysis of surface water, sediment, shallow soil, subsurface soil, and groundwater samples. Soil gas samples collected during the Phase II RI contained VOCs, with 10 of the 342 samples collected exceeding the hot-spot threshold concentrations of 300 micrograms per liter (µg/L) (BNI 1999a). Soil samples collected during the Phase II RI contained detectable concentrations of VOCs, semivolatile organic compounds (SVOCs), pesticides, and metals. Of the detected analytes, only two of the metals (arsenic and beryllium) exceeded EPA preliminary remediation goals (PRGs) for residential settings. These analytes were determined to be within the range of the background or naturally occurring concentrations. Groundwater samples collected during the Phase II RI contained VOCs, SVOCs, pesticides, metals, and gross alpha- and beta-emitting radionuclides. The compounds that exceeded maximum contaminant levels (MCLs) include TCE, PCE, several metals, and gross alpha-emitting isotopes.

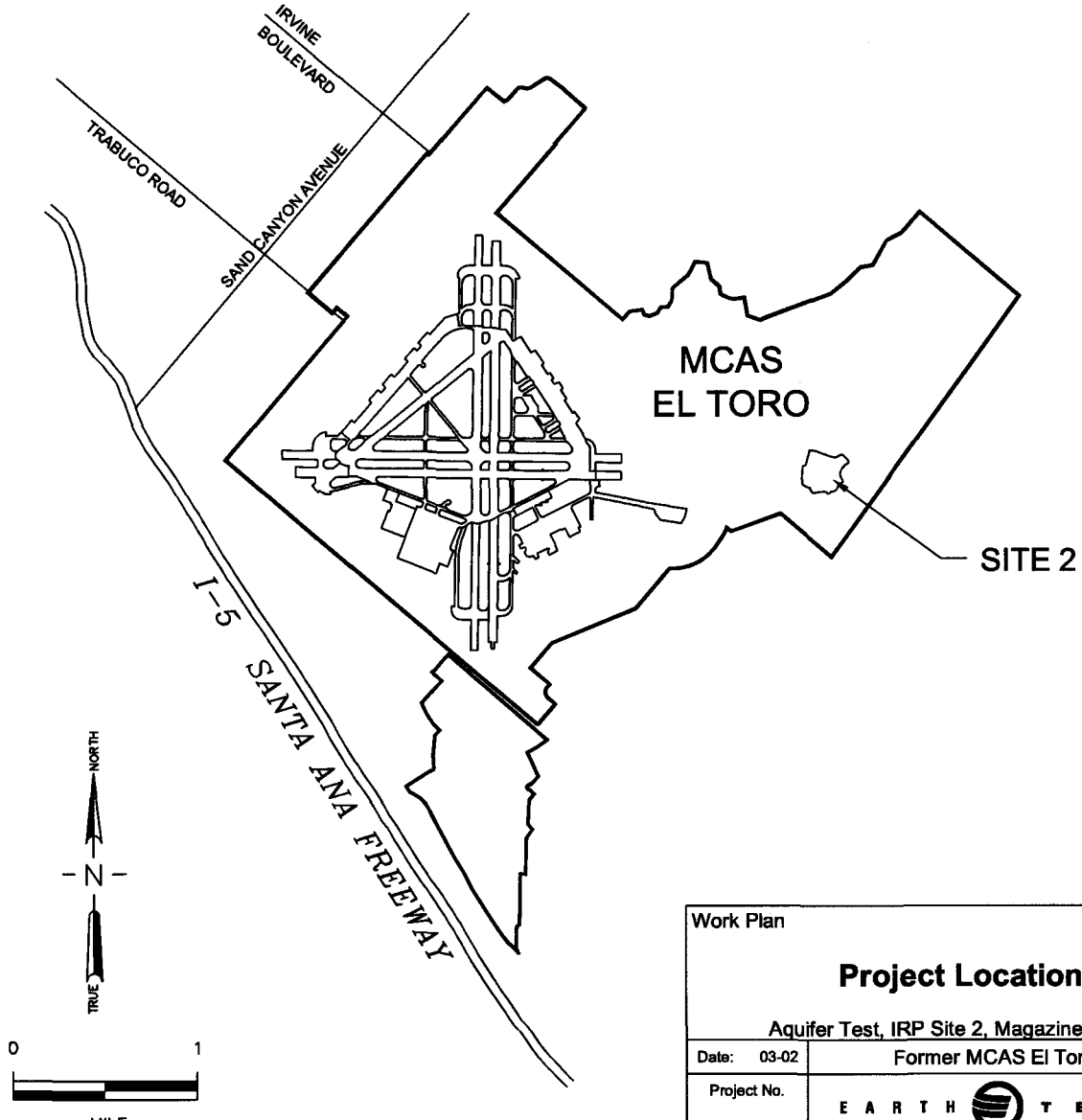
Short-term aquifer testing was conducted at Site 2 during the Phase II RI. Step-drawdown tests were performed at wells 02_DGMW60, 02NEW02, 02NEW08A, 02NEW13, and 02NEW14. Constant-rate tests were performed at wells 02NEW13 and 02NEW14. The results indicate the significant variance of hydraulic properties and uncertainty with regard to boundary conditions at Site 2. Data fom the previous aquifer testing are summarized in Section 1.4.4.

A feasibility study (FS) to evaluate potential remedies for impacted groundwater was prepared in 1997 (BNI 1997). Potential remedies evaluated in the FS included no action, institutional controls, containment, removal (groundwater extraction), in situ and ex situ treatment, and disposal actions. The FS identified the following potential remedial options: no action, compliance monitoring and reporting, deed restrictions, and natural attenuation. Additionally, potential substitutes or support technologies included Resource Conservation and Recovery Act (RCRA)-type cap, groundwater extraction and treatment, and dual-phase extraction.

The *Draft Final Record of Decision, Marine Corps Air Station El Toro, California (ROD)* was issued in June 1999 (BNI 1999a). The ROD presented the proposed remedial action for the soil at IRP Site 2. The proposed remedial action included a single-layer soil cap and associated maintenance, erosion control, access and land use restrictions, and long-term monitoring of landfill gas, leachate, and groundwater. Due to regulatory concerns regarding previous conclusions on the potential for natural attenuation of the VOCs, radionuclide concentrations above MCLs, and the potential for perchlorates to migrate from IRP Site 1, a final interim ROD (BNI 2000) addressing the soil remedy was issued. The remedy for groundwater at IRP Site 2 will be addressed in an addendum or a separate ROD (EPA 1999a,b and Cal/EPA 1999a,b).

The verification of VOCs in groundwater investigation confirmed localized concentrations of TCE and PCE in excess of the MCLs beneath Areas C1 and C2 (Earth Tech 2000). However, the upgradient lateral extent of TCE and PCE was only partially defined (Earth Tech 2000). During this investigation, nine groundwater monitoring wells and three piezometers were installed and a total of 24 groundwater wells and three piezometers were sampled. The investigation yielded inadequate evidence for anaerobic biodegradation of chlorinated solvents. Further, perchlorate was not detected. A supplemental investigation to evaluate the origin of radionuclides in groundwater





Work Plan		Final
Project Location Map		
Aquifer Test, IRP Site 2, Magazine Road Landfill		
Date: 03-02	Former MCAS El Toro	Figure 1-1
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY	

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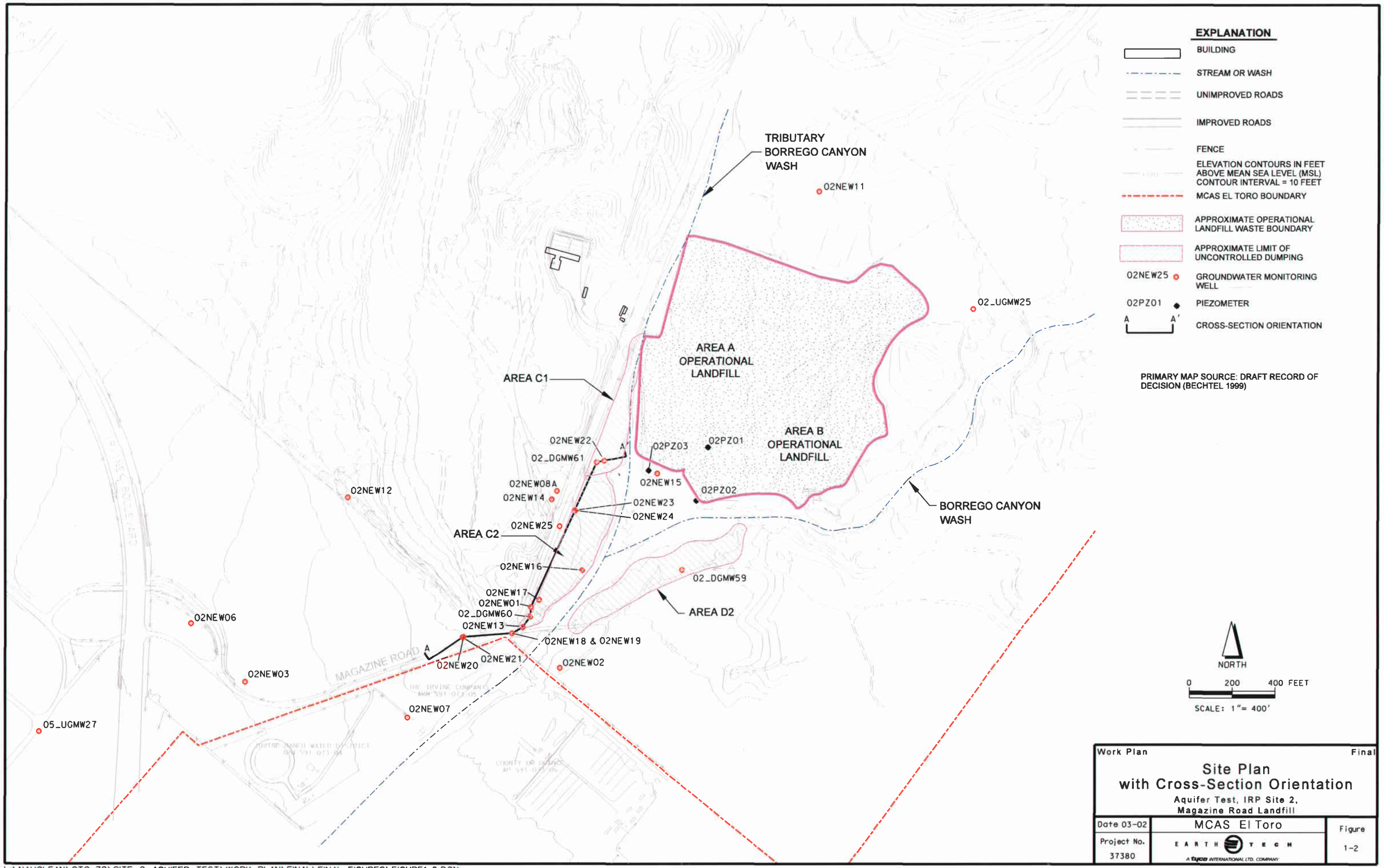

Work Plan — Final

Site Plan with Cross-Section Orientation

Aquifer Test, IRP Site 2,
Magazine Road Landfill

Date 03-02	MCAS El Toro	Figure
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY	1-2

L:\NAVCLEAN\CTO-78\SITE_2_AQUIFER TEST\WORK PLAN\FINAL\FINAL FIGURES\FIGURE1-2.DGN

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confirmed that the radionuclides detected in groundwater at MCAS El Toro are naturally occurring (Earth Tech 2001b).

A total of 25 groundwater monitoring wells and three piezometers are present at IRP Site 2 (Figure 1-2). Nine wells are sampled quarterly and analyzed for perchlorate, VOCs, anions, alkalinity, sulfide, total organic carbon (TOC), iron, methane, and radionuclides as a component of the CERCLA Long-Term Groundwater Monitoring Program (BNI 1999b).

1.4 EVALUATION OF EXISTING DATA

1.4.1 Geology and Hydrogeology

MCAS El Toro lies on the southeastern edge of the Tustin Plain, a gently sloping surface of alluvial fan deposits derived mainly from the Santa Ana Mountains. Silts and clays predominate in the central and northwestern portion of MCAS El Toro, and sands predominate near the foothills. The sands are generally well-graded and commonly contain clays. Sandstone and siltstone bedrock outcrops are present in the foothills, including at IRP Site 2. A cross section depicting lithologies encountered at IRP Site 2 is provided on Figure 1-3. The cross-section orientation is shown on Figure 1-2.

MCAS El Toro is located within the Irvine Groundwater Subbasin Forebay, which has been designated by the California Regional Water Quality Control Board (CRWQCB) as a public water supply source (CRWQCB 1995). The shallow aquifer directly below MCAS El Toro is not currently used for the municipal water supply; however, it is used for irrigation.

IRP Site 2 lies in a drainage basin consisting of alluvium and bedrock. Groundwater flows within the alluvium and bedrock, and the predominant groundwater flow direction beneath the former operational landfill is toward the southwest at a gradient of approximately 0.021 feet/foot. The gradient direction in the central portion of the site, southwest of the landfill, is also toward the southwest at approximately 0.044 feet/foot. As the groundwater flows from IRP Site 2, the flow direction changes abruptly toward the northwest at a gradient ranging from approximately 0.008 to 0.168 feet/foot.

In Section 3.0 of the Phase II RI report (BNI 1997), two aquifer systems were described with varying groundwater flow directions and gradients. It appears that these flow directions are based on the elevations in wells 02NEW08A, 02NEW14, and nearby piezometers. These elevations were evaluated without consideration of other groundwater elevations in wells at IRP Site 2. Additionally, the number of wells and control for the groundwater elevation maps presented in the Phase II RI (BNI 1996) is very limited. An equipotential map showing groundwater elevation data collected on 17 December 2001 is presented on Figure 1-4. The number of wells and controls used to generate this figure was increased, allowing for greater detail and confidence in the groundwater elevation contours. Detailed descriptions of the geology and hydrogeology at IRP Site 2 are presented in the *Technical Memorandum, Verification of VOCs in Groundwater, IRP Site 2, Magazine Road Landfill, Marine Corps Air Station El Toro, California* (Earth Tech 2000).

1.4.2 Surface Hydrology

Surface drainage at MCAS El Toro generally flows towards the southwest following the slope of the land. Several washes originate in the foothills northeast of MCAS El Toro and flow through or adjacent to the MCAS boundary en route to San Diego Creek.

IRP Site 2 is located within the lower portion of Borrego Canyon drainage basin. The former operational landfill area is upstream of the confluence of the main channel of Borrego Canyon Wash and a tributary. Ephemeral streams generally flow along the eastern side of the landfill in the main channel and along the western side of the landfill in the tributary channel.

1.4.3 VOC Concentrations in Groundwater

Analysis of groundwater samples for VOCs (Earth Tech 2000) yielded concentrations of TCE and PCE in excess of the 5-microgram-per-liter (µg/L) MCLs (EPA 2002a). Groundwater samples were collected from 24 monitoring wells at IRP Site 2 in March and April 2000 and from three piezometers in June 2000. All samples were analyzed for VOCs in accordance with EPA Method 8260B. During the quarterly groundwater sampling conducted in June 2000, only seven wells at IRP Site 2 were sampled. Similar concentrations of TCE and PCE were detected during both sampling events (Earth Tech 2000, BNI 1998a, CDM 2000a,b, CDM 2001). A summary of historical VOC results for groundwater at IRP Site 2 is provided in Appendix A. The estimated extent of dissolved PCE and TCE in groundwater is shown on Figure 1-5 and in Cross Section A-A' (Figure 1-6).

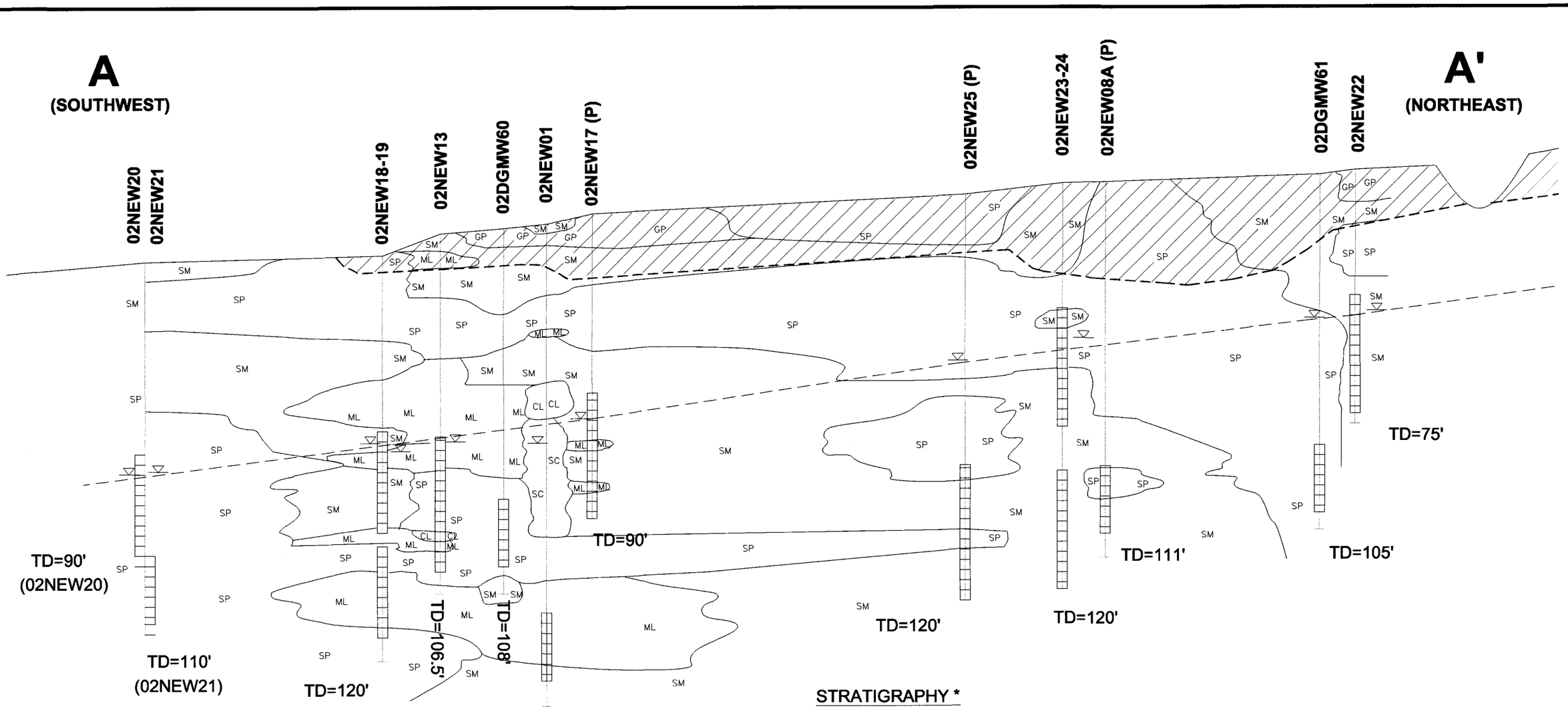
The extent of the PCE groundwater plume is defined in the south/southwest (downgradient) direction. The lateral extent in the cross-gradient and upgradient directions has not been fully defined. Based upon data collected in 2000, the highest reported concentration of PCE was 8 µg/L and was found in monitoring well 02NEW22. The extent of the TCE groundwater plume is defined in the south/southwest (downgradient) direction and in the west/northwest direction. The lateral extent toward the southeast and upgradient toward the north/northeast has not been fully defined. Based on data collected in 2000, the highest reported concentration of TCE was 152 µg/L in monitoring well 02NEW17.

Other VOCs detected during the March/April 2000 sampling event include acetone, bromodichloromethane, methylene chloride, chloroform, 1,2-dichloroethane (1,2-DCA), 1,1,2-trichloroethane (1,1,2-TCA), and toluene. A detailed description of the reported VOCs in groundwater at IRP Site 2 is presented in the *Verification of VOCs in Groundwater* (Earth Tech 2000), and a summary of historical VOC results is provided in Appendix A.

1.4.4 Aquifer Properties

Short-term aquifer testing was conducted at Site 2 during the Phase II RI. Step-drawdown tests were performed at wells 02_DGMW60. 02NEW02, 02NEW08A, 02NEW13, and 02NEW14. Constant-rate tests were performed at wells 02NEW13 and 02NEW14. Test durations and flow rates are provided in Table 1-1.

Transmissivity values calculated from the aquifer testing ranged from 1.4 to 245 feet squared per day. The range in flow rates and calculated transmissivity values represents the significant variance in hydraulic conductivity between the alluvial and bedrock units. Aquifer response in the monitoring wells indicated a diversity of boundary conditions (i.e., confined, unconfined, leaky-confined); however, the test durations were inadequate to allow the boundary conditions to be accurately ascertained.



EXPLANATION

02NEW24 MONITORING WELL

(P) INDICATES THE WELL IS PROJECTED ONTO THE LINE OF THE CROSS-SECTION

SCREENED INTERVAL OF MONITORING WELL

TD=142.5' TOTAL DEPTH OF WELL BORING IN FEET BELOW GROUND SURFACE

STRATIGRAPHIC/LITHOLOGIC CONTACT

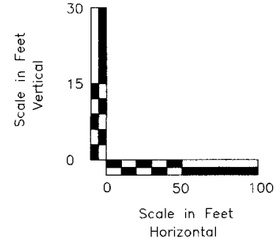
FILL MATERIAL

TOP OF GROUNDWATER (MEASURED 22 MAY 2000)

INFERRED GROUNDWATER SURFACE (22 MAY 2000)

STRATIGRAPHY *

GP	UNDIFFERENTIATED GRAVELLY SAND, GRAVELLY SILTY SAND, GRAVEL, SILTY GRAVEL, AND CLAYEY GRAVEL
SP	UNDIFFERENTIATED POORLY GRADED SAND, WELL-GRADED SAND, SANDSTONE, AND CONGLOMERATIC SANDSTONE
SC	UNDIFFERENTIATED CLAYEY SAND AND CLAYEY SANDSTONE
SM	UNDIFFERENTIATED SILTY SAND AND SITLY SANDSTONE
ML	UNDIFFERENTIATED SANDY SILT, CLAYEY SILT, SILT, SILTSTONE MUDSTONE, SANDY SILTSTONE, AND CLAYEY SILTSTONE
CL	UNDIFFERENTIATED SANDY CLAY, CLAYSTONE, AND SILTY CLAYSTONE
*	BASED UPON DATA RECORDED ON BORING LOGS DURING DRILLING



Work Plan — Final

Geologic Cross Section

Aquifer Test, IRP Site 2, Magazine Road Landfill

Date: 03-02	Former MCAS El Toro	Figure 1-3
Project No. 37380	EARTH TECH, A Tyco International Ltd. Company	

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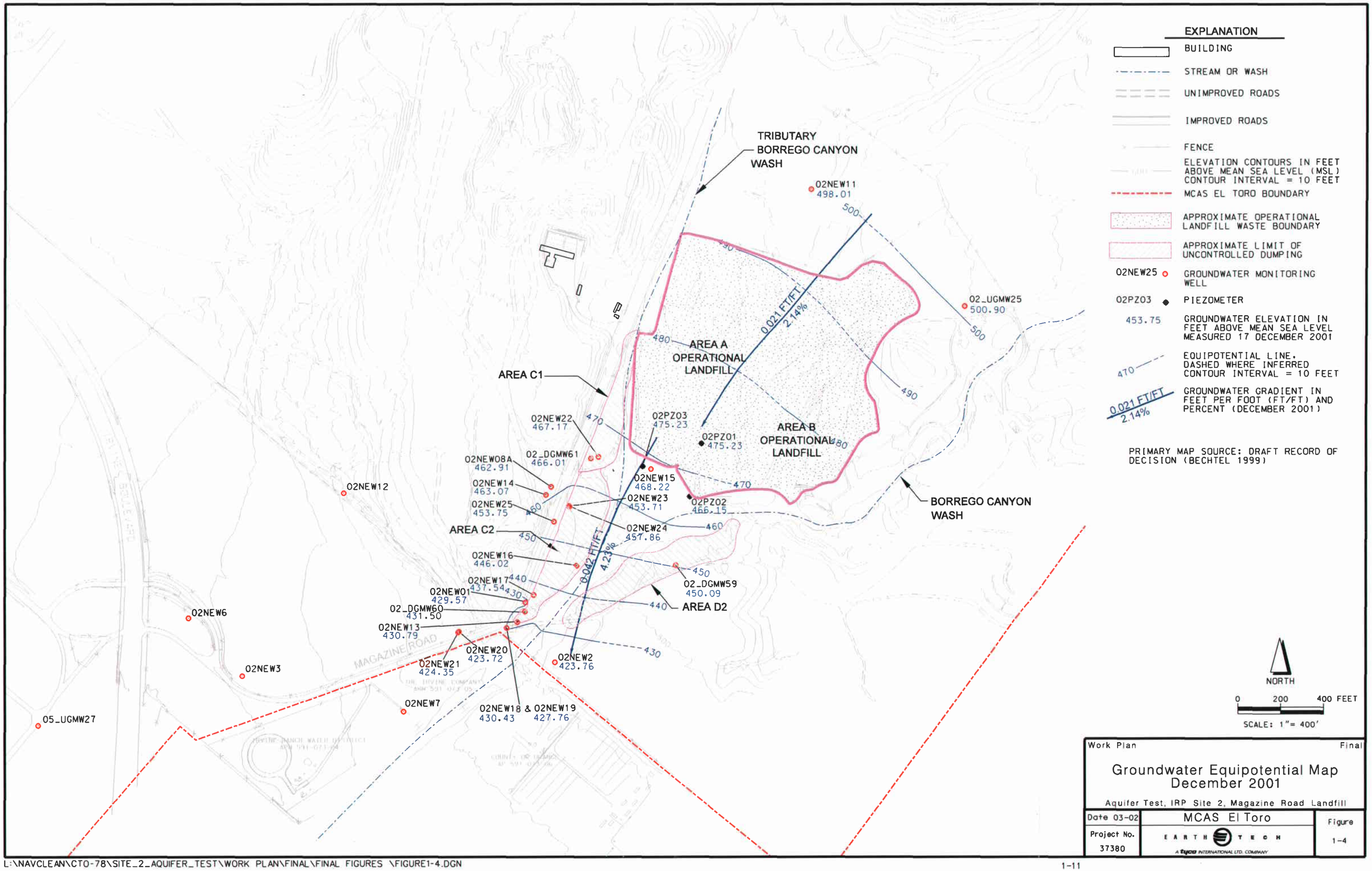

Work Plan — Final

Groundwater Equipotential Map December 2001

Aquifer Test, IRP Site 2, Magazine Road Landfill

Date 03-02	MCAS El Toro	Figure 1-4
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY	

L:\NAVCLEAN\CTO-78\SITE_2_AQUIFER_TEST\WORK PLAN\FINAL\FINAL FIGURES \FIGURE1-4.DGN

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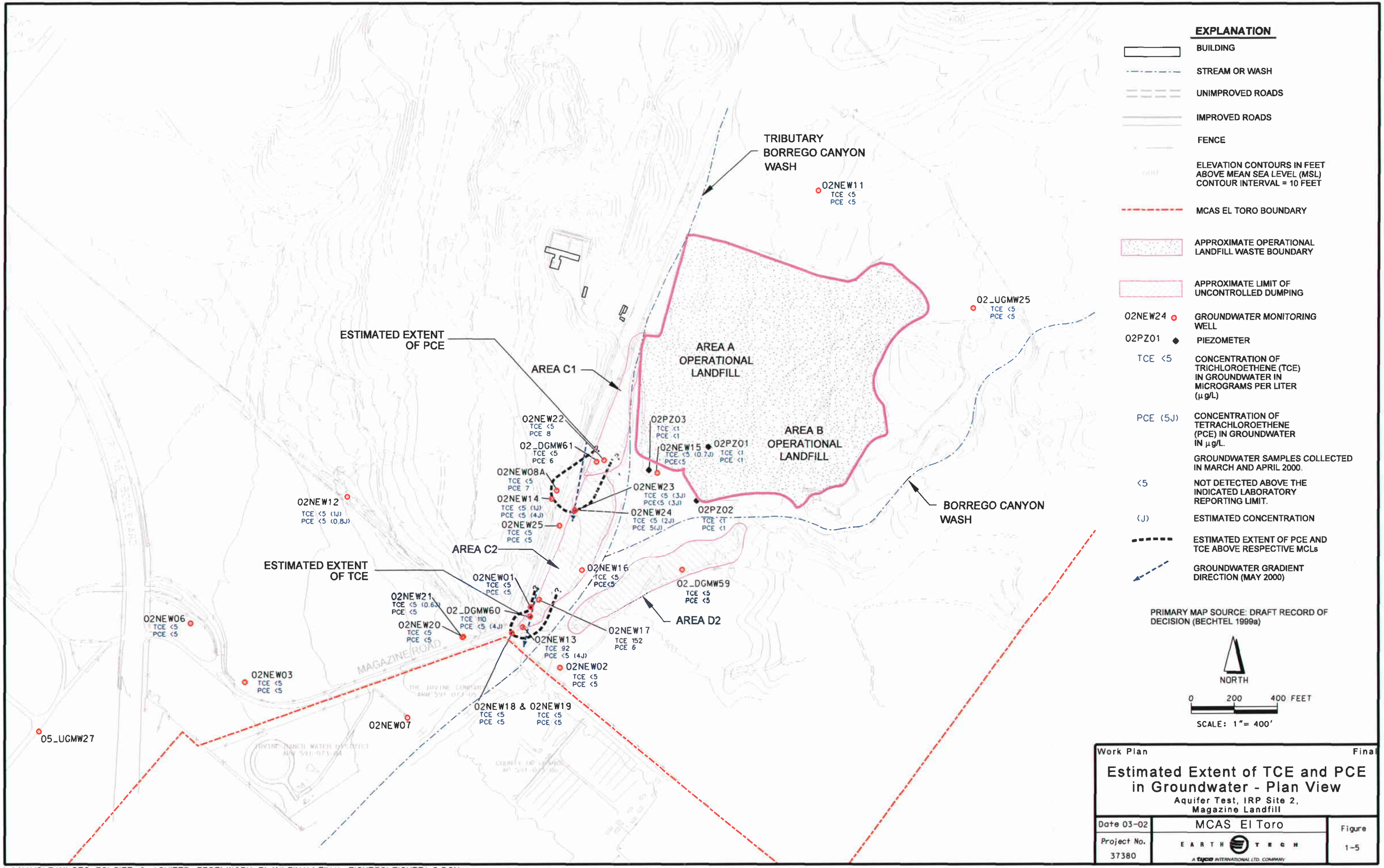

Work Plan — Final

Estimated Extent of TCE and PCE in Groundwater - Plan View

Aquifer Test, IRP Site 2, Magazine Landfill

Date 03-02	MCAS El Toro	Figure 1-5
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY	

L:\NAVCLEAN\CTO-78\SITE_2_AQUIFER_TEST\WORK PLAN\FINAL\FINAL FIGURES\FIGURE1-5.DGN

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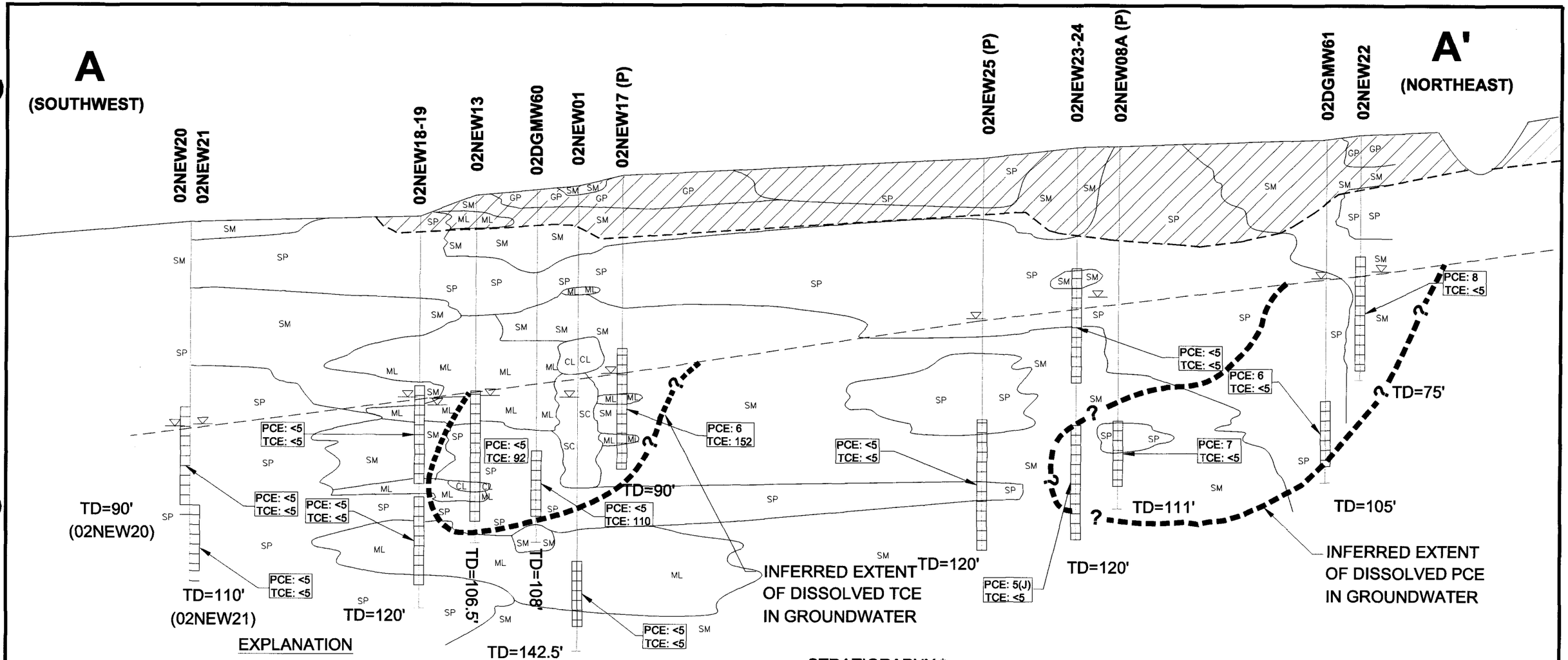


EXPLANATION

02NEW24 MONITORING WELL

(P) INDICATES THE WELL IS PROJECTED ON THE LINE OF THE CROSS-SECTION

SCREENED INTERVAL OF MONITORING WELL

TD=142.5' TOTAL DEPTH OF WELL BORING IN FEET BELOW GROUND SURFACE

STRATIGRAPHIC/LITHOLOGIC CONTACT

FILL MATERIAL

TOP OF GROUNDWATER (MEASURED 22 MAY 2000)

INFERRED GROUNDWATER SURFACE (22 MAY 2000)

PCE: 5(J)
TCE: <5

CONCENTRATION OF TETRACHLOROETHENE (PCE) IN GROUNDWATER IN MICROGRAMS PER LITER (µg/L) (SAMPLES COLLECTED MARCH-APRIL 2000)

CONCENTRATION OF TRICHLOROETHENE (TCE) IN GROUNDWATER IN µg/L (SAMPLES COLLECTED MARCH-APRIL 2000)

<5 NOT DETECTED ABOVE THE INDICATED LABORATORY REPORTING LIMIT

(J) ESTIMATED CONCENTRATION

STRATIGRAPHY *

GP UNDIFFERENTIATED GRAVELLY SAND, GRAVELLY SILTY SAND, GRAVEL, SILTY GRAVEL, AND CLAYEY GRAVEL

SP UNDIFFERENTIATED POORLY GRADED SAND, WELL-GRADED SAND, SANDSTONE, AND CONGLOMERATIC SANDSTONE

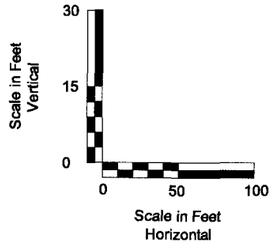
SC UNDIFFERENTIATED CLAYEY SAND AND CLAYEY SANDSTONE

SM UNDIFFERENTIATED SILTY SAND AND SITLY SANDSTONE

ML UNDIFFERENTIATED SANDY SILT, CLAYEY SILT, SILT, SILTSTONE MUDSTONE, SANDY SILTSTONE, AND CLAYEY SILTSTONE

CL UNDIFFERENTIATED SANDY CLAY, CLAYSTONE, AND SILTY CLAYSTONE

* BASED UPON DATA RECORDED ON BORING LOGS DURING DRILLING



Work Plan — Final

Estimated Extent of TCE and PCE in Groundwater Cross-Sectional View

Aquifer Test, IRP Site 2, Magazine Landfill

Date: 03-02	Former MCAS El Toro	Figure
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Table 1-1: Test Durations and Flow Rates

Well	Test Type	Duration[a]	Flow Rate[a] (gpm)
02_DGMW60	Step	35 minutes	1.5
02NEW02	Step	35 minutes	6.5
O2NEW08A	Step	35 minutes	6.0
02NEW13	Step	60 minutes	0.5
02NEW14	Step	45 minutes	16.0
02NEW13	Constant-rate	32 hours	0.3
02NEW14	Constant-rate	72 hours	10.0

Note:
a = represents step with maximum flow rate

1.4.5 Natural Attenuation

An initial evaluation of the potential for natural attenuation was conducted in 1998 (BNI 1998b). A supplemental evaluation conducted during the verification of VOCs in groundwater investigation (Earth Tech 2000) concluded that there is inadequate evidence that anaerobic degradation of TCE and PCE is occurring at the site. The supplemental evaluation was conducted using the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998). However, some of the water quality data used in the study was anomalous. Specifically, high concentrations of dissolved oxygen reported in some of the wells conflict with negative oxidation-reduction potential (ORP) concentrations reported in the same wells. Negative ORP values are indicative of reducing conditions, and reducing conditions are not consistent with high dissolved oxygen. Additionally, cis-DCE, a breakdown product of TCE, was detected in wells 02NEW13 and 02_DGMW60, suggesting that degradation of TCE has occurred. The natural attenuation scoring criteria and tables summarizing the results of the evaluation are provided in Appendix B.

1.4.6 Remedial Options for Groundwater

The FS for IRP Site 2 (BNI 1997) evaluated potential remedies for the impacted groundwater at IRP Site 2, including no action, institutional controls, containment, removal (groundwater extraction), in situ and ex situ treatment, and disposal actions. Based upon this evaluation, the following options were retained for consideration:

- No action
- Compliance monitoring and reporting
- Deed restrictions
- Natural attenuation

Following the evaluation of these options, natural attenuation was selected as the preferred alternative for groundwater at IRP Site 2. However, results of the natural attenuation screening conducted in March 2000 (Earth Tech 2000) yielded inadequate evidence for natural attenuation. Therefore, process options listed in the FS as "retained as potential substitutes or support technology" may need to be evaluated for the groundwater at IRP Site 2. These options are:

- RCRA-type cap (plans are currently underway as a remedy for soil at IRP Site 2),
- Groundwater extraction, treatment, and injection,
- Groundwater extraction, treatment, and surface discharge (irrigation), and
- Dual-phase extraction.

Long-term aquifer tests are required in order to ascertain hydraulic properties and flow capabilities specific to the plume areas and to provide data for the optimization of VOC mass removal. Data collected during the long-term aquifer test will be used during evaluation and selection of a response action for groundwater at IRP Site 2. These data will consist of the following:

- Natural attenuation properties of groundwater (dissolved oxygen and oxygen-reduction potential),
- Concentrations of VOCs in extracted groundwater,
- Long term, sustainable extraction rates, and
- Induced capture zones.

1.6 PROJECT APPROACH

The primary objective of this investigation will be to gather data that will allow the Navy to select the groundwater remedy for IRP Site 2. The Navy will gather additional data for evaluation of natural attenuation and evaluate groundwater extraction.

The data gathering process will be conducted in two phases. The initial phase will include sampling of existing groundwater monitoring wells and piezometers, and collection of hydropunch samples to confirm the extent of the TCE and PCE groundwater plumes. The resulting data will be used to establish baseline conditions prior to aquifer testing. The initial phase will also include collection of dissolved oxygen and oxygen-reduction potential data to supplement the evaluation of natural attenuation.

The second phase will consist of aquifer testing. Aquifer testing will be conducted after the evaluation of baseline conditions has been submitted to the BRAC Cleanup Team (BCT).

Soil remediation at Site 2 will include consolidating historical landfill refuse and capping the old landfill. Wells located in the areas of remediation/consolidation will be decommissioned. With the limited window-of-opportunity, Phase I and Phase II activities are scheduled to proceed back-to-back to facilitate obtaining data before decommissioning these wells.

The sampling design will focus on achieving the following site-specific objectives:

Phase I Objectives

- Confirm and/or delineate the estimated extent of the TCE and PCE groundwater plumes.
- Collect baseline VOC concentration data.
- Collect data to supplement the evaluation of natural attenuation potential for TCE and PCE.

Phase II Objectives

- Evaluate sustainable pumping rates and mass-removal rates specifically within the plume areas.
- Evaluate aquifer response induced by groundwater extraction.
- Quantify aquifer parameters.

2. DATA QUALITY OBJECTIVES

The project work plan has been developed using the EPA seven-step data quality objectives (DQO) process (EPA 2000). DQOs provide a framework for the key decisions about contaminant releases and threats they pose to human health and the environment. Steps 1 through 6 are presented in this section, and Step 7, the sampling design, is presented in the Field Sampling Plan (Section 3.1).

2.1 PROBLEM STATEMENTS

The following statements concisely describe the problem:

VOCs: Previous investigations have indicated concentrations of VOCs in excess of MCLs, primarily TCE and PCE. The lateral and vertical extents of PCE and TCE in the groundwater are partially defined. The VOC 1,4-dioxane has been associated with the presence of chlorinated hydrocarbons at some sites. This investigation will assess whether that correlation exists. Additionally, the previous assessment of the potential for natural attenuation indicated there was inadequate evidence of anaerobic biodegradation of the VOC plumes. Additional evaluation to confirm this previous conclusion is needed.

Aquifer Test: Estimates of hydraulic conductivity have been calculated based on slug tests and step-drawdown tests. Due to the potential need for active remediation of the VOC plumes in groundwater, further evaluation of the hydrogeologic parameters is needed to better understand the effect of groundwater extraction on the VOC plumes, and long-term data regarding sustainable flow rates and mass removal rates are required.

The resultant discharge of test groundwater effluent is governed under CERCLA, and the Department of Navy is not required to obtain a National Pollutant Discharge Elimination System (NPDES) permit. However, the Department of Navy will meet the substantive requirements of the CRWQCB permit for the quality of water discharged. As a courtesy, the CRWQCB will issue a discharge authorization waiver.

2.2 PROJECT DECISION QUESTIONS

The goal of the investigation is to resolve the project decision questions and identify alternative actions that may be taken based on the outcome of the investigation. This work plan was designed to address the following decision questions:

Contaminant (VOCs) Behavior

1. What are the lateral and vertical extents of the VOC plumes at IRP Site 2?

2. What is the potential for natural attenuation of VOCs at IRP Site 2?

Aquifer Characteristics:

3. What are the sustainable pumping rates and capture zones?

4. Will long-term pumping cause a significant reduction in the concentrations and spatial distribution of VOCs dissolved in groundwater?

2.3 DECISION INPUTS

The results of sampling and monitoring performed at IRP Site 2 in the course of this program will be used to resolve the decision questions. The critical data that will serve as input to the decisions are as follows:

VOCs: Samples collected from 23 existing groundwater monitoring wells, three existing piezometers, and eleven proposed hydropunch samples will be analyzed for VOCs and selected natural attenuation parameters. Depth-to-groundwater information will be collected, and the magnitude and direction of the groundwater gradient will be calculated.

Aquifer Test: Data collected during the aquifer test will be analyzed to assess hydrogeologic properties of the aquifer and the induced effects of pumping. Permit requirements are specified by the Regional Board.

The critical data and measurement inputs to the decisions are summarized in Table 2-1.

Table 2-1: Critical Data and Measurement Inputs to Decisions

Decision	Critical Data and Measurement Inputs
Hydrogeologic Properties and Response of Aquifer	Data collected during pumping test
Extent of VOCs in Groundwater	VOC concentrations from groundwater monitoring wells, piezometers, and hydropunch samples
Natural Attenuation Potential	Measurements of dissolved oxygen, oxidation-reduction potential, and concentrations of degradation products.

2.4 BOUNDARIES OF STUDY

The decisions have temporal and physical boundaries that are presented below. Physical boundaries are characterized by the lateral and vertical extent of the scope of the investigation. The vertical extent for groundwater sampling will be up to 250 feet below ground surface (bgs), with the lateral extent defined by monitoring wells 02NEW3 and 02NEW6 (downgradient), 02PZ01 (upgradient), and 02_DGMW59 and 02NEW12 (cross-gradient) (see Figure 1-2). Contaminant plumes are dynamic due to the continuous movement of groundwater. Therefore, the sampling results will be temporally applicable to the period in which the samples are collected.

2.5 DECISION RULES

The following decision rules for IRP Site 2 have been developed from the project decision questions and critical input data and measurements:

VOC Contaminants: Reported concentrations of VOCs in the groundwater will be mapped in plan view and cross section to show their vertical and lateral extent. Select samples will be analyzed for 1,4-dioxane to further characterize the presence of contamination. Groundwater elevation data will be used to establish the magnitude and direction of the groundwater gradient. Selected parameters pertaining to the biodegradation of TCE and PCE in groundwater will be measured. The results of the evaluation will be provided to the BCT members prior to initiating aquifer testing.

> ***If*** the lateral and vertical extent of VOCs in groundwater are sufficiently defined, ***then*** the proposed response actions for the groundwater remedy will be developed. (Decision Question1)

If the potential for natural attenuation exists, ***then*** passive response actions for the remedy of the groundwater will be considered. (Decision Question 2)

Aquifer Test: Data collected from the aquifer tests will be analyzed, and values for transmissivity and storativity will be calculated. Changes in the spatial distribution of the TCE plume caused by pumping will be mapped in plan and cross-sectional views and in time versus concentration graphs.

If the data collected during the aquifer test indicate sufficient sustainable pumping rates and capture zones, ***then*** an active groundwater remediation system may be recommended. (Decision Question 3)

If there is significant reduction in the concentration and a reduction in spatial distribution of VOCs, ***then*** active groundwater remediation may be an appropriate groundwater remedy. (Decision Question 4)

2.6 LIMITS OF DECISION ERROR

The investigation is based on a judgmental sampling design (as opposed to a statistically based design). Sample numbers and corresponding quantitative error estimates as well as statistical quantities to establish variability and the associated area of uncertainty around the decision thresholds are not applicable. Therefore, qualitative assessment of potential decision errors and error tolerances were developed for the decision rules and are presented in Table 2-2. Decision errors will be prevented by adherence to established data collection processes and careful evaluation of data.

Table 2-2: Qualitative Analysis of Decision Errors and Tolerances

Rule	Possible Errors	Associated Consequences	Areas of Uncertainty
VOCs	Overestimation of the lateral and vertical extent of VOCs	Wasted resources as a result of redundant corrective action	Uncertainty associated with measurement of VOC concentrations Uncertainty associated with locating new wells
	Underestimation of the lateral and vertical extent of VOCs	Failure to implement adequate corrective action	Uncertainty associated with measurement of VOC concentrations Uncertainty associated with locating new wells
	Conclusion that natural attenuation potential exists when it does not	Failure to take appropriate corrective action	Uncertainty of the conceptual model and method used to evaluate the potential for natural attenuation
	Conclusion that natural attenuation potential does not exist when it does	Wasted resources as a result of redundant corrective action	Uncertainty of the methods used to measure natural attenuation parameters
Aquifer Test	Incorrect characterization of hydrogeologic properties	Incorrect hydrogeologic properties used to design remediation system	Uncertainty associated with hydrogeologic properties outside the specific areas tested

3. FIELD SAMPLING PLAN

Methodologies and procedures will conform to project standard operating procedures (SOPs) (BNI 1999c). Major deviations from these procedures have not been identified at this time, although the need to modify field activities may arise due to field conditions and observations. Any necessary significant modifications (e.g., changes in equipment, materials, or deletion of a procedural step) will first be discussed with the CTO manager, the CLEAN II Program quality manager, and the Navy Remedial Project Manager (RPM). Upon approval, significant modifications and corresponding justification will be documented in the project report.

3.1 SAMPLING DESIGN FOR IRP SITE 2

A summary of the key elements of the groundwater sampling, aquifer test design, and the logic for selection of specific features is presented here. This section discusses Step 7 of the DQO process, "Optimization of the Design for Obtaining Data."

3.1.1 VOC Extent in Groundwater – Pre-Aquifer Testing

Monitoring well, piezometer, and hydropunch groundwater sampling is proposed for the delineation and characterization of VOCs in groundwater. With the exception of wells 02NEW11, 02_UGMW25, and 05_UGMW27, all existing groundwater monitoring wells and proposed hydropunch locations at IRP Site 2 will be sampled; samples will be analyzed for VOCs in accordance with EPA Method 8260B. The proposed hydropunch locations and existing monitoring wells and piezometers are shown in plan view on Figure 3-1. A cross-sectional view is provided on Figure 3-2 (note that monitoring wells, piezometers, and hydropunch locations that are located cross gradient from the known VOC concentrations are not shown). The proposed hydropunch locations and rationale are summarized in Table 3-1.

Table 3-1: Proposed Hydropunch Locations and Rationale

Well ID	Estimated Depth (ft bgs)	Rationale
02HP01	85	Shallow, upgradient evaluation of TCE
02HP02	80	Shallow, down and cross-gradient evaluation of TCE
02HP03	80	Shallow, cross-gradient evaluation of PCE
02HP04	80	Shallow, cross-gradient evaluation of TCE
02HP05	80	Shallow, cross-gradient evaluation of TCE
02HP06	140	Deep, vertical evaluation of TCE
02HP07	70	Shallow, upgradient evaluation of PCE
02HP08	95	Shallow, cross-gradient evaluation of PCE
02HP09	140	Deep, vertical evaluation of PCE
02HP10	85	Shallow, upgradient evaluation of TCE
02HP11	105	Downgradient evaluation of PCE

Notes:
ft bgs = feet below ground surface
ID = identification

The depths listed above are estimated and may be modified based upon conditions that may be encountered during the investigation, such as permeable zones.

Low concentrations of perchlorate have been reported in groundwater samples from three wells at IRP Site 2 (02_DGMW61 [5 µg/L], 02NEW08A [11, 9, and 8.2 µg/L], and 02NEW16 [3J µg/L]). During the VOC characterization, samples collected in the vicinity of previous perchlorate detections will be analyzed for perchlorate. Samples from 02_DGMW61, 02NEW08A, 02NEW16, and nearby wells 02NEW14, 02NEW22, and 02NEW25 will be analyzed for perchlorate in accordance with EPA Method 314.1.

Because the compound 1,4-dioxane has been associated with chlorinated solvents in groundwater at many sites in California, the sample with the highest chlorinated solvent concentration will also be analyzed for 1,4-dioxane in accordance with EPA Method 8270C.

Draft analytical results (i.e., unvalidated data) from monitoring well and hydropunch groundwater samples will be evaluated and forwarded to the BCT. In addition, the revised analytical results will be forwarded to the BCT following validation.

3.1.2 Potential for Natural Attenuation of VOCs

Dissolved oxygen and ORP data pertaining to the biodegradation of chlorinated solvents in groundwater will be collected from the wells listed in Table 3-2. In addition, detected biodegradation daughter products of PCE and TCE from all monitoring wells, piezometers, and hydropunch groundwater samples will be tabulated. The results will be used to evaluate the potential for natural attenuation of TCE and PCE. The evaluation will be based upon the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998). Previous sampling data from the verification of VOCs in groundwater (Earth Tech 2000) yielded anomalous results for dissolved oxygen and ORP. The measurements of these parameters will be made using downhole sampling equipment in addition to surface flow-through cells. The concentrations of dissolved oxygen and ORP measured downhole will be compared to concentrations measured at the surface. Pumping the water to the surface may alter it's chemistry, leading to the anomalous results previously reported.

Table 3-2: Monitoring Wells for Natural Attenuation Screening

Well ID	Rationale
02_UGMW25	Background (upgradient from existing TCE and PCE plumes)
02NEW20	Downgradient from existing TCE plume
02NEW21	Downgradient from existing TCE plume
02NEW01	Screened below existing TCE plume
02NEW13	Within existing TCE plume
02_DGMW60	Within existing TCE plume
02NEW08A	Within existing PCE plume
02NEW14	Downgradient from existing PCE plume
02_DGMW61	Within existing PCE plume

TRIBUTARY BORREGO CANYON WASH

02NEW11
TCE <5
PCE <5

ESTIMATED EXTENT OF PCE

AREA C1

AREA A FORMER OPERATIONAL LANDFILL

AREA B FORMER OPERATIONAL LANDFILL

02_UGMW25
TCE <5
PCE <5

02HP07/02PZ07

02HP08/02PZ08

02NEW22
TCE <5
PCE 8

02PZ03
TCE <1
PCE <1

02HP09/02PZ09

02_DGMW61
TCE <5
PCE 6

02NEW15
TCE <5 (0.7J)
PCE<5

02PZ01
TCE <1
PCE <1

02NEW08A
TCE <5
PCE 7

02NEW23
TCE <5 (3J)
PCE<5 (3J)

02NEW14
TCE <5 (1J)
PCE <5 (4J)

02NEW24
TCE <5 (2J)
PCE 5(J)

02PZ02
TCE <1
PCE <1

02NEW12
TCE <5 (1J)
PCE <5 (0.8J)

02NEW25
TCE <5
PCE <5

02HP01

02HP03

AREA C2

02HP11

ESTIMATED EXTENT OF TCE

02HP10

02NEW16
TCE <5
PCE<5

02_DGMW59
TCE <5
PCE <5

02NEW01
TCE <5
PCE <5

02HP05/02PZ05

02NEW21
TCE <5 (0.6J)
PCE <5

02_DGMW60
TCE 110
PCE <5 (4J)

AREA D2

02NEW06
TCE <5
PCE <5

02NEW20
TCE <5
PCE <5

02NEW17
TCE 152
PCE 6

02NEW13
TCE 92
PCE <5 (4J)

02HP02

02HP04/02PZ04

02NEW02
TCE <5
PCE <5

02HP06/02PZ06

02NEW03
TCE <5
PCE <5

02NEW18 & 02NEW19
TCE <5
PCE <5

02NEW07

05_UGMW27

BORREGO CANYON WASH

MAGAZINE ROAD

IRVINE RANCH WATER DISTRICT

EXPLANATION

- BUILDING
- STREAM OR WASH
- UNIMPROVED ROADS
- IMPROVED ROADS
- FENCE
- ELEVATION CONTOURS IN FEET ABOVE MEAN SEA LEVEL (MSL) CONTOUR INTERVAL = 10 FEET
- MCAS EL TORO BOUNDARY
- APPROXIMATE BOUNDARY OF FORMER OPERATIONAL LANDFILL
- APPROXIMATE LIMIT OF UNCONTROLLED DUMPING
- 02NEW24 ○ GROUNDWATER MONITORING WELL
- 02PZ01 ◆ PIEZOMETER
- TCE <5 CONCENTRATION OF TRICHLOROETHENE (TCE) IN GROUNDWATER IN MICROGRAMS PER LITER (µg/L)
- PCE 5(J) CONCENTRATION OF TETRACHLOROETHENE (PCE) IN GROUNDWATER IN µg/L.
- GROUNDWATER SAMPLES COLLECTED IN MARCH AND APRIL 2000.
- <5 NOT DETECTED ABOVE THE INDICATED LABORATORY REPORTING LIMIT.
- (J) CONCENTRATION REPORTED AT OR NEAR THE LABORATORY REPORTING LIMIT.
- ESTIMATED EXTENT OF PCE AND TCE ABOVE RESPECTIVE MCLs
- 02HP08▼ PROPOSED HYDROPUNCH GROUNDWATER SAMPLING LOCATION
- 02PZ06▼ PROPOSED PIEZOMETER
- GROUNDWATER GRADIENT DIRECTION (MAY 2000)

PRIMARY MAP SOURCE: DRAFT RECORD OF DECISION (BECHTEL 1999a)

NORTH

0 200 400 FEET

SCALE: 1"= 400'

Work Plan — Final

Proposed Hydropunch Groundwater Sampling Locations - Plan View

Aquifer Test, IRP Site 2, Magazine Road Landfill

Date 03-02	MCAS El Toro	Figure 3-1
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY	

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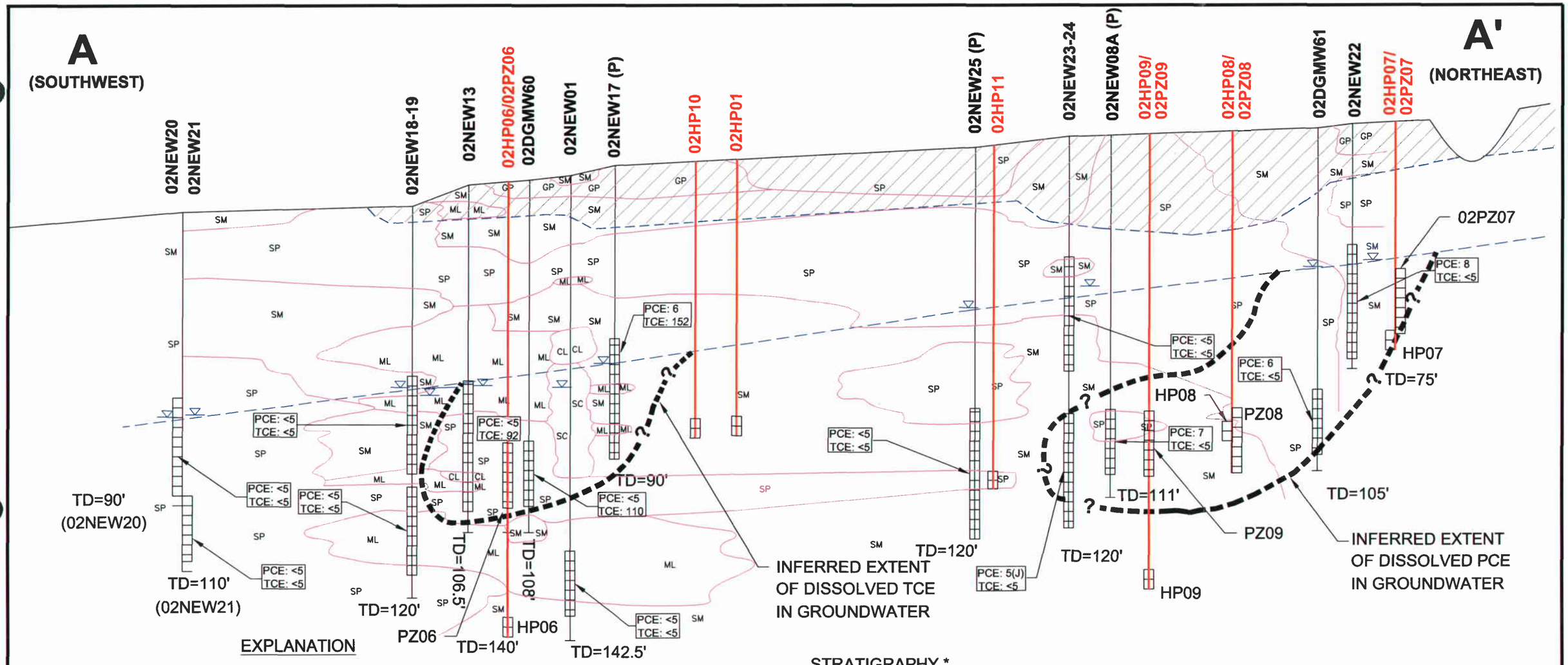
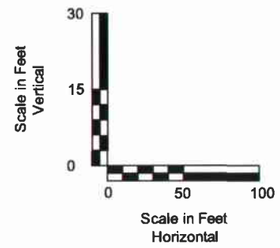


EXPLANATION

- **02NEW24** MONITORING WELL
- **02HP10** HYDROPUNCH SAMPLING LOCATION
- **02PZ06** TEMPORARY PIEZOMETER
- **(P)** INDICATES THE WELL IS PROJECTED ON THE LINE OF THE CROSS-SECTION
- SCREENED INTERVAL OF MONITORING WELL
- **TD=142.5'** TOTAL DEPTH OF WELL BORING IN FEET BELOW GROUND SURFACE
- STRATIGRAPHIC/LITHOLOGIC CONTACT
- FILL MATERIAL
- TOP OF GROUNDWATER (MEASURED 22 MAY 2000)
- INFERRED GROUNDWATER SURFACE (22 MAY 2000)
- PCE: 5(J) / TCE: <5 — CONCENTRATION OF TETRACHLOROETHENE (PCE) IN GROUNDWATER IN MICROGRAMS PER LITER (µg/L) (SAMPLES COLLECTED MARCH-APRIL 2000)
- CONCENTRATION OF TRICHLOROETHENE (TCE) IN GROUNDWATER IN µg/L (SAMPLES COLLECTED MARCH-APRIL 2000)
- <5 NOT DETECTED ABOVE THE INDICATED LABORATORY REPORTING LIMIT
- (J) ESTIMATED CONCENTRATION

STRATIGRAPHY *

- GP UNDIFFERENTIATED GRAVELLY SAND, GRAVELLY SILTY SAND, GRAVEL, SILTY GRAVEL, AND CLAYEY GRAVEL
- SP UNDIFFERENTIATED POORLY GRADED SAND, WELL-GRADED SAND, SANDSTONE, AND CONGLOMERATIC SANDSTONE
- SC UNDIFFERENTIATED CLAYEY SAND AND CLAYEY SANDSTONE
- SM UNDIFFERENTIATED SILTY SAND AND SITLY SANDSTONE
- ML UNDIFFERENTIATED SANDY SILT, CLAYEY SILT, SILT, SILTSTONE MUDSTONE, SANDY SILTSTONE, AND CLAYEY SILTSTONE
- CL UNDIFFERENTIATED SANDY CLAY, CLAYSTONE, AND SILTY CLAYSTONE
- * BASED UPON DATA RECORDED ON BORING LOGS DURING DRILLING



Work Plan — Final

Proposed Hydropunch Groundwater Sampling Locations Cross-Section View

Aquifer Test, IRP Site 2, Magazine Landfill

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3.1.3 Aquifer Test

An aquifer test using six existing groundwater monitoring wells (02NEW08A, 02NEW13, 02NEW17 02NEW22, 02_DGMW60 and 02_DGMW61) is proposed.

The proposed extraction and observation wells, pumping scenario, and approximate distances from pumping to observation wells are summarized in Table 3-3. The proposed pumping wells were selected based on their locations and screens within the TCE and PCE plumes. Well 02NEW08A was selected because it has a higher PCE concentration and is relatively higher yielding (5 to 6 gpm) compared to other wells in the vicinity of the PCE plume. The observation points were chosen based on direction and distance from the test wells. The proposed extraction sequence is from the highest to lowest anticipated flow rate.

Step-drawdown tests will be conducted on 02_DGMW61, 02NEW22, and 02NEW17 prior to conducting the constant-rate aquifer tests. Based on the results of the step-drawdown tests, the order of the pumping sequence may be changed to maintain the highest yielding to lowest yielding sequence.

Table 3-3: Proposed Extraction and Observation Wells

Observation Well ID	Pumping Well ID					
	PCE Plume Area			TCE Plume Area		
	First Pumping Well PCE Plume 02NEW08A	Second Pumping Well PCE Plume 02_DGMW61	Third Pumping Well PCE Plume 02NEW22	First Pumping Well TCE Plume 02_DGMW60	Second Pumping Well TCE Plume 02NEW17	Third Pumping Well TCE Plume 02NEW13
02NEW08A	0 feet	230 feet				
02NEW13				60 feet		0 feet
02NEW17				90 feet	0 feet	
02NEW22		40 Feet	0 feet			
02_DGMW60				0 feet	90 feet	60 feet
02_DGMW61	230 feet	0 feet	40 feet			
02NEW01				50 feet	50 feet	
02NEW02						255 feet
02NEW14	50 feet					
02NEW16					245 feet	
02NEW18				115 feet		55 feet
02NEW19				115 feet		55 feet
02NEW20				325 feet		280 feet
02NEW21				325 feet		280 feet
02NEW23	130 feet					
02NEW24	130 feet					
02NEW25	165 feet					
02PZ04				105 feet	120 feet	140 feet
02PZ05				75 feet	135 feet	75 feet
02PZ06				40 feet	80 feet	80 feet

Observation Well ID	Pumping Well ID					
	PCE Plume Area			TCE Plume Area		
	First Pumping Well PCE Plume 02NEW08A	Second Pumping Well PCE Plume 02_DGMW61	Third Pumping Well PCE Plume 02NEW22	First Pumping Well TCE Plume 02_DGMW60	Second Pumping Well TCE Plume 02NEW17	Third Pumping Well TCE Plume 02NEW13
02PZ07		85 feet	60 feet			
02PZ08	155 feet	135 feet	170 feet			
02PZ09	100 feet	165 feet	190 feet			

Notes:
The selected wells and pumping sequence will be reevaluated after the baseline sampling results have been reviewed.
The given distance indicates the separation between the observation well and the active pumping well.
PCE = tetrachloroethene
TCE = trichloroethene

Based upon previously reported aquifer test results, extraction rates are anticipated to range from less than 1 gpm to approximately 10 gpm; however, long-term yields are unknown.

During the aquifer test, groundwater elevation data will be collected from the following:

- All six pumping wells,
- Monitoring wells 02NEW01, 02NEW02, 02NEW14, 02NEW16, 02NEW18, 02NEW19, 02NEW20, 02NEW21, 02NEW23, 02NEW24, and 02NEW25, and
- Temporary piezometers 02PZ04, 02PZ05, 02PZ06, 02PZ07, 02PZ08, and 02PZ09.

The temporary piezometers (02PZ04, 02PZ05, 02PZ06, 02PZ07, 02PZ08, and 02PZ09) will be installed at hydropunch locations 02HP04, 02HP05, 02HP06, 02HP07, 02HP08, and 02HP09. Piezometer construction details are summarized in Table 3-4. The piezometers are necessary to measure groundwater changes perpendicular to the alignment of the extraction wells and decrease the distance between extraction and observation points. Elevation data will be collected in the pumping wells and nearby observation wells using water level transducers equipped with data recorders. Water level sounders will be used for wells further from the pumping wells. Water level transducers will be installed one week prior to commencement of the first pumping test.

Table 3-4: Construction Details of Proposed Piezometers

Piezometer ID	Borehole Diameter (inches)	Total Depth (feet bgs)	Casing Diameter (inches)	Screened Interval (feet bgs)	Slot Size (inches)
02PZ04	1.75	100	0.75	80–100	0.01
02PZ05	1.75	100	0.75	80–100	0.01
02PZ06	1.75	140	0.75	80–100	0.01
02PZ07	1.75	70	0.75	45–65	0.01
02PZ08	1.75	105	0.75	85–105	0.01
02PZ09	1.75	140	0.75	85–105	0.01

Notes:
Proposed depths and screened intervals are subject to change based upon field conditions.
bgs = below ground surface
ID = identification

The aquifer test will begin by pumping from two wells, one located in the TCE plume and one in the PCE plume. Pumping will continue until steady state conditions are achieved within each plume, then pumping from a second well at each plume location will be initiated until steady state conditions are again reached, then pumping from a third well at each plume location will be initiated.

A total pumping duration of six months is proposed in order to allow for the development of steady state conditions. The extended test duration will provide data for accurate characterization of aquifer characteristics, boundary conditions and effects, and computation of induced capture zones.

Groundwater samples will be collected weekly during the first month of operation (for each well) and biweekly thereafter, subject to adjustment based upon observed results. The analytical results will provide a measure of the rate of VOC removal, treatment requirements of extracted groundwater, and the effects of groundwater extraction on the VOC plumes.

3.1.4 VOC Extent in Groundwater – Post-Aquifer Test

When groundwater levels have recovered to pre-test conditions, all monitoring wells (except wells 02NEW11 and 02_UGMW25) will be sampled and analyzed for VOCs. The sample with the highest chlorinated solvent concentration will also be analyzed for 1,2-dioxane. Post-test analytical results will be compared with the baseline VOC concentrations collected prior to aquifer testing in order to assess the effect of pumping on the VOC plume distribution.

3.2 DATA COLLECTION

Data will be collected in accordance with the SOPs in the *Navy Clean II Program Procedures Manual* (BNI 1999c), and will include applicable documentation, data review, validation, and technical oversight. Details of these procedures are presented in the following sections.

Proposed field activities include the following:

- Groundwater sampling
- Sample handling, storage, and shipping
- Subsurface clearance
- Hydropunch groundwater sampling
- Piezometer construction
- Aquifer testing
- Groundwater sampling

Although some tasks may be performed concurrently, field sampling tasks will be performed in the general order presented below.

3.2.1 Groundwater Sampling

The physical and chemical properties listed in Table 3-5 will be assessed in accordance with CLEAN SOP 8, *Groundwater Sampling* (BNI 1999c). The dissolved oxygen and ORP measurements will be taken prior to purging the well and during sampling.

Table 3-5: Monitoring Parameters

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

The field crew will collect groundwater samples from each well in accordance with the SOP. The samples will be analyzed for the constituents listed in Table 3-6.

Table 3-6: Groundwater Sampling Summary

Analytes	Analytical Method	Number of Samples			
		Field Samples	Field Duplicates	Equipment Rinsates [a]	Total
Pre-Test Baseline Sampling					
VOCs – Target	SW8260B [b]	36	4	10	50
1,4-Dioxane	SW8270C [b]	1	1	-	2
Perchlorate	EPA 314	6	1	-	7
Aquifer Test Samples [c]					
VOCs – Target analytes	SW8260B [b]	36	6	-	42
Treatment System Samples					
VOCs – discharge compliance [d]	SW8260B [b]	27	3	-	30
TPH [e]	8015M	3	1	-	4
General chemistry [e]	Various	3	1	-	4
Post-Test Sampling					
VOCs	SW8260B [b]	26	3	10	39
1,4-Dioxane	SW8270C [b]	1	1	-	1
Perchlorate	EPA 314	6	1	-	1

Notes:
[a] Based on the estimated number of sampling days
[b] EPA Methods for Solid Waste (EPA 2002b)
[c] Samples will be collected weekly during the first month of operation (from each pumping well), and biweekly thereafter
[d] Sampled weekly, Site 16 waste discharge requirements (WDR) requirement
[e] Sampled Quarterly, Site 16 WDR requirement

3.2.2 Subsurface Clearance

Project personnel will perform an evaluation of records prior to the preliminary selection of hydropunch locations. The evaluation will include a review of available site plans, utility layouts, construction as-built drawings, and results of previous subsurface investigations, and coordination with the Certified Safety Officer and caretaker staff. This survey will be conducted prior to drilling or sampling. In addition, a geophysical survey will be conducted prior to any intrusive activities.

3.2.3 Hydropunch Groundwater Sampling

Proposed hydropunch sampling locations are shown on Figure 3-1. In areas where lithology has not been adequately defined, the lithology will be evaluated using cone penetrometer testing (CPT) technology. A second push will then be required for groundwater sampling. In locations where lithology has been adequately identified, only one push for groundwater sampling will be conducted. All equipment will be decontaminated before each use, in accordance with CLEAN SOP 11, *Decontamination of Equipment* (BNI 1999c), and Section 3.4 of this document.

The hydropunch sampler will be advanced to the specified sampling depth based on the CPT data and/or correlation with lithology described in the cross sections. The push rods will then be raised, exposing the hydropunch screen. A groundwater sample will be extracted by lowering a disposable bailer through the push rods. The groundwater sample will be decanted into laboratory-supplied containers and submitted for analysis of VOCs in accordance with EPA Method 8260B. Sample handling procedures outlined in Section 3.3 will be followed.

3.2.4 Piezometer Construction

Six hydropunch boreholes (02HP04, 02HP05, HP0206, 02HP07, 02HP08, and HP0209) will be converted to temporary piezometers 02PZ04, 02PZ05, 02PZ06, 02PZ07, 02PZ08, and 02PZ09, and used to monitor groundwater elevations during the pumping tests. Each piezometer will consist of 0.75-inch polyvinyl chloride (PVC) casing and screen (0.010-inch slot size). After pushing to the specified depth, the PVC casing and screen will be assembled and lowered through the CPT push rods. After the casing and screen are in place, the push rods will be removed, exposing the casing and screen to the aquifer. A gravel pack around the casing will not be installed. A sanitary seal will be placed around the upper five feet of casing.

A temporary wellhead will be installed at the ground surface and completed with protective casing or a monument riser installed around the top of the well casing within a cement surface seal. The monument will extend at least 18 inches above grade and will have at least 2 inches of clearance between the top of the well casing and the lid of the monument. A 2-foot-by-2-foot cement pad that gently slopes away from the well and is at least 3 inches deep will be constructed around the protective casing. A slip cap or locking cap will be installed at the top of the well casing. The monument will be fitted with a case-hardened lock to prevent unauthorized entry.

Piezometer location surveys will be conducted by a California-registered land surveyor for horizontal location to the nearest 0.1 foot and for vertical location to the nearest 0.01 foot referenced to mean sea level (MSL). The vertical elevation will be surveyed at a notch cut in the top of the well casing, typically on the north side of the well. All water level measurements will be made from this point. The elevation of the ground surface adjacent to the monitoring well will be surveyed to the nearest 0.01 foot. Horizontal locations and ground surface elevations of the five remaining hydropunch locations will also be surveyed.

Records for the piezometers detailing the timing, amount of materials, and methods of installation and construction will be prepared by the field manager during installation. These records will be kept in a hardbound field notebook that will be forwarded to the CTO manager. Records will be filled out with indelible ink. Construction records will include the date, time, and quantities of materials used at each stage. A complete listing of the stages of construction is provided in CLEAN SOP 5, *Monitoring Well Installation and Development* (BNI 1999c).

3.2.5 Aquifer Test

The aquifer test will include the following:

1. Water level transducers will be installed in the six extraction wells, the six proposed temporary piezometers, and monitoring wells 02NEW01, 02NEW14, 02NEW18, 02NEW19, 02NEW23, 02NEW24, and 02NEW25. Data loggers will be connected to the transducers to record water levels at a user-specified logarithmic schedule that allows for shorter time-interval measurements at the beginning of the test and progressively longer intervals as the test progresses. Groundwater elevations from the remaining monitoring wells will be collected on a weekly basis using water level sounders.
2. Groundwater elevations will be monitored for one week in the extraction and observation wells prior to pumping to establish atmospheric and temporal changes. This data will be used to calibrate water level measurements recorded during pumping.
3. Water level measurements will be taken periodically with a water level sounder to confirm the accuracy of the water level transducers.
4. Step-drawdown tests will be conducted on each extraction well. Recovery rates will be monitored.
5. Following rebound from the initial step-drawdown tests, pumping will begin with wells 02_DGMW60 and 02NEW08A. The pumping rate will begin at a rate determined during the step-drawdown test.
6. After steady-state conditions are reached, collected data will be used to evaluate whether, given the time constraints, it will be practical to conduct separate pump tests on each well prior to conducting the sequential multiple well test. If practical, separate pump tests will be conducted on each well. However, if the data indicate that, given the time required to rebound to initial conditions prior to each test, there will not be time to conduct both the separate and multiple well tests, the sequential multiple well tests will proceed as originally planned.
7. Pumping will then be initiated on the second extraction well within each plume (02NEW17 and 02_DGMW61). Drawdown will be monitored until steady-state conditions are achieved. After steady-state conditions are reached again, pumping will be initiated on the third extraction well within each plume (02NEW13 and 02NEW22). Groundwater elevation data will be regularly collected from the data loggers and evaluated. Pumping will be increased until the maximum flow is achieved while maintaining sufficient head above the pump intake.
8. Groundwater samples will be collected from the pumping wells for VOC analysis on a weekly basis during the first month of operation and biweekly thereafter. The sampling frequency will be subject to change based upon observed results.
9. After the pumps are turned off, a recovery test will begin. Recovery will continue until groundwater levels reach static conditions or 90 percent of static conditions.
10. Extracted groundwater will be temporarily stored in a holding tank, treated using granular activated carbon, and discharged into another holding tank. Details of the proposed treatment system and monitoring activities are described in Appendix C.

3.2.6 Groundwater Sampling

Following the completion of the aquifer tests, all groundwater monitoring wells (except wells 02NEW11 and 02_UGMW25 and piezometers) will be sampled for VOC analysis. Groundwater sampling will be conducted as described in Section 3.2.1.

3.3 SAMPLE HANDLING

Table 3-7 outlines the chemical parameters to be tested and the types of containers and preservation method to be used. These may be modified to accommodate selected laboratory preferences, but will meet the essential requirements of the method.

Table 3-7: Requirements for Sample Preservation, Maximum Holding Time, and Containers

Analyte	Analytical Method(s)	Preservation	Maximum Holding Time	Number × Sample Container Type [a]
Total Volatile Petroleum Hydrocarbons	SW5030B/ SW8015B	HCl to pH<2 Cool to 4°C	14 days [b]	Three 40-mL VOC w/ Teflon-lined septa
Volatile Organic Compounds	SW5030B/ SW8260B	HCl to pH<2 Cool to 4°C	14 days [b]	Three 40-mL VOC w/ Teflon-lined septa
Total Extractable Petroleum Hydrocarbons	SW3520C/ SW8015B	Cool to 4°C	7 days [c]/40 days [d]	Two 1-L amber glass
Semivolatile Organic Compounds	SW3520C/ SW8270C	Cool to 4°C	7 days [c]/40 days [d]	Two 1-L amber glass
Inorganic Nitrogen	WW 350, WW352	H_2SO_4 to pH<2, Cool to 4°C	28 days [b]	1 500-mL plastic
Solids	WW 160.1, WW160.1	Cool to 4°C	7 days [b]	1 500-mL plastic
Perchlorate	EPA314.1	Cool to 4°C	28 days [b]	1 500-mL plastic
Sulfide	WW 376	Zinc acetate, NaOH to pH>10	7 days [b]	1 500-mL plastic

Notes:
°C = degrees Celsius
L = Liter; mL = milliliter
HCl = hydrochloric acid
H_2SO_4 = sulfuric acid

[a] Sample container volumes may be modified to meet laboratory specific procedures.
[b] From sample collection to analysis.
[c] From sample collection to extraction.
[d] From sample extraction to analysis.

3.3.1 Sample Designation

Sample containers will be labeled as follows:

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

EPA Sample ID Number. To facilitate data tracking and storage, all samples will be labeled with a five-character sample ID number, referred to as an EPA ID, in accordance with recordkeeping, sample labeling, and chain-of-custody (COC) procedures. The ID number for CTO 0078 is determined as follows:

LFzzz

Where

L	The Long Beach office
F	CTO-78
zzz	Chronological number, starting with 001

For example, the EPA number "LF030" would represent the 30th sample collected for the MCAS El Toro investigation, a project managed by Earth Tech's Long Beach office. Quality control (QC) samples will be included in the chronological sequence. If a sample is lost during shipping, a replacement sample will be assigned a new EPA number. If different containers for the *same* sample are shipped to the laboratory on different days, a new EPA number must be assigned. All sample identification numbers will be recorded in field logs, records, and a database to ensure traceability of the sample to the designated location or site.

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

#-bbcc-dee-Dfff

Where

#	IRP Site number (02)
bb	Sample type and matrix (see Table 3-8)
cc	Location number (e.g., 02_DGMW60)
d	Sample or QC identifier (see Table 3-9)
ee	Chronological sample number from a particular sampling location (e.g., 01, 02, 03, etc.)
D	The letter "D" denoting depth
fff	Depth of sample in feet bgs. For field blanks and equipment rinsates, the depth field will contain the month and date of collection.

Table 3-8: Earth Tech Sample ID Character Identifiers

Identifier	Sample Type	Matrix
GW	Groundwater Well	Water
QW	Field QC	Water

Table 3-9: Earth Tech Sample ID QC Identifiers

Identifier	QC Sample Type	Description
S	Normal Sample	All non-field QC Samples
D	Duplicate	Field Duplicate

Identifier	QC Sample Type	Description
E	Equipment Rinsate	Water
F	Field Blank	Water

3.3.2 Sample Custody

All samples will be recorded on COC forms in accordance with CLEAN SOP 10, *Sample Custody, Transfer, and Shipment* (BNI 1999c). Samples will be shipped or delivered to the analytical laboratory within 24 hours.

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

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

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

3.4 EQUIPMENT DECONTAMINATION

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

All consumable equipment (e.g., gloves, disposable bailers) and liquid and solid wastes (e.g., purged groundwater, decontamination water, soil cuttings) will be treated as potentially hazardous and discarded in accordance with the procedures prescribed in Section 3.5.

The field team will perform personnel decontamination prior to leaving the work site at the conclusion of each workday, following procedures described in the Draft *Addendum 1 to the Health and Safety Plan (HSP)* (Earth Tech 2001c).

3.5 INVESTIGATION-DERIVED WASTE

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

- Spent activated carbon
- Purged groundwater
- Decontamination water
- Disposable personnel protection and sampling equipment

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

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

Spent Activated Carbon. Spent activated carbon from the groundwater treatment process will be properly disposed of. The carbon will be contained in appropriate containers and transported off site by a disposal contractor.

Decontamination Water and Purged Groundwater. Non-disposable sampling equipment and personal protective equipment (PPE) will be cleaned and decontaminated between each sampling or activity location, as appropriate, in accordance with the procedures described in Section 3.4. Decontamination water will be collected in troughs or buckets. Collected decontamination water will be transferred daily to DOT-approved 55-gallon drums. Drums containing liquid IDW will be left with a headspace of 5 percent by volume to allow for expansion of the liquid and volatile contaminants. The drums will be labeled with the date and contents, in accordance with CLEAN SOP 22, *Investigation-Derived Waste Management* (BNI 1999c). Drums containing IDW will be inventoried daily, stored on pallets at a designated staging area, and covered with tarps. Decontamination water will be transferred into the 20,000-gallon influent tank and treated along with extracted groundwater generated during aquifer testing.

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

IDW Disposal Plan. A disposal contractor will dispose of all IDW within 90 calendar days of completing the field activities. Should hazardous waste disposal be required, an IDW disposal plan for appropriate screening, sampling, chemical analysis, and disposal of the waste will be prepared. Based on the results of previous assessments of the site, it is not anticipated that hazardous waste will be generated; therefore, an IDW disposal plan has not been prepared to date.

3.6 FIELD QUALITY CONTROL

Project data quality will be assured through internal (field and laboratory) and external (second-party review and validation) processes designed to meet the DQOs. To ensure sample quality, only personnel trained in sampling techniques will collect samples. Standard sample collection procedures will be followed. Field logs and notes will be reviewed by a second party in accordance with CLEAN SOP 17, *Logbook Protocols* (BNI 1999c). Quality control samples such as field duplicates, field blanks, and equipment rinsate samples will be collected to ensure that field samples are representative.

Field Duplicates. Groundwater replicates will be collected at the frequency listed in Table 3-6. Field duplicates or replicates will be evaluated qualitatively to assess the reproducibility of the sample-collection procedures. The results of the analyses will be compared to laboratory criteria to assess whether the results demonstrate that the error inherent in the sampling procedures is within the expected analytical error.

If field duplicate data exceed the laboratory analytical error criteria, then further evaluation of sample collection procedures, laboratory sub-sampling procedures, analytical results, and other sample results will be conducted. The findings of the additional review will be included in the data quality assessment section of the report, which will include a discussion of the effect of the discrepancy on the ability to make decisions based on the data.

Field Blanks. A single field blank per water source will be collected to measure potential contamination resulting from the water used for the final rinse in the decontamination process. An ambient field blank will be collected to evaluate potential VOC contamination from ambient conditions. Analytes detected in field blanks will be compared to analytes in equipment rinsates and analytes found in samples. The effect of the presence of the analytes in the field blanks will be discussed in the QAPP (Section 4).

Equipment Rinsates. Equipment rinsates will be collected during each sampling event to assess possible contribution of analytes from reusable sample-collection equipment. Final rinse water from the decontamination process will be poured through clean equipment, collected, and submitted for analysis of target analytes for that day.

3.7 INSPECTION AND ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Supplies and consumables are items necessary to support sampling and analysis. The acceptance criteria listed in Table 3-10 ensures that they are of acceptable quality.

Table 3-10: Acceptance Criteria for Common Supplies and Consumables

Item	Minimum Acceptance Criteria
Water sample preservatives	Sample preservatives will be at least pesticide grade or equivalent.
Decontamination water —Deionized/Potable	Deionized water, and if necessary potable water, will be analyzed via field blanks for possible contamination. Field blanks will be analyzed once per sampling event for each water source.
Sample bottles	New, unused bottles with certificates of analysis from the vendor.

3.8 LABORATORY ANALYSIS

Samples collected during this investigation will be analyzed as shown in Table 3-6. Methods selected are based on the data quality requirements of the project and current technology. Target analytes will be analyzed in accordance with the methods specified.

4. QUALITY ASSURANCE PROJECT PLAN

The QAPP for the groundwater sampling and aquifer test at IRP Site 2 of the former MCAS El Toro has been prepared in accordance with the requirements and specifications of the following:

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

  EWI #1 "Chemical Data Validation" (SWDIV 1999)
  EWI #2 "Review, Approval, Revision, and Amendment of Field Sampling Plan and Quality Assurance Project Plan" (SWDIV 1999)
  EWI #3 "Laboratory Quality Assurance Program" (SWDIV 1999)

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

4.1 PROJECT MANAGEMENT

The project is managed in accordance with the contract requirements and specifications in CTO no. 0078 of the CLEAN II program, contract number N62742-94-D-0048.

4.1.1 Task Organization

Tasks associated with the investigation are summarized in Table 4-1 and described in the following subsections.

Table 4-1: Task Summary

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

Note:
SOW = statement of work

4.1.1.1 DATA REVIEW AND PROJECT PLANNING

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

4.1.1.2 FIELD ACTIVITIES

Field activities include collecting groundwater samples from 11 hydropunch locations, converting 6 of the hydropunch locations to piezometers, sampling 23 groundwater monitoring wells and piezometers, conducting a long-term aquifer test on six groundwater monitoring wells, and conducting post-aquifer test groundwater sampling. The IT Group will supply the following field support for this project:

- Monitoring Well Sampling

- Subsurface clearance
- Cone Penetrometer Testing/Hydropunch groundwater sampling
- Install pumps for aquifer tests
- Install treatment system for extracted groundwater
- Conduct step-drawdown and constant-rate aquifer testing
- Handling of IDW

4.1.1.3 Data Evaluation and Report Preparation

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

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

Data collected during fieldwork and pertinent previously reported data will be evaluated and presented in a technical memorandum. The technical memorandum will provide the results of the data collection and evaluation, including the following:

- The extent of the TCE and PCE groundwater plumes
- The potential for natural attenuation
- Aquifer characteristics and response of the TCE groundwater plume to groundwater pumping
- Recommendations regarding supplemental activities for IRP Site 2

4.1.1.4 Meetings

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

4.1.1.5 Purchasing Support

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

4.1.1.6 Project Management

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

4.1.2 Project Organization

The project organization chart (Figure 4-1) identifies project team members.

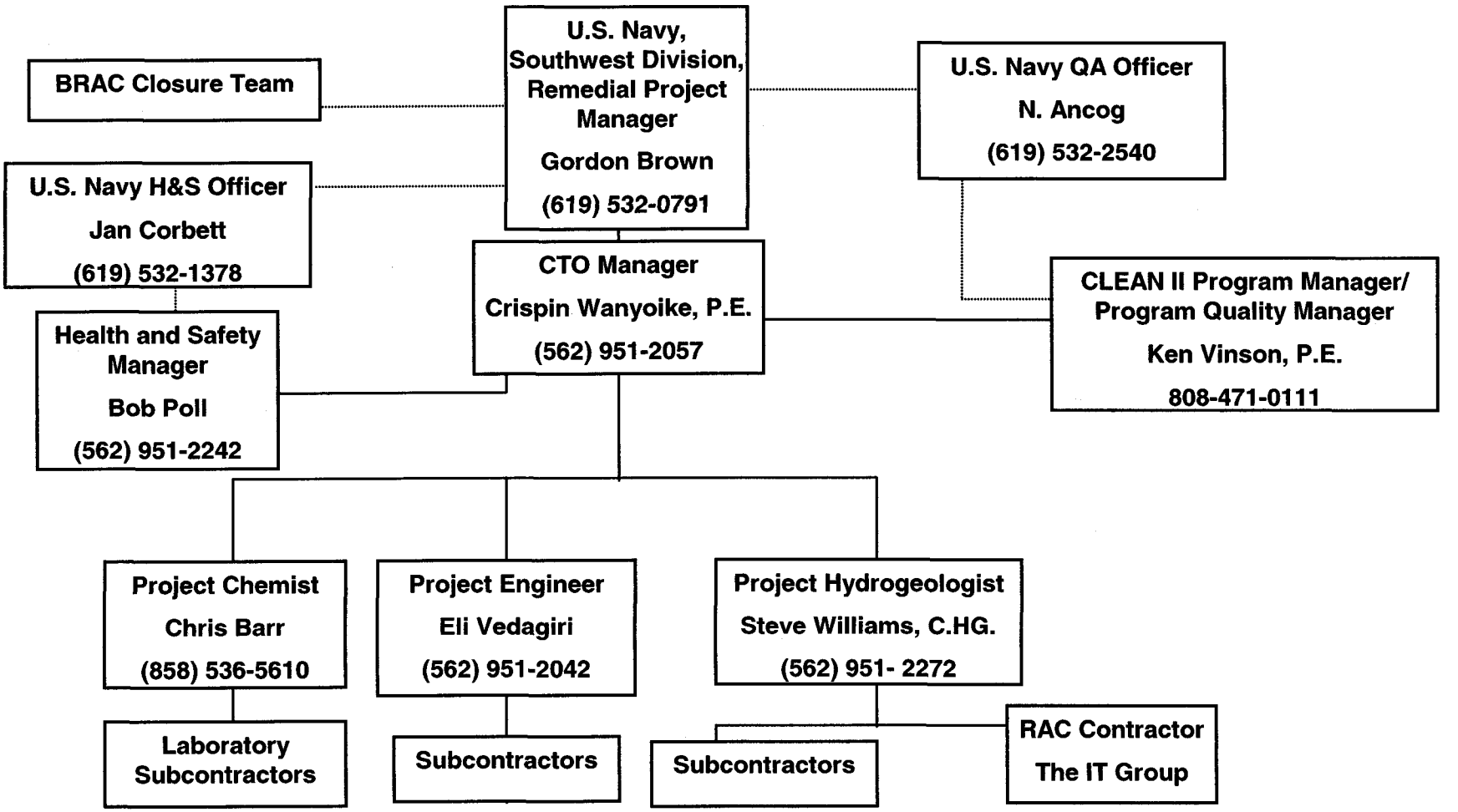

Figure 4-1: Project Organization Chart

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

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

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

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

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

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

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

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

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

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

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

Project Hydrogeologist. Oversees field operations that relate to groundwater and soil sampling, and evaluates technical data. Prepares planning documents and technical specifications for collection of data. Oversees technical performance of subcontractors.

Project Engineer. Oversees field activities and evaluates technical data in conjunction with the project hydrogeologist. Prepares planning documents for collection of data. Conducts data analysis and evaluation and prepares technical reports.

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

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

4.1.3 Schedule

The field activities investigation will span approximately 10 months. The schedule shown on Figure 4-2 is for planning purposes only and will be revised as needed.

4.1.4 Data Quality Objectives

The EPA's seven-step DQO process (EPA 2000) has been followed to develop the work plan as discussed in Section 2.

4.1.5 Documentation and Deliverables

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

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

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

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

Laboratory Documentation. The laboratory will provide Level IV data packages for all results as required to perform validation in accordance with EPA guidance for data review (EPA 1994, 1999c). The packages will include a case summary, report forms, QC sample analysis results, acceptance criteria, calculations, chromatograms, and applicable bench logs and preparation notes. The laboratory will also provide data deliverables in a specified electronic format compatible with the project database, developed in compliance with NEDTS. All laboratory deliverables will be submitted within 30 calendar days of receipt of samples.

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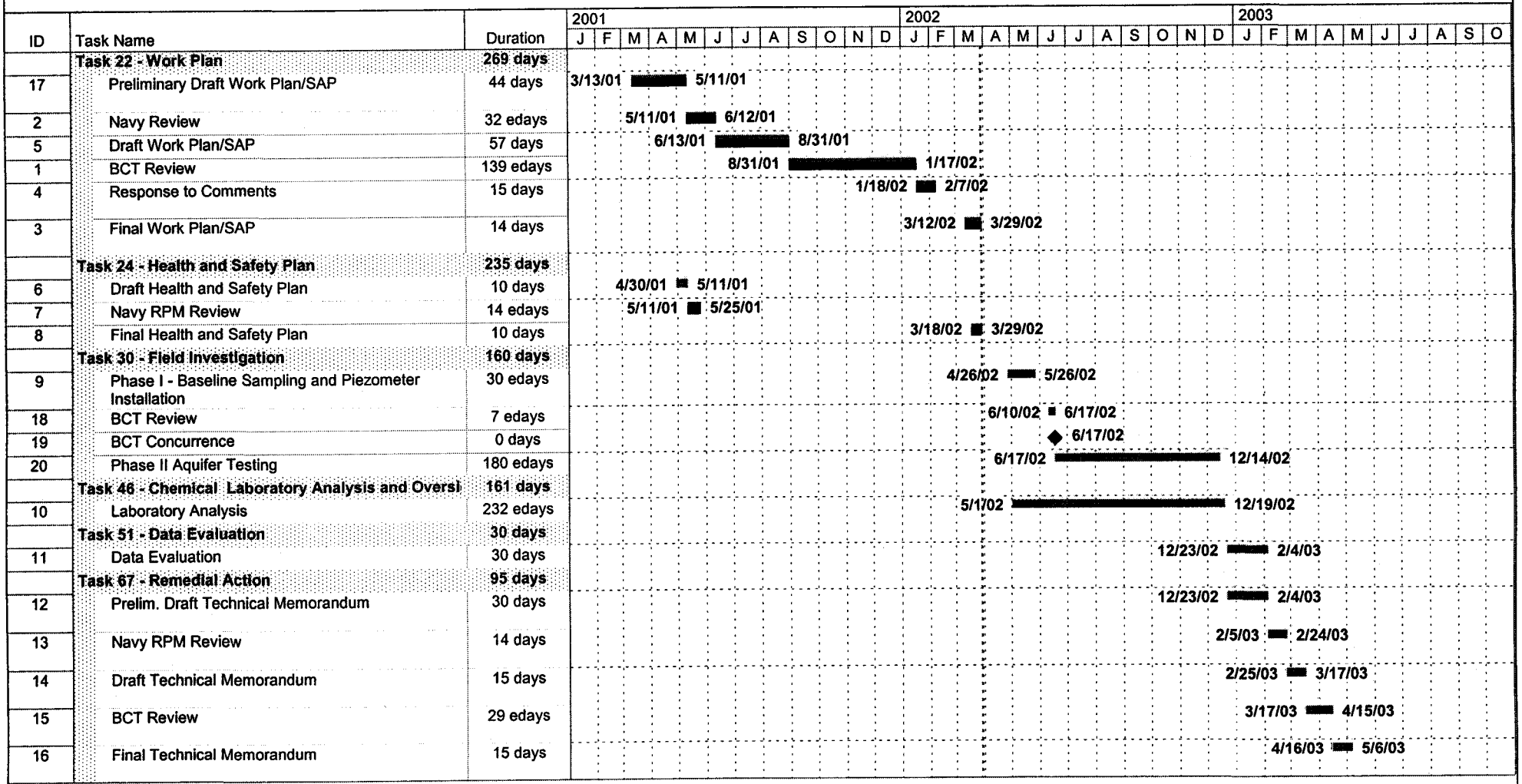
Figure 4-2
Long Term Aquifer Test
IRP Site 2
MCAS El Toro



Project: Long Term Aquifer Pump Testing Site 2
Print Date: Fri 3/29/02
Contract No: N62742-94-d-0048/CTO-78

Task ——— Progress ——— Milestone ◆ Summary

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4.2 MEASUREMENT AND DATA ACQUISITION

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

4.2.1 Field Sampling Quality Assurance Measurements

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

4.2.1.1 TRIP BLANK

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

4.2.1.2 TEMPERATURE BLANK

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

4.2.1.3 FIELD DUPLICATES

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

It is expected that variability of the analytical results from field duplicate hydropunch groundwater samples may be greater than for the groundwater samples collected from monitoring wells using conventional sampling procedures. Hydropunch sampling techniques do not control introduction of sediment, and, because they are collected from a very localized portion of the aquifer, hydropunch samples are considered point samples. The use of the field duplicate data will be to characterize the range of values that would be expected from the aquifer, but will not be used to disqualify results.

4.2.1.4 FIELD BLANKS

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

4.2.1.5 EQUIPMENT RINSATE BLANK

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

4.2.2 Laboratory Analytical Methods and Requirements

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

4.2.2.1 Volatile Organic Compounds

VOCs will be analyzed in accordance with EPA Method 8260B, using sample collection and preparation in accordance with EPA 5030B. The analytes will be compounds on the EPA Contract Laboratory Program (CLP) target list.

4.2.2.2 1,4-Dioxane

The target analyte will be analyzed in accordance with EPA Method 8270C, using sample collection and preparation in accordance with EPA 3520C.

4.2.2.3 Perchlorate

The target analyte will be analyzed in accordance with EPA Method 314, using sample collection and preparation in accordance with the method.

4.2.2.4 Total Petroleum Hydrocarbons

Petroleum hydrocarbons will be analyzed by USEPA Method 8015, using both 5030B and 3520C for sample preparation.

4.2.2.5 General Chemistry

Target analytes will be analyzed in accordance with EPA methods specified in the regulations for discharge monitoring. The methods are shown in Table 3-6.

4.2.3 Quality Control Requirements

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

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

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

The values shown in Table 4-2 will be used to validate the data and assess the acceptability for the project goals. Laboratory-derived acceptance criteria will be used if the criteria are either narrower

than those presented in Table 4-2, or if not, they will be developed in accordance with the published method to represent realistic operational criteria.

Table 4-2: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold [a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R) [b]	
				MS/MSD	LCS
Total Volatile Petroleum Hydrocarbons (Extraction: SW 5030B. Analysis: SW8015B) (mg/L)					
Volatile Petroleum Hydrocarbons	0.1	0.1	25	70–130	75–125
Total Extractable Petroleum Hydrocarbons (Extraction: SW 3520C. Analysis: SW8015B) (mg/L)					
Extractable Petroleum Hydrocarbons	0.1	0.1	50	50–150	60–140
Volatile Organic Compounds (Extraction: SW5030B. Analysis: SW8260B) (µg/L)					
1,1,1-Trichloroethane	5	1	20	70–130	75—25
1,1,2,2-Tetrachloroethane	1	1	20	70–130	75–125
1,1,2-Trichloroethane	5	1	20	70–130	75–125
1,1-Dichloroethane	5	1	20	70–130	75–125
1,1-Dichloroethene	6	1	20	70–130	75–125
1,2-Dichloroethane	0.5	0.5	20	70–130	75–125
cis-1,2-Dichloroethene	61	1	20	70–130	75–125
trans-1,2-Dichloroethene	120	1	20	70–130	75–125
1,2-Dichloropropane	5	1	20	70–130	75–125
2-Butanone	1,900	100	40	50–150	60–140
2-Hexanone	--	50	40	50–150	60–140
4-Methyl-2-pentanone	160	50	40	50–150	60–140
Acetone	610	100	40	50–150	60–140
Benzene	1	1	20	70–130	75–125
Bromodichloromethane	0.18	0.1	20	70–130	75–125
Bromoform	8.5	1	20	70–130	75–125
Bromomethane	8.7	1	20	70–130	75–125
Carbon disulfide	1,000	1	20	70–130	75–125
Carbon tetrachloride	0.5	0.5	20	70–130	75–125
Chlorobenzene	110	1	20	70–130	75–125
Chloroethane	4.6	1	20	70–130	75–125
Chloroform	0.17	0.1	20	70–130	75–125
Chloromethane	1.5	1	20	70–130	75–125
cis-1,3-Dichloropropene	0.5	0.5	20	70–130	75–125
Dibromochloromethane	0.13	0.1	20	70–130	75–125
Ethylbenzene	1,300	1	20	70–130	75–125
Methylene chloride	4.3	3	20	70–130	75–125
Styrene	1,600	1	20	70–130	75–125
Tetrachloroethene	1.1	1	20	70–130	75–125
Toluene	720	1	20	70–130	75–125
trans-1,3-Dichloropropene	0.5	0.5	20	70–130	75–125
Trichloroethene	1.6	1	20	70–130	75–125
Vinyl chloride	0.5	0.5	20	70–130	75–125
Xylenes (total)	1,400	1	20	70–130	75–125

Analyte	Project Decision Threshold [a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R) [b]	
				MS/MSD	LCS
Semivolatile Organic Compounds (Extraction: SW3520C. Analysis: SW8270C) (µg /L)					
1,2,4-Trichlorobenzene	190	10	30	44–142	44–142
1,2-Dichlorobenzene	370	10	30	42–155	42–155
1,3-Dichlorobenzene	5.5	10	30	36–125	36–125
1,4-Dichlorobenzene	*5*	5	30	30–125	30–125
1,4-Dioxane	3	3	30	30–125	30–125
2,2'-oxybis(1-Chloropropane)	0.96*	10	30	35–135	35–135
2,4,5-Trichlorophenol	3,600	10	30	25–175	25–175
2,4,6-Trichlorophenol	6.1	5	30	39–128	39–128
2,4-Dichlorophenol	110	10	30	46–125	46–125
2,4-Dimethylphenol	730	10	30	45–139	45–139
2,4-Dinitrophenol	73	10	30	30–151	30–151
2,4-Dinitrotoluene	73	10	30	39–139	39–139
2,6-Dinitrotoluene	37	10	30	51–125	51–125
2-Chloronaphthalene	490	10	30	60–125	60–125
2-Chlorophenol	30	10	30	41–125	41–125
2-Methylnaphthalene	--	10	30	41–125	41–125
2-Methylphenol	1,800	10	30	50–125	50–125
2-Nitroaniline	2.1*	50	30	50–125	50–125
2-Nitrophenol	--	10	30	44–125	44–125
3,3'-Dichlorobenzidine	0.15*	10	30	29–175	29–175
3-Nitroaniline	--	50	30	51–125	51–125
4,6-Dinitro-2-methylphenol	--	50	30	26–134	26–134
4-Bromophenyl-phenylether	--	10	30	53–127	53–127
4-Chloro-3-methylphenol	--	10	30	44–125	44–125
4-Chloroaniline	150	10	30	45–136	45–136
4-Chlorophenyl-phenyl ether	--	10	30	51–132	51–132
4-Methylphenol	180	10	30	33–125	33–125
4-Nitroaniline	--	50	30	40–143	40–143
4-Nitrophenol	290	50	30	25–131	25–131
Acenaphthene	360	10	30	49–125	49–125
Acenaphthylene	--	10	30	47–125	47–125
Anthracene	1,800	10	30	45–165	45–165
Benzo(a)anthracene	0.09*	10	30	51–133	51–133
Benzo(a)pyrene	*0.2*	0.2	30	41–125	41–125
Benzo(b)fluoranthene	0.09*	10	30	37–125	37–125
Benzo(g,h,i)perylene	--	10	30	34–149	34–149
Benzo(k)fluoranthene	0.92*	10	30	37–125	37–125
bis(2-Chloroethoxy)methane	--	10	30	49–125	49–125
bis(2-Ethylhexyl)phthalate	4.8*	10	30	33–129	33–129
bis-(2-Chloroethyl)ether	0.01*	10	30	44–125	44–125
Butylbenzylphthalate	7,300	10	30	26–125	26–125
Carbazole	3.4*	50	30	29–135	29–135
Chrysene	9.2	5	30	55–133	55–133

Analyte	Project Decision Threshold [a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R) [b]	
				MS/MSD	LCS
Di-n-butylphthalate	3,600	10	30	34–126	34–126
Di-n-octylphthalate	730	10	30	38–127	38–127
Dibenzo(a,h)-anthracene	0.01*	10	30	50–125	50–125
Dibenzofuran	24	10	30	52–125	52–125
Diethylphthalate	29,000	10	30	37–125	37–125
Dimethylphthalate	360,000	10	30	25–175	25–175
Fluoranthene	1,500	10	30	47–125	47–125
Fluorene	240	10	30	48–139	48–139
Hexachlorobenzene	*1*	1	30	46–133	46–133
Hexachlorobutadiene	0.86*	10	30	25–125	25–125
Hexachlorocyclopentadiene	50	50	30	41–125	41–125
Hexachloroethane	4.8*	5	30	25–153	25–153
Indeno(1,2,3-cd)-pyrene	0.09*	10	30	27–160	27–160
Isophorone	71	10	30	26–175	26–175
N-Nitroso-di-n-propylamine	0.01*	10	30	37–125	37–125
N-Nitroso-diphenylamine	13	10	30	27–125	27–125
Naphthalene	6.2	5	30	50–125	50–125
Nitrobenzene	3.4*	5	30	46–133	46–133
Pentachlorophenol	1	1	30	28–136	28–136
Phenanthrene	--	10	30	54–125	54–125
Phenol	21,000	10	30	25–125	25–125
Pyrene	183	10	30	47–136	47–136
General Chemistry					
Ammonia (Inorganic nitrogen) (WW 350) (mg/L)	1	1	25	75–125	75–125
Nitrate-nitrite (WW 352) (mg/L)	1	1	25	75–125	75–125
Perchlorate	4	4	25	75–125	75–125
Total dissolved solids (WW160.1)	10	10	25	na	75–125
Total suspended solids (WW160.2)	10	10	25	na	75–125
Sulfide (WW376) (mg/L)	0.4	0.1	25	75–125	75–125

Notes:
mg/L = milligram per liter
LCS = laboratory control sample
MS = matrix spike
-- = none established
MSD = matrix spike duplicate
RPD = relative percentage of difference
% R = percent recovery
SW = Test Method for Solid Waste (EPA 2002b)

* Laboratory reporting limits are greater than the project decision thresholds; see discussion in the subsection Reporting Limits below for evaluation of these analytes.
Decision thresholds shown in italics are based on drinking water MCLs. PRGs for these compounds are too low to be detected with reasonable analytical confidence.
[a] For VOCs and SVOCs, lower of California Modified PRGs and EPA Region IX PRGs (EPA Region IX 1999), or the waste discharge requirement has been used; analytes whose PRGs are lower than the laboratory reporting limits, the lower of the primary MCLs, or the waste discharge requirement have been used.
[b] Laboratory-specific performance criteria.

Reporting Limits. The laboratory will have current and documented reporting limits consistent with the values presented in Table 4-2. Reporting limits that exceed the selected decision criteria will be evaluated on an individual basis. Analytes not detected in any sample at the site or that have

no reasonable expectation to be the result of site activities will not be included in further evaluation. Analytes that are identified as site COPCs will be incorporated into the site evaluation and recommendations. The detection limit will be addressed as a factor in the uncertainty associated with the decision-making process.

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

Laboratory Control Samples. A laboratory control sample (LCS) will be analyzed with every batch of 20 samples or less for accuracy. The LCS will consist of a method blank spiked with a known amount of analyte that will be carried through the entire preparation and analysis procedure. The LCS source will be different from that used to prepare calibration standards. Analytes used for the LCS will comply with the method requirements. Control charts may be used, and control limits will be calculated based upon historical data. When control limits are exceeded, the analysis will be stopped, and the problem corrected. Samples associated with the out-of-control LCS will be reanalyzed in another batch, unless documented evidence is presented to show that associated samples were not affected. Guidance limits for the LCS listed in Table 4-2 will be used unless more restrictive laboratory-specific limits are established or statistically based limits are developed.

Matrix Spikes. A matrix spike (MS) will be analyzed for at least one out of every 20 samples to measure matrix effects on accuracy. The MS will consist of additional aliquots of sample spiked with a known amount of analyte. Compounds to be spiked will be in accordance with the laboratory SOP or the published method. Guidance limits for the MS listed in Table 4-2 will be used unless more restrictive laboratory-specific limits are established. If the analyte concentration in the sample is greater than twice the amount of spike added, the spike will be considered invalid and the recovery will not be calculated. If a valid spike recovery exceeds acceptance limits but the LCS is in control, matrix interference is indicated.

Duplicates or Matrix Spike Duplicates. A duplicate or a matrix spike duplicate (MSD) will be analyzed for at least one out of every 20 samples to measure precision. For any batch of samples that does not contain a duplicate or MSD (i.e., when insufficient sample is available), two LCSs may be used. However, every effort will be made to provide sufficient sample for laboratory QC. If the relative percentage of difference (RPD) does not meet the established acceptance limits, the problem will be investigated and corrected. Any affected samples will be reanalyzed in a separate batch. Acceptance limits for duplicates/MSDs listed in Table 4-2 will be used unless more restrictive laboratory-specific limits are established or statistically derived limits are developed.

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

4.2.4 Calibration and Preventive Maintenance

Water level measurements will be performed in accordance with standard procedures. Water level transducers will be placed in the wells and the output verified periodically with manual

measurements. The transducers will be acquired from the factory and accompanied by appropriate calibration documentation.

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

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

4.2.5 Acceptance Requirements for Supplies and Consumables

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

Consumables used in sample collection include the tubing installed in each well. New materials in original packaging from the supplier will be used and selected on the basis of being appropriate for the application.

4.2.6 Data Management

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

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

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

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

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

4.3 PROJECT QUALITY ASSURANCE OVERSIGHT

Samples will be submitted to an NFESC-evaluated laboratory for analysis by methods cited in Table 4-2. The laboratory will also be certified by the California State Environmental Laboratory Accreditation Program. Laboratory data quality strategies and criteria were developed in accordance with the project DQOs and the following references:

- *Navy Installation Restoration Chemical Data Quality Manual* (NFESC 1999)
- *SW-846 On-Line, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2002b)
- *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1999c)
- *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994)

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

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

4.3.1 Field Audits

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

4.3.2 Laboratory System Audits

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

4.3.3 Laboratory Performance Review

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

- Internal laboratory oversight by laboratory QA manager
- Frequent progress reports and discussions between the project chemist and the laboratory project manager
- Project chemist oversight of deliverables and reports

- Desktop evaluation of reports and data packages
- Data validation, as discussed in Section 4.4.2

4.3.4 Corrective Actions

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

4.3.5 Reports to Management

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

4.4 Data Validation and Usability

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

4.4.1 Desktop Data Review

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

4.4.2 Data Validation

The data validation strategies presented in the SWDIV EWI #1 (SWDIV 1999) specify investigations at National Priorities List sites will be subject to a minimum of 20 percent Level IV validation, with the remainder of the data subject to Level III validation.

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

4.4.2.1 Level III Validation

A minimum of Level III validation, as described in SWDIV EWI #1 (SWDIV 1999), will be performed on all samples collected during the investigation. Systematic concerns identified in Level III may be cause for additional Level IV review. Such review will be conducted until a return to compliance is verified.

4.4.2.2 Level IV Validation

Level IV validation will be performed on at least 20 percent of the samples, typically the first data packages submitted by the laboratory. The Level IV validation is intended to assess whether any significant, systematic errors are present in the laboratory procedures or processes. If the Level IV

validation identifies systematic errors, the laboratory will be required to initiate corrective action and ensure that such errors are corrected.

4.4.3 Data Usability

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

Data may be assigned the following qualifiers:

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

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

5. DATA EVALUATION

5.1 HYDROGEOLOGY

The stratigraphy encountered during cone penetrometer testing will be used to update the geologic interpretation at IRP Site 2 and will be added to existing geologic cross sections. Groundwater elevation measurements will be used to establish the current groundwater flow patterns, including updated calculation of the hydraulic gradient magnitude and direction at IRP Site 2. Groundwater elevation data will be plotted in plan view and in cross section.

5.2 DISTRIBUTION OF TCE AND PCE

Results of VOC analyses will be used to update the conceptual distribution of TCE and PCE at IRP Site 2. The data will be mapped in plan and cross-sectional views in conjunction with contemporaneous VOC data from existing wells (i.e., quarterly sampling results). The mapped extent of TCE and PCE will allow for the selection and planning of additional activities to be performed at IRP Site 2, including response actions and supplementary monitoring.

5.3 NATURAL ATTENUATION POTENTIAL

The natural attenuation potential for TCE and PCE at IRP Site 2 will be evaluated based on the screening criteria presented in Appendix B.

5.4 AQUIFER TEST

Data collected during the aquifer test will be used to evaluate aquifer characteristics (transmissivity, storativity, and boundary conditions), well capture zones, and VOC removal rates. This evaluation will be used to assess the effectiveness of groundwater extraction alternatives for the VOC plumes. Aquifer characteristics and water level data will be used to estimate the capture zone of each extraction well and assist in the selection of additional well sites during remedial design for IRP Site 2.

5.4.1 Step-drawdown Testing

Step-drawdown tests will be performed on monitoring wells 02_DGMW61, 02NEW22, and 02NEW17. The water level data will be plotted on semi-log graph paper, which will allow for extrapolation of long-term drawdown levels and estimation of sustainable pumping rates.

5.4.2 Constant-Rate Testing

The proposed aquifer testing involves constant-rate tests with multiple wells added as the tests progress. The constant-rate tests will commence at the rates derived from the step-drawdown tests. The data collected during the tests will be the basis for estimating aquifer characteristics (transmissivity, storativity, and boundary conditions), extraction well capture zones, and VOC removal rates. The aquifer test data will be plotted on semi-log and/or log-log graphs for evaluation. The plots reveal aquifer response to pumping, boundary conditions (such as recharge boundaries and impermeable or low-flow boundaries), and the effects of multiple pumping wells.

5.4.3 Transmissivity

Aquifer transmissivity, the product of hydraulic conductivity and aquifer thickness, measures the aquifer's ability to transmit water. The calculated transmissivity values will be used in the

computation of capture zones. Estimation of aquifer transmissivity will include the Neuman, Cooper-Jacob, and/or Theis analytical methods, as appropriate.

5.4.4 Storativity

Storativity is the amount of water released from storage per unit surface area of aquifer per unit decline in hydraulic head. Storativity values are used to calculate theoretical drawdown and well efficiency. Estimation of storativity will include the same methods used to estimate transmissivity (Neuman, Cooper-Jacob, and/or Theis).

5.4.5 Capture Zones

Capture zones for each test will be computed using drawdown data and derived aquifer characteristics. The capture zones will be plotted in plan view and will indicate the areal extent of hydraulic containment.

5.4.6 VOC Mass Removal Rates

The VOC mass removal rate will be estimated using the pumping rates, durations, and VOC concentrations in extracted groundwater. The mass removal rate will yield anticipated remedial durations and treatment requirements of extracted groundwater.

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Appendix A
Historical VOC Results

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02_DGMW59	12/15/1992	**0.6**	J	<1	U	-----	-	-----	-	<1	U	<2	U	-----	-
02_DGMW59	6/23/1993	<1	U	<1	U	-----	-	-----	-	<1	U	<2	U	-----	-
02_DGMW59	08/16/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<10	U	<0.5	U	-----	-
02_DGMW59	11/30/95	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW59	02/06/96	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW59	11/14/96	**0.7**	J	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02_DGMW59	03/26/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02_DGMW59	07/03/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02_DGMW59	10/27/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02_DGMW59	10/07/98	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	U
02_DGMW59	01/27/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW59	05/03/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	U
02_DGMW59	07/21/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW59	04/03/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02_DGMW59	06/20/00	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02_DGMW60	11/18/1992	**82**	-	**8**	-	-----	-	-----	-	**8**	-	<2	U	-----	-
02_DGMW60	6/23/1993	**61**	-	**6**	-	-----	-	-----	-	**5**	-	<2	U	-----	-
02_DGMW60	08/15/95	**94**	-	**4.6**	J	**7.2**	J	**1**	J	**9**	J	<0.5	UJ	-----	-
02_DGMW60	11/28/95	**81**	-	**3.2**	J	**7.3**	J	<2	UJ	-----	-	<2	UJ	-----	-
02_DGMW60	02/06/96	**98**	-	**4**	-	**1**	-	<1	U	-----	-	<1	U	-----	-

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02_DGMW60	11/04/96	**203**	-	**7**	-	-----	-	-----	-	**20**	-	<1	U	-----	-
02_DGMW60	03/26/97	**150**	-	**5**	J	-----	-	-----	-	**10**	-	<10	U	-----	-
02_DGMW60	07/01/97	**160**	-	**5**	-	-----	-	-----	-	**18**	-	-----	-	-----	-
02_DGMW60	10/28/97	**190**	-	**6**	-	-----	-	-----	-	**22**	-	-----	-	-----	-
02_DGMW60	10/12/98	**130**	D	**4.2**	-	**14**	-	**2.3**	-	-----	-	<1	U	<4	U
02_DGMW60	01/25/99	**130**	D	**4.6**	-	**14**	-	**2.1**	-	-----	-	<1	U	-----	-
02_DGMW60	05/03/99	**130**	D	**4.4**	-	**13**	-	**2**	-	-----	-	<1	U	<4	U
02_DGMW60	07/19/99	**140**	-	**4.7**	-	**14**	-	**2.2**	-	-----	-	<1	U	-----	-
02_DGMW60	04/04/00	**110**	-	**4**	J	**9**	-	**1**	J	-----	-	<5	U	-----	-
02_DGMW60	06/21/00	**100**	-	**3**	-	-----	-	-----	-	**10**	-	-----	-	-----	-
02_DGMW61	12/14/92	**1**	-	**2**	-	-----	-	-----	-	<1	U	<2	U	-----	-
02_DGMW61	06/22/93	**2**	-	**4**	-	-----	-	-----	-	<1	U	<2	U	-----	-
02_DGMW61	08/16/95	<0.5	U	**13**	-	<0.5	U	<0.5	U	<10	U	<0.5	U	-----	-
02_DGMW61	11/29/95	<1	U	**19**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW61	02/08/96	<1	U	**14**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW61	11/04/96	<1	U	**20**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02_DGMW61	03/26/97	**1**	J	**12**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02_DGMW61	07/02/97	<1	U	**10**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02_DGMW61	10/28/97	**0.9**	J	**11**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02_DGMW61	10/08/98	<1	U	**5.2**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW61	01/25/99	**0.5**	J	**6.2**	-	<1	U	<1	U	-----	-	<1	U	-----	-

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02_DGMW61	04/27/99	**0.5**	J	**6**	-	<1	U	<1	U	-----	-	<1	U	**5**	-
02_DGMW61	07/19/99	<1	U	**6**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02_DGMW61	03/30/00	<5	U	**6**	-	<5	U	<5	U	-----	-	<5	U	-----	-
02_DGMW61	06/21/00	<1	U	**3**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02_UGMW25	12/09/92	**0.9**	J	<1	U	-----	-	-----	-	<1	U	<2	U	-----	-
02_UGMW25	06/22/93	<1	U	<1	U	-----	-	-----	-	<1	U	<2	U	-----	-
02_UGMW25	08/17/95	<0.5	UJ	<0.5	UJ	<0.5	UJ	<0.5	UJ	<10	U	<0.5	UJ	-----	-
02_UGMW25	11/28/95	<0.5	UJ	<0.5	UJ	<0.5	UJ	<0.5	UJ	-----	-	<0.5	UJ	-----	-
02_UGMW25	02/07/96	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_UGMW25	11/12/96	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02_UGMW25	03/26/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02_UGMW25	07/02/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02_UGMW25	10/27/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02_UGMW25	10/07/98	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	U
02_UGMW25	02/01/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_UGMW25	04/26/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	U
02_UGMW25	07/15/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02_UGMW25	04/10/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	<4	U
02NEW01	10/13/95	**62**	-	**1**	-	**11**	-	<1	U	-----	-	<1	U	-----	-
02NEW01	10/16/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW01	12/26/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-

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Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02NEW01	11/04/96	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW01	03/26/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW01	07/01/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW01	10/28/97	**0.4**	J	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW01	03/17/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW02	09/14/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW02	10/03/95	<0.5	U	<0.5	U	**4.4**	-	<0.5	U	-----	-	<0.5	UJ	-----	-
02NEW02	12/21/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW02	11/26/96	**1**	-	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW02	03/26/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW02	07/03/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW02	10/27/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW02	10/08/98	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW02	01/27/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW02	05/04/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	U
02NEW02	07/20/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW02	03/31/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	<4	U
02NEW02	06/20/00	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW03	10/04/95	**0.6**	-	**0.7**	-	<0.5	U	<0.5	U	-----	-	<0.5	UJ	-----	-
02NEW03	10/06/95	<0.5	U	<0.5	UJ	<0.5	U	<0.5	U	-----	-	<0.5	UJ	-----	-
02NEW03	12/28/95	<0.5	U	**0.4**	J	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-

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IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02NEW03	11/08/96	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW03	03/24/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW03	07/02/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW03	10/23/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW03	03/22/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW06	10/11/95	**0.7**	-	**1.5**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW06	10/13/95	**0.7**	-	**0.9**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW06	12/27/95	**0.9**	-	**1**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW06	11/07/96	<1	U	**0.9**	**J**	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW06	03/24/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW06	07/02/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW06	10/23/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW06	03/21/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	<8	U
02NEW07	10/20/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW07	12/27/95	<0.5	U	**0.3**	J	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW07	01/08/97	**2**	-	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW07	03/20/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW07	07/11/97	**8**	-	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW07	10/22/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02NEW08A	09/26/95	**6.9**	-	**0.7**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW08A	09/27/95	<0.5	U	**7.2**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW08A	09/28/95	<0.5	U	**3.9**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW08A	12/27/95	<0.5	U	**17**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW08A	11/07/96	<1	U	**19**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW08A	03/25/97	<1	U	**11**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW08A	07/02/97	<1	U	**12**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW08A	10/27/97	**0.6**	J	**12**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW08A	10/14/98	<1	U	**14**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW08A	01/28/99	<1	U	**13**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW08A	04/27/99	<1	U	**9.3**	-	<1	U	<1	U	-----	-	<1	U	**11**	-
02NEW08A	07/20/99	<1	U	**14**	-	<1	U	<1	U	-----	-	<1	U	**9**	-
02NEW08A	03/30/00	<5	U	**7**	-	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW08A	06/21/00	<1	U	**7**	-	-----	-	-----	-	<1	U	-----	-	**8.2**	-
02NEW11	09/21/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW11	10/31/95	<0.5	U	<0.5	UJ	<0.5	UJ	<0.5	U	-----	-	<0.5	U	-----	-
02NEW11	12/21/95	<0.5	UJ	<0.5	UJ	<0.5	UJ	<0.5	UJ	-----	-	<0.5	UJ	-----	-
02NEW11	11/12/96	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW11	03/25/97	<1	U	<1	U	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW11	07/08/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW11	10/23/97	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02NEW11	10/14/98	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW11	01/21/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW11	04/26/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	U
02NEW11	07/15/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	<4	UJ
02NEW11	03/31/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	<4	U
02NEW11	06/22/00	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	<4	U
02NEW12	11/17/95	<0.5	U	<0.5	U	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW12	12/28/95	**2**	-	**2**	-	<0.5	U	<0.5	U	-----	-	<0.5	U	-----	-
02NEW12	11/07/96	**2**	-	**2**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW12	03/25/97	**4**	-	**3**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW12	06/30/97	**2**	-	**2**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW12	10/23/97	**1**	-	**1**	-	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW12	03/23/00	**1**	J	**0.8**	J	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW13	05/13/96	<1	U	<1	UJ	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW13	06/07/96	**15**	-	**1**	-	**1**	-	<1	U	-----	-	<1	U	-----	-
02NEW13	12/05/96	**62**	-	**8**	-	-----	-	-----	-	**5**	-	<1	U	-----	-
02NEW13	10/28/97	**80**	D	**5**	-	-----	-	-----	-	<10	U	-----	---	-----	-
02NEW13	03/16/00	**92**	-	**4**	J	**9**	-	**1**	J	-----	-	<5	U	-----	-

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02NEW14	05/13/96	<2	U	**26**	J	<2	U	<2	U	-----	-	<2	U	-----	-
02NEW14	06/07/96	<1	U	**9**	-	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW14	12/05/96	**3**	-	**8**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW14	03/26/97	<1	U	**5.0**	-	-----	-	-----	-	<1	U	<1	U	-----	-
02NEW14	03/20/00	**1.0**	J	**4.0**	J	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW15	10/12/98	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW15	02/01/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW15	04/26/99	<1	U	<1	U	**0.4**	J	<1	U	-----	-	<1	U	<4	U
02NEW15	07/19/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW15	04/10/00	**0.7**	J	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW15	06/22/00	<1	U	<1	U	-----	-	-----	-	<1	U	-----	-	-----	-
02NEW16	10/12/98	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW16	01/26/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW16	05/04/99	<1	U	**0.3**	J	<1	U	<1	U	-----	-	<1	U	**3**	J
02NEW16	07/21/99	<1	U	<1	U	<1	U	<1	U	-----	-	<1	U	-----	-
02NEW16	04/10/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW17	03/10/00	**152**	-	**6**	-	**16**	-	**3**	J	-----	-	<5	U	-----	-
02NEW18	03/17/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW19	03/15/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW20	03/08/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	<8	U
02NEW21	03/10/00	**0.6**	J	<5	U	<5	U	<5	U	-----	-	<5	U	<4	U
02NEW22	03/16/00	<5	U	**8**	-	<5	U	<5	U	-----	-	<5	U	-----	-
02NEW23	03/14/00	**3**	J	**3**	J	<5	U	<5	U	-----	-	<5	U	<8	U

Table A-1: Analytical Results for VOCs and Perchlorate in Groundwater
IRP Site 2 - Magazine Road Landfill, Marine Corps Air Station El Toro

Well ID	Date	TCE (µg/L)		PCE (µg/L)		cis-1,2-DCE (µg/L)		trans-1,2-DCE (µg/L)		Total 1,2-DCE (µg/L)		VC (µg/L)		Perchlorate (µg/L)	
02NEW24	03/13/00	**2**	J	**5**	J	<5	U	<5	U	-----	-	<5	U	<8	U
02NEW25	03/14/00	<5	U	<5	U	<5	U	<5	U	-----	-	<5	U	-----	-

Notes:
Detected concentrations shown in boldface.
VOCs = volatile organic compounds
TCE = trichloroethene
PCE = tetrachloroethene
cis-1,2-DCE = cis-1,2-dichloroethene
trans-1,2-DCE = trans-1,2-dichloroethene
VC = vinyl chloride
µg/L = micrograms per liter
<1 = not detected above the indicated laboratory detection limit
----- = not analyzed/not applicable
- = no laboratory or reviewer qualifier associated with this data
J = The data falls outside the quality control limits, but the exceedance is not sufficient to cause rejection of the data.
U = Not detected above the laboratory reporting limit.
UJ = The analyte was not detected above the laboratory reporting limit. However, the reporting limit is an estimated quantity.
D = The concentration was obtained from diluted sample analysis.

Appendix B
Natural Attenuation Screening Criteria and Screening Results

Table 2.4 Interpretation of Points Awarded During Screening Step 1

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation* of chlorinated organics
6 to 14	Limited evidence for anaerobic biodegradation* of chlorinated organics
15 to 20	Adequate evidence for anaerobic biodegradation* of chlorinated organics
> 20	Strong evidence for anaerobic biodegradation* of chlorinated organics

**reductive dechlorination*

The following two examples illustrate how Step 1 of the screening process is implemented. The site used in the first example is a former fire training area contaminated with chlorinated solvents mixed with fuel hydrocarbons. The presence of the fuel hydrocarbons appears to reduce the ORP of the ground water to the extent that reductive dechlorination is favorable. The second example contains data from a dry cleaning site contaminated only with chlorinated solvents. This site was contaminated with spent cleaning solvents that were dumped into a shallow dry well situated just above a well-oxygenated, unconfined aquifer with low organic carbon concentrations of dissolved organic carbon.

Example 1: Strong Evidence for Anaerobic Biodegradation (Reductive Dechlorination) of Chlorinated Organics

Analyte	Concentration in Most Contaminated Zone	Points Awarded
Dissolved Oxygen	0.1 mg/L	3
Nitrate	0.3 mg/L	2
Iron (II)	10 mg/L	3
Sulfate	2 mg/L	2
Methane	5 mg/L	3
ORP	-190 mV	2
Chloride	3 times background	2
PCE (released)	1,000 µg/L	0
TCE (none released)	1,200 µg/L	2
cis-DCE (none released)	500 µg/L	2
VC (none released)	50 µg/L	2
	Total Points Awarded	23 Points

In this example, the investigator can infer that biodegradation is likely occurring at the time of sampling and may proceed to Step 2.

Example 2: Anaerobic Biodegradation (Reductive Dechlorination) Unlikely

Analyte	Concentration in Most Contaminated Zone	Points Awarded
Dissolved Oxygen	3 mg/L	-3
Nitrate	0.3 mg/L	2
Iron (II)	Not Detected (ND)	0
Sulfate	10 mg/L	2
Methane	ND	0
ORP	+ 100 mV	0
Chloride	background	0
TCE (released)	1,200 µg/L	0
cis-DCE (none released)	ND	0
VC (none released)	ND	0
	Total Points Awarded	1 Point

Table B-1: Weighting For Preliminary Screening for Anaerobic Biodegradation Processess - Trichloroethene Plume

Analytical Parameter	Units	Concentration Criteria	Background (Upgradient) 02_UGMW25	Degradation Score 02_UGMW25	Screened Below TCE Plume 02NEW01	Degradation Score 02NEW01	Within TCE Plume 02NEW13	Degradation Score 02NEW13	Within TCE Plume 02_DGMW60	Degradation Score 02_DGMW60	Downgradient From TCE Plume 02NEW20	Degradation Score 02NEW20	Downgradient From TCE Plume 02NEW21	Degradation Score 02NEW21
Oxygen	mg/L	<0.5/>5	3.17	0	8.83	-3	9.25	-3	2.13	0	8.92	-3	8.93	-3
Nitrate	mg/L	<1	12	0	<0.5	2	11	0	14	0	7	0	277	0
Iron II	mg/L	>1	0.0	0	0.0	0	0.0	0	0.0	0	0.65	0	0.10	0
Sulfate	mg/L	<20	250	0	110	0	210	0	210	0	230	0	90	0
Sulfide	mg/L	>1	0.23	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0
ORP	millivolts	<50/<-100	7	1	-55	1	69	0	0	1	-20	1	-34	1
PH	pH units	5<pH<9	7.17	0	7.34	0	6.89	0	7.05	0	7.00	0	7.65	0
TOC	mg/L	>20	2	0	<1	0	<1	0	2.9	0	1.96	0	<1	0
Temperature	°C	>20°C	19.28	0	23.6	1	23.3	1	24.87	1	20.0	0	26.9	1
Carbon Dioxide	mg/L	>2 x background	33	-----	16.5	0	93	1	27	0	45	0	6.7	0
Alkalinity	mg/L	>2 x background	264	-----	201	0	424	0	164	0	243	0	171	0
Chloride	mg/L	>2 x background	259	-----	48	0	117	0	111	0	150	0	116	0
BTEX	mg/L	>0.1	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Tetrachloroethene	µg/L	-----	<5	-----	<5	-----	<5	-----	4J	-----	<5	-----	<5	-----
Trichloroethene	µg/L	from PCE?	<5	-----	<5	-----	92	-----	110	-----	<5	-----	<5	-----
cis-DCE	µg/L	from TCE?	<5	-----	<5		9	2	9	2	<5		<5	
trans-DCE	µg/L	from TCE?	<5	-----	<5	0	<5		1J		<5	0	<5	0
Vinyl Chloride	µg/L	from DCE?	<5	-----	<5	0	<5	0	<5	0	<5	0	<5	0
TDS	mg/L	(used to quantify CO_2)	940	-----	441	-----	947	-----	902	-----	969	-----	450	-----
Cumulative Biodegradation Score:			**02_UGMW25:**	**1**	**02NEW01:**	**1**	**02NEW13:**	**1**	**02_DGMW60:**	**4**	**02NEW20:**	**-2**	**02NEW21:**	**-1**

Notes:
Screening protocol and scoring values derived from *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998).
PCE = tetrachloroethene
TCE = trichloroethene
mg/L = milligrams per liter
<0.5 = not detected above the indicated laboratory reporting limit
ORP = oxygen reduction potential
pH = negative log of the hydrogen ion
TOC = total organic carbon
BTEX = benzene, toluene, ethylbenzene, and xylenes
ND = not detected above the laboratory reporting limit
µg/L = micrograms per liter
DCE = dichloroethene
J = indicates that the reported concentration is estimated and is between the practical quantitation limit and the method detection limit
TDS = total dissolved solids
CO_2 = carbon dioxide
----- = not applicable
EPA = Environmental Protection Agency

Table B-2: Weighting For Preliminary Screening for Anaerobic Biodegradation Processess - Tetrachloroethene Plume

Analytical Parameter	Units	Concentration Criteria	Background (Upgradient) 02_UGMW25	Degradation Score 02_UGMW25	Within PCE Plume 02NEW08A	Degradation Score 02NEW08A	Within PCE Plume 02_DGMW61	Degradation Score 02_DGMW61	Downgradient From PCE Plume 02NEW14	Degradation Score 02NEW14
Oxygen	mg/L	<0.5/>5	3.17	0	2.69	0	2.86	0	9.01	-3
Nitrate	mg/L	<1	12	0	9.5	0	5.3	0	11.3	0
Iron II	mg/L	>1	0.0	0	0.0	0	0.0	0	0.0	0
Sulfate	mg/L	<20	250	0	163	0	220	0	154	0
Sulfide	mg/L	>1	0.23	0	<0.2	0	<0.2	0	<0.2	0
ORP	millivolts	<50/<-100	7	1	-6.0	1	137	0	81	0
PH	pH units	5<pH<9	7.17	0	7.03	0	7.11	0	6.88	0
TOC	mg/L	>20	2	0	1.85	0	1.32	0	2	0
Temperature	°C	>20 °C	19.28	0	21.94	1	21.69	1	21.4	1
Carbon Dioxide	mg/L	>2 x background	33	-----	50	0	40	0	71	1
Alkalinity	mg/L	>2 x background	264	-----	279	0	287	0	285	0
Chloride	mg/L	>2 x background	259	-----	48	0	46	0	50	0
BTEX	mg/L	>0.1	ND	0	ND	0	ND	0	ND	0
Tetrachloroethene	µg/L	-----	<5	-----	7	-----	6	-----	<5	-----
Trichloroethene	µg/L	From PCE?	<5	-----	<5	0	<5	0	<5	0
Cis-DCE	µg/L	From TCE?	<5	-----	<5		<5		<5	
Trans-DCE	µg/L	From TCE?	<5	-----	<5	0	<5	0	<5	0
Vinyl Chloride	µg/L	From DCE?	<5	-----	<5	0	<5	0	<5	0
TDS	mg/L	(used to quantify CO_2)	940	-----	654	-----	681	-----	692	-----
Cumulative Biodegradation Score:			**02_UGMW25:**	**1**	**02NEW08A:**	**2**	**02_DGMW61:**	**1**	**02NEW14:**	**-1**

Notes:
Screening protocol and scoring values derived from *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998).
PCE = tetrachloroethene
TCE = trichloroethene
mg/L = milligrams per liter
<0.5 = not detected above the indicated laboratory reporting limit
ORP = oxygen reduction potential
pH = negative log of the hydrogen ion
TOC = total organic carbon
BTEX = benzene, toluene, ethylbenzene, and xylenes
ND = not detected above the laboratory reporting limit
µg/L = micrograms per liter
DCE = dichloroethene
TDS = total dissolved solids
CO_2 = carbon dioxide
----- = not applicable
EPA = Environmental Protection Agency

Appendix C
Proposed Treatment System and System Monitoring Activities

IRP SITE 2 GROUNDWATER TREATMENT SYSTEM

INTRODUCTION

This documentation was prepared in response to a comment by Ms. Patricia Hannon of the Regional Water Quality Board on the Draft Aquifer Test Work Plan requesting that additional details on the proposed treatment and discharge of extracted groundwater. This appendix includes process-flow description, a schematic drawing of the proposed system, estimated volume of water expected to be discharged, and a list of chemical parameters in the extracted groundwater that will be analyzed for, both prior to and after treatment.

EXTRACTION WELL DESCRIPTION

Groundwater will be extracted from wells in and around the TCE and PCE plume areas. The TCE plume extraction wells are 02_DGMW60, 02NEW13, and 02NEW17. The PCE plume extraction wells are 02NEW08A, 02_DGMW61, and 02NEW22. The aquifer test will begin by pumping from two wells, one located in the TCE plume (02_DGMW60) and one in the PCE plume (02NEW08A). Pumping will continue until a steady state condition is achieved, then pumping from a second well at each plume location will be initiated until a steady state condition is again reached, then pumping from a third well at each plume location will be initiated. Based on a review of previous extraction test results, the anticipated starting flow rates for each pumping well were estimated. These flow rates and anticipated sequence of operation are summarized in Table C-1.

Table C-1: Summary of Initial Flow Rates and Anticipated Sequence of Operation

Extraction Well ID	Initial Flow Rate (gpm)	Maximum Anticipated Flow Rate (gpm)	Sequence of Operation	Plume Area
02_DGMW60	1.0	3	First	TCE Plume Area
02NEW17	1.0	3	Second	
02NEW13	0.3	2	Third	
02NEW08A	1.0	5	First	PCE Plume Area
02_DGMW61	1.0	3	Second	
02NEW22	1.0	3	Third	

MAXIMUM INFLUENT CONCENTRATIONS OF MAJOR CONSTITUENTS

The most recent groundwater sampling results indicate that the major constituents in the influent stream are TCE and PCE. Minor constituent that may be in the influent stream include cis- and trans-1,2-dichloroethene. Perchlorate has been detected in two of the proposed extraction wells. The TCE concentrations in the proposed extraction wells has ranged from 0.5 µg/L to 203 µg/L; PCE concentrations ranged from 0.3 µg/L to 20 µg/L; 1,2-dichloroethene concentrations ranged from 0.8 µg/L to 22 µg/L. Perchlorate concentrations in well 02NEW08A ranged from 8.2 µg/L to 11 µg/L. Table C-2 lists the maximum historic concentrations of the major influent stream constituents.

Table C-2: Maximum Historic Influent Concentrations of Major Constituents

Extraction Well ID	TCE (µg/L)	PCE (µg/L)	Total 1,2-DCE (µg/L)	Perchlorate (µg/L)
02_DGMW60	203	8	22	-
02NEW17	152	6	19	-
02NEW13	92	8	10	-
02NEW08A	0.6	19	-	11
02_DGMW61	2	20	-	-
02NEW22	-	8	-	-

Notes:
µg/L = micrograms per liter
TCE = trichloroethene
PCE = tetrachloroethene
Total 1,2-DCE = total 1,2-dichloroethene

The average volume of groundwater that is estimated to be treated on a month-to-month basis is shown in Table C-3. This table also shows the mass loading that is expected for the treatment system on a month-to-month basis. The basic assumptions are: 1) the concentrations of the groundwater constituents remain constant throughout the extraction period; 2) the second and third extraction wells are brought on-line after one month of operation of each preceding well; and 3) since the concentrations of other constituents are relatively low, they are not included in the volume and mass loading calculations.

Table C-3: Cumulative Volume and VOC Mass Loading for the Treatment System

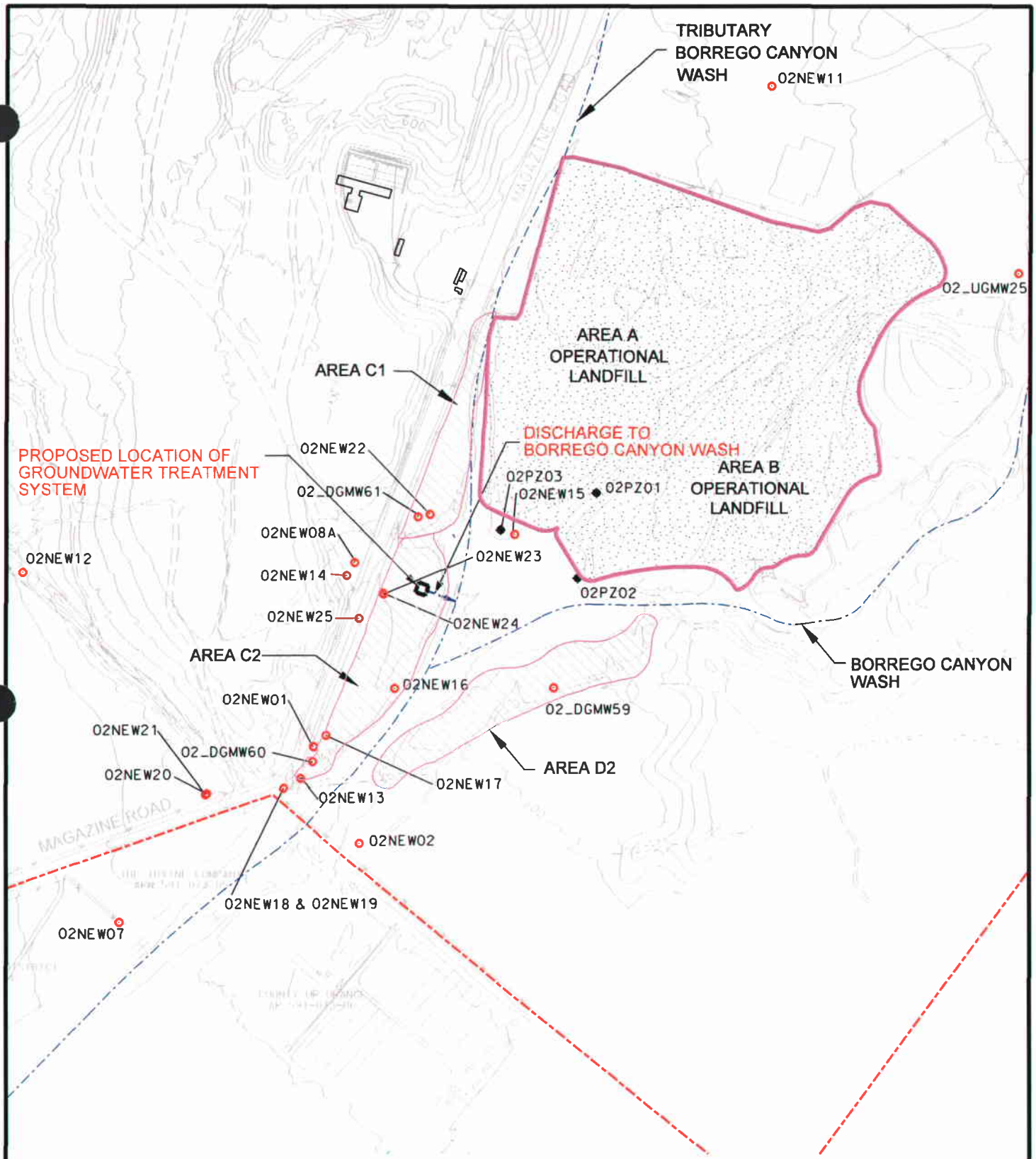
Month	Number of Extraction Wells	Cumulative Volume[1] (gallons) [gallons per day[2]]	Constituent Mass Loading (pounds)
First	2	172,800 [5760]	0.094
Second	4	518,400 [11,520]	0.309
Third	6	907,200 [17,280]	0.573
Fourth	6	1,468,800 [17,280]	0.838
Fifth	6	1,944,000 [17,280]	1.102
Sixth	6	2,419,200 [17,280]	1.367

Note:
[1] Assumes an average flow rate of 2 gpm for each extraction well.
[2] The value in the [ ] parenthesis denotes volume in gallons per day.

DETAILS OF THE TREATMENT SYSTEM COMPONENTS

The location of the proposed treatment system on the IRP Site 2 footprint is shown in Figure C-1 and a schematic process-flow diagram is shown on Figure C-2.

Piping. Piping for the treatment system shall consist of Schedule 80 polyvinyl chloride (PVC) material. All piping shall be leak tested prior to shipment. The piping shall be tested at a minimum pressure of 80 pound per square inch – gauge (psig) for a period of not less than 2 hours. The pipe routing will allow for easy access to valves and fittings, instrumentation, and control devices. Each line will be labeled to identify flow content and flow direction.



Work Plan	Final
Treatment System Location	
Aquifer Test, IRP Site 2, Magazine Landfill	
Date 03-02	MCAS El Toro
Project No. 37380	EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY
	Figure C-1

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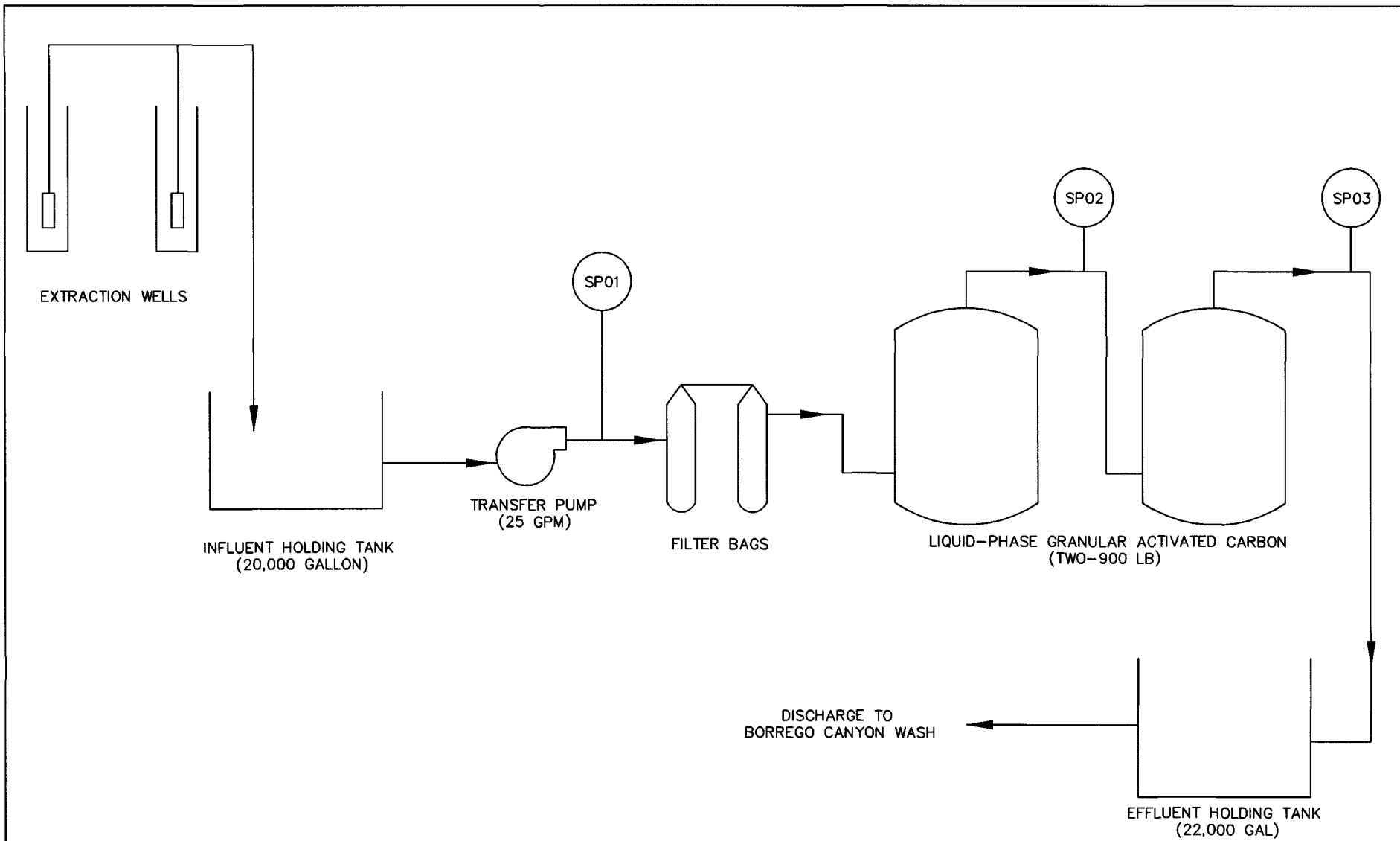

Work Plan		Final
Groundwater Treatment System Process Flow Diagram Aquifer Test IRP Site 2		
Date 03-02	Former MCAS El Toro	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	C-2

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Valves. The treatment system will be equipped with valves to control the direction and rate of flow, isolate individual components for servicing, and isolate instrumentation and sample ports. Valves will be oriented parallel with vertical or horizontal axes of reference. Valves shall be installed with stems upright or horizontal, not inverted. Valves will be firmly supported to avoid undue stress on the piping system. All valves shall be installed such that easy access during operation, removal, and maintenance is provided.

Instrumentation and System Control. Operation of the treatment systems shall be entirely automatic with alarm indication of malfunction and for routine maintenance. The minimum requirements for controls, instrumentation, and alarms are discussed below. The raw feed pump or transfer pump shall be controlled with liquid-level probes placed in the untreated water or equalization tank. The pump discharge line shall be equipped with a high-pressure pump shut-off switch. The carbon vessels shall have a pressure differential indicator.

Electrical. All electrical components, including but not limited to motors, probes, switches, enclosures, conduit, and other appurtenances, shall conform to National Fire Protection Association (NFPA) 70 requirements for operation.

System Installation. All system components shall be securely mounted on a common steel skid base. All equipment shall be factory piped and wired on a common epoxy-painted steel skid.

Equalization Tanks. The 20,000-gallon capacity equalization tanks will provide adequate storage buffer for steady water flows to the subsequent water treatment system and will be equipped with necessary liquid-level sensors to monitor the water level inside the tank.

Transfer Pump. A centrifugal feed pump with liquid controls delivers the water from the equalization tank through two in-line bag filters to the Liquid-Phase Granular Activated Carbon (LPGAC). The feed pump is capable of pumping 25 gpm, at a total discharge head of 100 feet.

In-line Bag Filters. Two 10-micron filters remove any particulate matter greater than 10 microns in size from the water stream, thereby protecting the downstream process equipment, piping, and instrumentation from clogging. The bag filters will have differential pressure gauges, which indicate when the filter needs to changed and can be bypassed during filter change-out by means of isolation valves.

LPGAC. Two 1,000-pound carbon-vessels containing virgin liquid-phase granular activated carbon.

Effluent Holding Tank. A 20,000-gallon holding tank will store the treated effluent pending discharge to the Borrego Canyon Wash.

GROUNDWATER TREATMENT SYSTEM OPERATION

The extracted water from individual extraction wells is pumped into the equalization tanks via 2-inch Schedule 80 PVC piping or hoses. A transfer pump then delivers the water from the equalization tank to the LPGAC via the filters. A flow meter records the cumulative flow of the treated groundwater. These LPGAC vessels are operated in series and the water enters from the top and flows down through each of the carbon beds. The carbon vessels will be valved to allow changes in the lead-lag sequence following carbon change-outs. Groundwater will be monitored using a sample port (SP01) located at the inlet of the lead granular activated carbon (GAC) unit and represents influent groundwater. Sample port SP02 (midpoint) is located between the lead and lag LPGAC vessels and will be used to monitor breakthrough of VOCs through the lead carbon vessel. Sample port SP03 is located at the outlet of second (lag) GAC unit and represents treated water from

the treatment system. The treated groundwater will be temporarily stored in a 20,000-gallon effluent holding tank prior to discharge to the Borrego Canyon Wash. The treatment system will be equipped with pressure gauges (inlet, midpoint, and outlet) to record the pressure variations within the treatment system. The groundwater treatment system will initially be operated in a batch mode of 20,000 gallons and then operated in a steady mode after the first batch.

OPERATION AND MAINTENANCE

Routine maintenance is required on all components of the system. Any repairs to the system shall be made as soon as possible after the need is identified. All wellheads, well boxes, and access areas shall be kept clean and free of debris, liquids, and rainwater. All valves shall be kept operable and properly adjusted, and all sample ports shall be maintained in usable condition. The hoses and connections to the groundwater extraction pumps will be periodically inspected for splits and cracks. All aboveground piping shall be inspected for physical damage and degradation. The in-line filters shall be visually checked for damage, leaks, or corrosion. The maintenance of the LPGAC skid shall include visual check of the pressure gauges and adjustments to valves and regulators, tightening flanges, and connections to eliminate leakage and backwashing.

MONITORING AND SAMPLING DETAILS

As a part of monitoring, data will be collected from the groundwater treatment system and the extraction wells weekly to monitor its performance. Monitored parameters include temperatures, pressures, and flow-rates of each process component of the groundwater treatment system. At each extraction well, the flow rate and depth to water will be recorded. As a part of sampling activity, water samples will be collected from two sample ports (inlet [SP01] and outlet [SP03]) within the groundwater treatment system every month. The effluent from the lead carbon vessel (midpoint) will be collected from midpoint port SP02 after every 100,000-gallons or biweekly to check for breakthrough point in the lead carbon vessel. The activated carbon in the lead vessel will be replaced once the concentrations at the midpoint port exceed the discharge requirements. The piping/hose configuration will then be changed to make the vessel with new activated carbon the polish/lag unit.

Prior to the start of the treatment, a single groundwater sample from the equalization tank will be collected for the fish toxicity test and Title 22 metal analysis. All water samples collected from the sample port locations (SP01, SP02, and SP03) will be analyzed for constituents as shown in Table C-3. For most constituents, the most stringent of the federal or state primary drinking water standards (MCLs) will be used as maximum allowable concentrations for contaminants in the treated effluent water at IRP Site 2. For constituents with no MCLs, the maximum allowable concentration will be the average monthly concentration in new general waste discharge permit for the Santa Ana Region.

Table C-3: Treatment System Sampling and Monitoring Schedule

		Influent		Midpoint		Effluent		
Parameter/Method	Discharge Requirement (µg/L)	Record/ Analyze	Frequency	Record/ Analyze	Frequency	Record/ Analyze	Frequency	Remarks
Flowrate		√	Daily					Flow rate monitored and recorded daily during system operation
PH		√	Monthly			√	Monthly	
Temperature		√	Monthly			√	Monthly	
Total Petroleum Hydrocarbons	100	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	Effluent samples will be collected weekly for the first month and biweekly thereafter. For constituents (i.e., non-VOC) that are not detected during the first month of operation, the sampling frequency will be changed to monthly.
Benzene	1	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Toluene	150	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Xylene	1750[1]	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Ethylbenzene	700	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Carbon Tetrachloride	0.5	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Chloroform	80[2]	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Dichlorobromomethane	80[2]	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Methyl Ethyl Ketone	120	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	

Table C-3: Treatment System Sampling and Monitoring Schedule

		Influent		Midpoint		Effluent		
Parameter/Method	Discharge Requirement (µg/L)	Record/ Analyze	Frequency	Record/ Analyze	Frequency	Record/ Analyze	Frequency	Remarks
Methyl Isobutyl Ketone	120	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
MTBE	13	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Naphthalene	10	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Tetrachloroethene (PCE)	5	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Trichloroethylene (TCE)	5	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
1,1-Dichlorethane	5	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
1,1-Dichloroethylene	6	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
1,2-Dichloroethylene	5	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
1,1,1-Trichloroethane (TCA)	200	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
TBA	5	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	
Total Residual Chlorine	100	√	Monthly	√	Biweekly or every 100,000 gallons	√	Monthly	

Table C-3: Treatment System Sampling and Monitoring Schedule

		Influent		Midpoint		Effluent		
Parameter/Method	Discharge Requirement (µg/L)	Record/ Analyze	Frequency	Record/ Analyze	Frequency	Record/ Analyze	Frequency	Remarks
Sulfides	0.4	√	Monthly	√		√	Monthly	
Total Dissolved Solids (TDS)		√	Monthly	√		√	Monthly	
Suspended Solids	75	√	Monthly	√		√	Monthly	
Perchlorate	4	√	Monthly	√		√	Monthly	
1,4-Dioxane		√	Monthly	√		√	Monthly	
Fish Toxicity	LC_{50} (96 hours)	√	One time			√	One time	One time evaluation to document that the groundwater does not pose a risk to aquatic organisms
Title 22 Metals		√	One time			√	One time	

Notes:
1 MCL is for either a single isomer or sum of the isomers.
2 1998 Final Rule for Disinfectants and Disinfection By-products: The total for trihalomethanes is 80 µg/L.