AR_N00217_000936
HUNTERS POINT
SSIC NO. 5090.3.A

FINAL

IN SITU SEQUENTIAL ANAEROBIC–AEROBIC BIOREMEDIATION TREATABILITY STUDY

Remedial Unit C5, Building 134
Installation Restoration Site 25
Hunters Point Shipyard
San Francisco, California

Environmental Multiple Award
Contract Number N68711-01-D-6011
Contract Task Order 0004

Document Control Number NAV004-031-H

November 23, 2005

Submitted to:

Base Realignment and Closure
Program Management Office West
1230 Columbia Street
San Diego, California 92101

Submitted by:

Shaw Environmental, Inc.
4005 Port Chicago Highway
Concord, California 94520-1120

FINAL

IN SITU SEQUENTIAL ANAEROBIC–AEROBIC BIOREMEDIATION TREATABILITY STUDY

Remedial Unit C5, Building 134
Installation Restoration Site 25
Hunters Point Shipyard
San Francisco, California

Environmental Multiple Award
Contract Number N68711-01-D-6011
Contract Task Order 0004

Document Control Number NAV004-031-H

November 23, 2005

Approved by: _____ Date: 11/23/05
Daniel P. Leigh P.G., R.G., C.H.G.
Shaw Technical Manager

REGISTERED GEOLOGIST Daniel P. Leigh No. 6872 STATE OF CALIFORNIA

Approved by: Suman Sharma Date: 11/23/05
Suman Sharma
Shaw Sr. Project Scientist

Approved by: _____ Date: 11/23/05
David A. Cacciatore, Ph.D., P.E.
Shaw Project Manager

REGISTERED PROFESSIONAL ENGINEER DAVID ADAM CACCIATORE NO. CH6035 EXP. 3-31-06 CHEMICAL STATE OF CALIFORNIA

Shaw Environmental, Inc.

4005 Port Chicago Highway
Concord, CA 94521
Phone: 925.288.9898
Fax: 925.288.0888

Shaw™ Shaw Environmental, Inc.

November 23, 2005

DCN: NAV004-039-H

Ms. Kyle Olewnik, Contract RPM
Department of the Navy
Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

Subject: **EMAC – Contract No. N68711-01-D-6011**
Contract Task Order No. 004, Hunters Point, CA
Transmittal of Final Treatability Study Report

Dear Mr. Brooks:

This letter transmits the *Final In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study Remedial Unit C5, Building 134, IR Site 25, Hunters Point Shipyard, San Francisco, California*. This submittal incorporates editorial comments generated from the Agencies' review of the draft document.

If you have any questions, please contact me at (925) 288-2299, or Dan Leigh at (925) 288-2193.

Sincerely,

David A. Cacciatore, Ph.D., P.E.
Project Manager

Enclosures

cc:

Shaw	SWDIV
D. Cacciatore	D. Silva (2)
D. Leigh	K. Foreman
S. Sharma	P. Brooks
M. Yurovsky	
EMAC Program Files	

Table of Contents

List of Figures iv
List of Tables iv
List of Photos iv
List of Appendices v
Acronyms and Abbreviations vi

Executive Summary ES-1
1.0 Introduction 1-1
1.1 Site Description and Background 1-1
1.2 Installation Restoration Site 25 1-2
1.3 Objectives 1-5
1.4 Scope of Work 1-5
1.5 Project Time Line 1-6
2.0 Site Geology 2-1
2.1 Hydrogeology 2-1
2.1.1 Site Stratigraphy and Lithology 2-1
2.1.1.1 Artificial Fill 2-1
2.1.1.2 Undifferentiated Upper Sand 2-1
2.1.1.3 Bay Mud 2-2
2.1.1.4 Undifferentiated Sediments 2-2
2.1.1.5 Bedrock 2-2
2.1.2 Hydrostratigraphy 2-2
2.1.2.1 A-Aquifer 2-3
2.1.2.2 Bedrock Water-bearing Zone 2-4
2.1.3 Tidal Effects 2-4
2.1.4 Groundwater Flow Patterns 2-4
2.1.5 Hydraulic Characteristics 2-5
2.1.5.1 Groundwater Flow Velocity 2-5
2.1.6 Hydrogeological Conceptual Model Summary 2-5
2.2 Nature and Extent of Contamination in Groundwater at RU-C5 2-6
3.0 Dechlorination of Chlorinated Ethenes Process 3-1
3.1 Chlorinated Ethenes 3-1
3.2 Chlorinated Benzenes 3-3
3.3 Chlorinated Ethanes 3-4
4.0 Performance Boring Drilling and Temporary Well Installation 4-1
4.1 Site Preparation 4-1
4.2 Direct Push Soil Borings 4-1
5.0 Treatability Study Operations 5-1
5.1 Stage 1 - Anaerobic ISB 5-1
5.1.1 Anaerobic Process System 5-1
5.1.2 Anaerobic Process Operations 5-2
5.1.2.1 Phase 1 – Substrate Injection and Distribution 5-2
5.1.2.2 Phase 2 – Biodegradation Monitoring 5-2

5.2 Stage 2 - Aerobic ISB 5-3
5.2.1 Aerobic Process System 5-3
5.2.2 Aerobic Process Operations 5-3
5.3 Groundwater Sampling and Monitoring 5-3
5.4 Soil Sampling 5-4
5.5 Waste Management 5-4
5.5.1 Solid Waste 5-4
5.5.2 Liquid Waste 5-5
6.0 Treatability Study Monitoring Results 6-1
6.1 Groundwater Results for the Locations Within Treatment Area 6-1
6.1.1 Biostimulation Results 6-1
6.1.2 Field Parameters and General Chemistry Results 6-1
6.1.2.1 pH 6-2
6.1.2.2 Specific Conductance 6-2
6.1.2.3 Temperature 6-3
6.1.2.4 Dissolved Oxygen 6-3
6.1.2.5 ORP 6-3
6.1.2.6 Nitrate 6-4
6.1.2.7 Ferrous Iron 6-4
6.1.2.8 Sulfate and Sulfide 6-4
6.1.3 Volatile Organic Acids and Alkalinity 6-5
6.1.3.1 Volatile Organic Acids 6-5
6.1.3.2 Alkalinity 6-6
6.1.4 Total Organic Carbon 6-6
6.1.5 Volatile Chlorinated Solvents 6-7
6.1.5.1 Chlorinated Ethenes 6-7
6.1.5.2 Chlorinated Ethanes 6-7
6.1.6 Dissolved Gasses 6-7
6.1.6.1 Ethene and Ethane 6-7
6.1.6.2 Methane 6-8
6.1.7 Semivolatile Organics 6-8
6.1.7.1 Chlorinated Benzenes 6-8
6.1.7.2 Diesel Range Organics 6-8
6.1.7.3 Phenols 6-8
6.1.7.4 PCBs 6-9
6.1.8 Dissolved Metals 6-9
6.1.8.1 Arsenic 6-9
6.1.8.2 Cadmium 6-10
6.1.8.3 Chromium 6-10
6.1.8.4 Manganese 6-10
6.1.8.5 Mercury 6-11
6.2 Results for Groundwater for the Locations Outside of Treatment Area 6-11
6.3 Soil Samples Results 6-13
6.4 Data Quality Assessment 6-13

7.0 Discussion of TS Results 7-1
7.1 Summary of Stage 1 TS – Anaerobic Bioremediation 7-1
7.1.1 Evaluation of Geochemical Changes 7-3
7.1.1.1 Oxygen & Oxidation Reduction Potential 7-4
7.1.1.2 pH 7-4
7.1.1.3 Specific Conductance 7-4
7.1.1.4 Ferrous Iron 7-4
7.1.1.5 Sulfate 7-5
7.1.1.6 Methanogenesis 7-5
7.1.1.7 Total Organic Carbon 7-5
7.1.1.8 Volatile Organic Acids 7-6
7.1.1.9 Propionic Acid 7-6
7.1.2 Chlorinated Organics 7-6
7.1.2.1 Chlorinated Ethenes Biodegradation (PCE, TCE, DCE, and VC) 7-6
7.1.2.2 Chlorobenzenes Biodegradation (1,2,4-TCB, 1,2-DCB, 1,3-DCB, 1,4-DCB, and CB) 7-9
7.1.2.3 Chlorinated Ethanes 7-10
7.1.3 Other Chemicals of Concern 7-11
7.1.4 Vertical Migration 7-11
7.2 Summary of Stage 2 Aerobic ISB 7-11
7.2.1 Geochemical Changes 7-12
7.2.1.1 Oxygen 7-12
7.2.1.2 Oxidation-Reduction Potential (ORP) 7-13
7.2.1.3 pH 7-13
7.2.1.4 Specific Conductance 7-13
7.2.1.5 Ferrous Iron 7-13
7.2.1.6 Sulfate 7-13
7.2.1.7 Methane 7-14
7.2.1.8 Total Organic Carbon 7-15
7.2.2 Organics 7-15
7.2.2.1 Chlorinated Organics 7-15
7.2.2.2 Non Chlorinated Organics 7-16
7.3 Evaluation of Large Diameter Well for Enhancement of Groundwater Extraction 7-17
7.4 Evaluation of Extent of Aerobic Conditions 7-17
7.5 Evaluation of Dehalococcoides sp Population 7-18
7.6 Evaluation of Metals in Groundwater 7-20
8.0 Conclusions and Recommendations 8-1
8.1 Design Information 8-1
8.2 Stage 1 - Anaerobic Biodegradation Conclusions 8-2
8.3 Conclusions Stage 2- Aerobic Biodegradation 8-4
8.4 Recommendations 8-4
8.5 Summary 8-5
9.0 References 9-1

List of Figures

Figure 1 Site Location Map
Figure 2 Treatability Study Area - Groundwater Monitoring Well Locations
Figure 3 Building 134 Utilities Drawing
Figure 4 Monitoring Probe, Well, and Soil Boring Locations
Figure 5 Treatability Study Test Cell Cross Section
Figure 6 Fraction of Organics in DNAPL (Well IR25MW902A)
Figure 7 Dechlorination Pathway of Chlorinated Ethenes
Figure 8 Dechlorination Pathway of Chlorinated Benzenes
Figure 9 Dechlorination Pathway of Chlorinated Ethanes (1,2-DCA)
Figure 10 Anaerobic ISB Injection Skid Schematic Diagram
Figure 11 In-Well Equipment, Anaerobic ISB
Figure 12 Aerobic ISB Injection Skid Schematic Diagram
Figure 13 In-Well Equipment, Aerobic ISB

List of Tables

Table 1 Timeline for Sequential Aerobic Anaerobic Bioremediation Treatability Study at Site RU-C5, Hunters Point Shipyard
Table 2 Groundwater Sampling Locations and Frequency
Table 3 Groundwater Elevations RU-C5 Building 134, Hunters Point Shipyard

List of Photos

Photo No. 1 Exterior of Building 134 and conceptual cross section
Photo No. 2 Treatability study area and bioremediation system layout

List of Appendices

Appendix A	Boring Logs (Hardcopy)
Appendix B	Chains of Custody
Appendix C	Groundwater Analyses Data Summary Table for the Treatment Area
Appendix D	Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area
Appendix E	Soil Analyses Data Summary Table
Appendix F	Chemical Data Graphs
Appendix G	Laboratory Analytical Reports
Appendix H	Data Quality Assessment
Appendix I	Daily Report Logs
Appendix J	Response to Comments (Hardcopy)

Acronyms and Abbreviations

%	percent
°C	degree(s) Celsius
µg/L	microgram(s) per liter
1,2-DCA	1,2-dichloroethane
1,3-DCB	1,3-dichlorobenzene
1,2-DCB	1,2-dichlorobenzene
1,4-DCB	1,4-dichlorobenzene
APCL	Applied Physics and Chemistry Laboratory
As	arsenic
AST	aboveground storage tank
bgs	below ground surface
CA	chloroethane
CB	chlorobenzene
Cd	cadmium
cell/mL	cell per milliliter
CH_4	methane
cis-1,2-DCE	cis-1,2-dichloroethene
cm^3/min	cubic centimeter(s) per minute
cm/sec	centimeters per second
COPC	chemical of potential concern
CO_2	carbon dioxide
Cr	chromium
CTO	Contract Task Order
DCA	dichloroethane
DCB	dichlorobenzene
DCE	dichloroethene
DHC	Dehalococcoides *sp*
DNA	deoxyribonucleic acid
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
Eh	redox potential
EMAC	Environmental Multiple Award Contract
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ERH	electrical resistance heating
Fe	iron
Fe^{2+}	ferrous iron
Fe^{3+}	ferric iron
ft	foot (feet)
ft/day	foot (feet) per day
ft/ft	feet per foot (feet)
GDGI	Groundwater Data Gaps Investigation
gpm	gallon(s) per minute

H_2	hydrogen
H_2O	water
Hg	mercury
HPS	Hunters Point Shipyard
IR	Installation Restoration
iSOC™	in-situ Submerged Oxygen Curtain
IT	IT Corporation
ISB	in situ bioremediation
mg/L	milligram(s) per liter
Mn	manganese
MP	monitoring point
mS/cm	milliSiemen(s) per centimeter
MSDS	material safety data sheet
mV	millivolt
Navy	U.S. Department of the Navy
NSTI	Naval Station Treasure Island
O_2	oxygen
ORP	oxygen-reduction potential
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCR	polymerase chain reaction
Phase II GDGI	Phase II Groundwater Data Gaps Investigation
PRC	PRC Environmental Management, Inc.
RI	Remedial Investigation
RU	Remedial Unit
SC	specific conductance
SO_4	sulfate
SU	standard unit(s)
SVE	soil vapor extraction
SVOC	semivolatile organic compound
TCA	trichloroethane
TCB	trichlorobenzene
TCE	trichloroethene
TDS	total dissolved solids
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons as diesel
TPH-e	total petroleum hydrocarbons extractable
TS	Treatability Study
TtEMI	Tetra Tech EM, Inc.
VC	vinyl chloride
VOA	volatile organic acid
VOC	volatile organic compound
WBZ	water-bearing zone

Executive Summary

An In Situ Bioremediation (ISB) Treatability Study (TS) was conducted at Building 134 in Remedial Unit C5 (RU-C5) at Hunters Point Shipyard (HPS). The TS, which was conducted from April 2004 until May 2005, evaluated the potential for ISB to treat chlorinated and non-chlorinated organics present in the groundwater at RU-C5. Prior to base closure, the TS site (a portion of Building 134) was used by the Navy for degreasing operations. A degreasing rack and associated degreaser pit were located inside the building and an attached separator was located directly outside the building. Based on contaminant distribution and historical use of solvents at the site, the degreaser pit and separator are considered to be the source of contaminants.

Previous investigations and baseline soil and groundwater analyses confirmed that soil and groundwater had been affected by a variety of chlorinated and non-chlorinated organics. Chlorinated organics primarily consisted of chlorinated ethenes including tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene, and vinyl chloride; chlorinated benzenes including 1,2-dichlorobenzene and 1,4-dichlorobenzene (1,2-DCB and 1,4-DCB, respectively), and chlorobenzene; and chlorinated ethanes including 1,2-dichloroethane. Non-chlorinated organics detected at the site include various petroleum hydrocarbons such as benzene, polychlorinated aromatic hydrocarbons, total petroleum hydrocarbons, and non-petroleum-related hydrocarbons such as phenols. Generally, the concentration of non-chlorinated organics is substantially lower than that of the chlorinated organics. Much lower concentrations of other contaminants were also observed at the site.

Small amounts of dense non-aqueous phase liquids (DNAPLs) have been detected in several of the wells located at the site. During previous investigations, analysis of these DNAPLs indicated that they consist primarily of chlorinated benzenes including 1,2-DCB (48 percent by weight [%]) and 1,4-DCB (11%), and chlorinated ethenes including PCE (12%) and TCE (1.5%). The remaining 27.5% consists of a variety of chlorinated and non-chlorinated organics, and moisture.

Baseline soil and groundwater analysis indicated that conditions were favorable for enhanced biodegradation of the contaminants. The presence of chlorinated ethene degradation products, including dichloroethene and vinyl chloride, and chlorinated benzene degradation products, including chlorobenzene, indicated that ISB of the contaminants was already occurring in the TS area. In addition, the microorganism capable of complete degradation of the chlorinated ethenes (Dehalococcoides *sp*) was observed in groundwater collected from the TS area. Based on site conditions, it was determined that biostimulation of the indigenous organisms, by supplying appropriate substrate, would be sufficient for degradation of the observed contaminants.

Prior to conducting the TS, the degreaser pit and separator were removed from the site. In addition, affected soils in the degreaser pit area were excavated to the top of the water table, a depth of approximately 7 feet below ground surface. Soil in the separator area was excavated to a depth of approximately 18 feet below ground surface. The excavated material was characterized and disposed of at an appropriate landfill. The degreaser pit excavations was back filled with clean fill soil and finished with 8 inches of concrete. The separator area excavation was back filled with gravel.

The TS was conducted in two stages including an anaerobic ISB stage (Stage 1) and an aerobic ISB stage (Stage 2). The purpose of Stage 1 was to evaluate the biological degradation of chlorinated organics including the chlorinated ethenes, ethanes, and benzenes under anaerobic conditions. Stage 1 extended from April to December 2004. The purpose of Stage 2 was to evaluate the biodegradation of potentially reduced residual chlorinated organics and non-chlorinated organics under aerobic conditions. Stage 2 extended from January to May 2005.

The TS was conducted in the area of the former degreaser and separator pits within and just out of the Building 134. The TS system consisted of an extraction well (IR25EW01A), an injection well (IR25IW02A), and two intermediate groundwater monitoring wells (IR25MW53A and IR25MW54A). For the sake of brevity, the IR25 suffix will be omitted from the reference to the wells discussed in this text. Existing wells were also used for baseline and post-TS perimeter monitoring. An additional well (MW56A) was installed to evaluate the potential for vertical migration of the contaminants during substrate distribution.

Anaerobic biodegradation of the chlorinated organics in Stage 1 was accomplished by pumping groundwater from the extraction well, amending the extracted water with sodium lactate, and injecting the amended water into the injection well. In addition, hydrogen gas was introduced into the well during recirculation. Throughout the TS, groundwater recirculation was ineffective in distributing the substrate. Therefore, to increase substrate distribution, groundwater was extracted from the extraction well, amended with sodium lactate, and injected into MW54A. This resulted in the distribution of substrate throughout the remainder of the TS area. Hydrogen gas was later added to MW54A in an attempt to accelerate dechlorination rates.

Reducing conditions conducive to the biodegradation of the chlorinated organics within the TS wells were established during the anaerobic stage. Geochemical changes indicative of transformation to reducing conditions were observed in each TS well. Reductive dechlorination of the chlorinated ethenes and chlorinated benzenes occurred once highly reducing conditions were established. Complete degradation of chlorinated ethenes to ethene and ethane was observed in three of the TS wells. Reductive dechlorination of 1,2-DCB and 1,4-DCB to chlorobenzene was observed in each of the monitoring wells. Reductive dechlorination of

chlorobenzene to benzene was also observed, although the degradation rate during this TS was found to be very slow.

Although degradation of 1,2-dichloroethane was observed, the process did not result in the production of chloroethane, as would be anticipated if the degradation proceeded through sequential reductive dechlorination. An alternative process for the degradation of dichloroethane may be dichloroelimination, where two chlorine atoms are removed simultaneously, resulting in the production of ethane and possibly ethene. Both ethene and ethane were observed during the anaerobic TS.

Evaluation of data from performance monitoring well MW54A was inconclusive as to the rates of degradation of the chlorinated organics at that location. Although ethene was present at that location, indicating complete reductive dechlorination was occurring; PCE and TCE were present throughout Stage 1. In addition, the concentration of the contaminants varied widely between sampling events with no evidence of the sequential degradation pattern observed.

Post-anaerobic stage analysis identified the presence of DNAPL adjacent to performance monitoring well MW54A. The presence of the DNAPL is considered to substantially affect the evaluation of the data from that well. The data indicate that complete anaerobic biodegradation of the chlorinated ethenes to ethene is occurring at that location; however, the presence of a continuing source of parent products prevents the determination of the contaminant degradation rates.

Introduction of oxygen (O_2) to the TS area successfully facilitated aerobic biodegradation of non-chlorinated organics and residual reduced chlorinated organics. O_2 delivery was accomplished using iSOC™ technology, or an in situ Submerged Oxygen Curtain, which provides high concentrations of gas without sparging the groundwater. iSOC™ units were installed in each of the TS area performance monitoring wells. O_2 was then delivered from gas cylinders at flow rates that would not result in stripping of volatile organic compounds.

During the aerobic stage, conditions conducive to the aerobic biodegradation of organics were established in the TS wells. Geochemical parameters indicative of aerobic conditions indicated that many of the parameters had returned to their pre-Stage 1 condition. Elevated concentrations of oxygen were established in each of the TS performance monitoring wells. Data confirmed that the addition of the oxygen stimulated the indigenous microorganisms, thus degrading the remaining chlorobenzene and benzene.

The TS demonstrated that sequential anaerobic and aerobic ISB is an effective treatment technology for mixed chlorinated organic plumes, such as that observed at RU-C5. The combination of ISB techniques accomplished the degradation of chlorinated and non-chlorinated

organics to concentrations below drinking water standards. A highly-effective population of Dehalococcoides *sp* is present at RU-C5, and therefore, biostimulation alone is effective for degradation of the chlorinated ethenes and benzenes.

Because of the highly heterogeneous site hydrogeologic conditions, groundwater recirculation was determined to be an ineffective mechanism for substrate delivery in low-permeability sediments encountered at RU-C5. Although the iSOCs were effective at creating aerobic conditions adjacent to the injection locations, the method was not effective for creating a large aerobic area. The presence of DNAPLs prohibited the quantification of ISB degradation rates in well MW54A; however, ISB is considered to be occurring at that location based on the presence of ethene and ethane.

Based on the results of the successful TS, the following evaluation work may be considered:

- Evaluate the combination of processes for treatment of DNAPL and dissolved-phase contaminants. Such treatment processes may include injection of high concentration substrate to increase solubility of DNAPL and increase biodegradation rates. Also, physical removal processes, such as combinations of electrical resistance heating and biodegradation or chemical oxidation, may be effective treatment technologies.

- Evaluate alternate substrate distribution technologies. The TS demonstrated that chlorinated ethenes will be completely degraded in the presence of substrate. However, substrate distribution by recirculation was demonstrated to be ineffective in low-permeability aquifers. High-pressure injection has been effectively demonstrated for distribution of solid reductants at HPS, and therefore should be equally applicable for biological substrate distribution.

- Hydrogen was demonstrated to be effective for enhancement of biodegradation. Although aquifers with low hydraulic conductivity reduce the substrate distribution of liquid substrates, they are highly permeable to gases such as hydrogen and O_2. Therefore, the addition of hydrogen gas may be an effective substrate enhancement in low-permeability aquifers.

- Addition of O_2 was demonstrated to be an effective mechanism for enhancement of aerobic biodegradation of chlorobenzene and non-chlorinated organics. Although the iSOC™ technology was effective in creating small highly aerobic areas, a more aggressive mechanism for O_2 delivery is recommended. These mechanisms may include low-flow biosparging of O_2, hydrogen peroxide addition, and ozonation or solid O_2 addition such as Oxygen Release Compound (ORC) or Permox.

The TS at RU-C5 demonstrated a process that can be applied at HPS for ISB of many organics observed. The technology can be modified and enhanced for application to several sites at HPS. The presence of a highly efficient chlorinated ethene degrading culture at HPS provides a mechanism for bioaugmentation throughout the shipyard, without requiring the introduction of a non-indigenous organism.

1.0 Introduction

This Treatability Study (TS) Report has been prepared by Shaw Environmental, Inc. for the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command, Southwest Division, under Contract Number N68711-01-D-6011. This work was performed as part of Shaw's Firm Fixed Price Environmental Multiple Award Contract (EMAC) for Remediation Services pursuant to the *Final Project Plans, In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study, Remedial Unit C5, Building 134, Hunters Point Shipyard, San Francisco, California* (herein referred to as the Work Plan) (Shaw, 2004a). Shaw conducted a Sequential Anaerobic-Aerobic Bioremediation TS in Building 134, Installation Restoration (IR) Site 25, Hunters Point Shipyard (HPS), San Francisco, California, under Contract Task Order (CTO) Number 04.

This section provides a brief description of the site, including background, fill history, hydrogeology, nature and extent of groundwater contamination, TS objectives, TS scope of work, and TS timeline.

1.1 Site Description and Background

HPS is located in the City and County of San Francisco, California, situated on a long promontory, extending eastward into San Francisco Bay (Figure 1, "Site Location Map, IR25, Building 134, Parcel C"). HPS consists of 936 acres, 493 of which are on land, and is divided into six parcels (A through F) to facilitate environmental investigation and cleanup activities. Parcel C consists of shoreline and lowland coast in the east-central portion of HPS along San Francisco Bay. The Sequential Anaerobic-Aerobic Bioremediation TS Area is within IR25 in Parcel C (Figure 2, "Treatability Study Area - Groundwater Monitoring Well Locations"). Utilities in the vicinity of the Treatability Study are presented in Figure 3 "Building 134 Utilities Drawing".

HPS has been utilized as a shipyard since the late 19th century. Beginning in the 1940s, the Navy operated HPS as a ship repair and maintenance facility. The Navy discontinued activities at HPS in 1974, and the shipyard remained relatively unused until 1976. From 1976 to 1986, the Navy leased HPS to Triple A Machine Shop, a private ship repair company. In 1986, the Navy resumed occupancy of HPS; however, Triple A did not vacate the property until March 1987. In 1989, due to the presence of hazardous materials from past Navy and Triple A operations, HPS was placed on the National Priorities List, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act of 1986. In 1991, HPS was selected for closure pursuant to the terms of the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510). Closure of HPS

includes conducting environmental remediation activities and transfer of the property to the City of San Francisco for future non-defense reuse.

The portion of the property now known as Parcel C has been used almost exclusively for industrial purposes since the late 1800s.

1.2 Installation Restoration Site 25

IR25 is located in the northwestern corner of Parcel C and covers an area of 1.5 acres. Building 134, the only structure located in IR25, was formerly used by the Navy as a machine shop and an industrial laboratory. Groundwater in the area surrounding subsurface degreaser pits in Building 134 was identified as Remedial Unit (RU) 6 in the *Draft Final Parcel C Feasibility Study, Hunters Point Shipyard, San Francisco, California* (Tetra Tech EM, Inc. [TtEMI], 1998). This designation was due to the presence of volatile organic compounds (VOCs) and other organic contaminants in groundwater and the potential for human health risk through inhalation and ecological risk to aquatic receptors. RU-6 was later expanded slightly to include the area surrounding Building 134 and renamed RU-C5, *Final Field Sampling Plan and Quality Assurance Plan [FSP/QAPP] for Phase I Groundwater Data Gaps Investigation* [GDGI], *Hunters Point Shipyard, San Francisco, California* (TtEMI, 2000). A complete list of the RU designations at HPS are provided in the *Parcel C Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California* (Groundwater Summary Report) (TtEMI, 2004). Based on the City of San Francisco's Redevelopment Plan, published in the Hunters Point Shipyard Redevelopment Plan, City and County of San Francisco (San Francisco Redevelopment Agency, 1997), the RU-C5 area will be zoned to accommodate mixed land use, referring to combined commercial, industrial, and residential.

Building 134 includes contained offices, machine shops, a refrigeration repair shop, an industrial quality and reliability assurance laboratory, and storage facilities. Degreaser pits within the building, labeled "chlorinated materials," were set within a sump that drained to an oil/water separator located outside the building. The tanks, sump, and oil/water separator were removed as part of Shaw's EMAC CTO 001, Task 5. Details of the removal activity are available in the *Construction Report, Well Decommissioning/Installation and Site Excavation, In Support of Anaerobic-Aerobic Bioremediation at RU-C5, Building 134, Hunters Point Shipyard, San Francisco, California* (Shaw, 2004b). Fuel distribution lines, which passed beneath the central part of Building 134, have been decommissioned. Fuel lines adjacent to the north and east of Building 134 were removed during remedial actions at Parcel B. Based on site usage, chemicals of potential concern (COPCs) at RU-C5 were identified in the Groundwater Summary Report (TtEMI, 2004) as solvents, oils, polychlorinated biphenyls (PCBs), acids, and metals.

Physical features of the RU-C5 vicinity and details of the separator and degreaser pit area in Building 134 are further described in the Groundwater Summary Report (TtEMI, 2004). The figures contained in that report also identify locations of water supply, storm drain, former fuel lines, former tank farm, associated IR06 excavations, and sanitary sewer lines, in addition to locations of monitoring wells, piezometers, and soil borings.

Soil investigations refined the COPCs suggested by site history. Eighty soil samples were collected from the RU-C5 vicinity during the Remedial Investigation (RI) and subsequent investigations *Draft Final Parcel B Remedial Investigation Report, Hunters Point Shipyard, San Francisco, California* (PRC Environmental Management, Inc. [PRC], 1996). *Draft Parcel B Construction Summary Report, Hunters Point Shipyard, San Francisco, California* (TtEMI, 2002). Samples of the sludge and oil in the degreaser pit and floor scrapings were also collected.

Following the investigations, the Navy identified the following COPCs in soil at RU-C5:

- Trichloroethene (TCE)
- Vinyl chloride (VC)
- 1,2-dichlorobenzene (1,2-DCB)
- 1,4-dichlorobenzene (1,4-DCB)
- Total petroleum hydrocarbons (TPH)
- Polychlorinated aromatic hydrocarbons (PAHs)
- Aroclor-1260
- Antimony
- Copper
- Lead
- Manganese (Mn)
- Zinc

Groundwater samples collected from the RU-C5 vicinity between 2000 and 2001 exceeded evaluation criteria established in the Field Sampling Plan/Quality Assurance Program Plan Addenda for Phase II Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California (Phase II GDGI) (TtEMI, 2001) for VOCs, metals, PCBs, pesticides, and semivolatile organic compounds (SVOCs). Twenty VOCs were detected above Phase II GDGI criteria; including TCE, tetrachloroethene (PCE), benzene, cis-1,2-dichloroethene (cis-1,2-DCE), chlorobenzene, 1-2-DCB, 1,4-DCB, and VC. Metals detected above Phase II GDGI criteria were aluminum, chromium (Cr), cobalt, Mn, nickel, thallium, and zinc. PCBs and pesticides detected above GDGI goals were Aroclor-1260, 4,4'-dichloro-diphenyl-trichloroethane, endrin, endosulfan, gamma-chlordane, and heptachlor epoxide. SVOCs detected

above Phase II GDGI goals included PAHs (benzo[a]pyrene, benzo[a]anthracene, fluoranthene, fluorine, naphthalene, and phenanthrene) and bis(2-ethylhexyl)phthalate.

Free-phase petroleum product has been observed at two wells in RU-C5 in 2002: IR25MW11A and IR25MW19A. For the sake of brevity, the IR25 suffix will be omitted from the reference to all wells discussed in the remainder of the text. Previous analysis of the product at MW11A showed that the fuel was in the diesel range; however, chlorobenzene and VC were also detected (TtEMI, 2002). In 2002, Shaw observed dense non-aqueous phase liquid (DNAPL) at MW15A2, MW19A, and MW902B. Analysis of the DNAPL from MW19A indicated the presence of multiple VOCs, dominated by dichlorobenzenes and PCE. Analytical results were documented in the Groundwater Summary Report (TtEMI, 2004). These wells are located within the area of groundwater contamination, near the northern end of Building 134. Analysis of the DNAPL collected from MW902B in 2001 revealed that the majority of the DNAPL consisted of chlorinated benzenes and chlorinated ethenes as shown in Figure 6, "Fraction of Organics in DNAPL (Well IR25MW902A)". DNAPL was also observed in 2004, in monitoring probe location MW54A-BH, installed to measure dissolved oxygen (DO) and other field parameters during the Stage 2 Aerobic ISB portion of the TS. Figure 4, "Monitoring Probe, Well, and Soil Boring Locations," shows the location of the monitoring probes.

The degreaser pits and sump were identified in the Groundwater Summary Report as the primary sources of solvents detected in RU-C5. The tank farm, fuel lines, degreaser pit, and machine shop operations were identified as sources of SVOCs, petroleum, pesticides, PCBs, and metals. Some metals also occur naturally in soils and bedrock at the site.

A soil vapor extraction (SVE) system was installed and operated for nearly five months inside Building 134, as described in the *Draft Treatability Study Report, Soil Vapor Extraction Treatability Study, Building 134, Parcel C, Hunters Point Shipyard, San Francisco* (IT, 2001). Seventeen SVE wells and 46 vapor monitoring wells were installed in January 2001 and operated from February to June 2001. SVE wells were located in the degreaser pit and sump area in the northern portion of Building 134, as well as in the central area of the building, near MW16A, and were screened from 2 to 10 feet (ft) below ground surface (bgs). Both soil-gas and soil sampling results indicated that PCE, TCE, dichloroethene (DCE), and TPH as gasoline were present. The cumulative VOC mass removed within the test performance period was estimated at 5 pounds, with mass removal rates between 0.002 and 0.005 pounds per hour. Nearly half of the extracted vapors were comprised of Freon-11 (trichlorofluoromethane), and the remainder was primarily comprised of PCE, TCE, toluene, and xylenes.

The oil/water separator and sump were decommissioned by Shaw (Shaw, 2004b). As part of this work, 14 monitoring and SVE wells were abandoned and, after the sump and separator were decommissioned, an injection well and 4 monitoring wells were installed. An extraction well

was installed as part of the backfilling operations of the separator excavation. These new wells in addition to several of existing wells were used during the course of the TS. The TS area is presented in Figure 2. The layout of the TS wells is shown in Figure 4 and a cross section of the TS test cell is presented as Figure 5, "Treatability Study Test Cell Cross Section." Additional detail on the TS area are provided in Photos No. 1 and No. 2, which depict the exterior and interior of Building 134, respectively, with conceptual cross sections of the subsurface.

1.3 Objectives

The goal of this ISB TS is to evaluate the degradation of various organic compounds in a sequential (i.e., two-step) anaerobic-aerobic process. In addition, the data must provide a sound technical basis for comparing ISB with other groundwater treatment alternatives. The following objectives were established to meet this goal:

- Provide data sufficient to evaluate the effectiveness, implementability, and cost of the technology as applied to a full-scale remediation. The U.S. Environmental Protection Agency (EPA) document entitled, *Guidance for Conducting Remedial Investigations and Feasibility Studies under the CERCLA* (EPA, 1988), was used in determining the data requirements necessary to support these objectives within the study.
- Obtain baseline concentrations for COPCs.
- Obtain field and laboratory data to evaluate the viability and effectiveness of anaerobic treatment technology for degrading the dissolved chlorinated ethene contamination in groundwater beneath the site. The required data will be obtained by monitoring system operation, and by collecting and analyzing groundwater samples.
- Obtain field and laboratory data to evaluate the viability and effectiveness of aerobic biological treatment technology of degradation of chlorinated ethane, chlorinated ethane, and PAH contamination in the groundwater at RU-C5. The required data will be obtained by monitoring system operation, and collection and analysis of groundwater samples.
- Continue to refine best management practices in this newly developing technology application.

1.4 Scope of Work

The scope of work for this TS was presented in the Work Plan (Shaw, 2004a) and is summarized below.

The scope of work for Stage 1 Anaerobic ISB included the following:

- Collect baseline groundwater samples for laboratory analysis from wells located within and around the treatment area, as shown in Figure 2.

- Design, construct, install, and operate a groundwater-fermentable substrate injection system.
- Perform an anaerobic bioremediation TS to evaluate the effectiveness of anaerobic degradation of chlorinated ethenes in groundwater within the TS area.
- Collect performance monitoring groundwater samples from wells located within and around the treatment area during the anaerobic bioremediation treatment to evaluate effectiveness of the treatment system (Figure 2).
- Collect performance soil samples for laboratory analysis from the saturated zone at four locations near wells MW53A, MW54A, MW55A, and IW02A (Figure 2). Initial baseline soil samples were collected prior to the onset of the TS during construction associated with Contract Number N68711-01-D-6011.

The scope of work for Stage 2 Aerobic ISB included the following:

- Install and operate an oxygen (O_2).
- Perform an aerobic bioremediation TS to evaluate the effectiveness of aerobic degradation of PAH, 1,2-dichloroethane (1,2-DCA), DCBs, and residual chlorinated ethene contaminants in groundwater within the TS area.
- Collect performance monitoring groundwater samples from wells located within and around the treatment area during the aerobic bioremediation treatment test to evaluate effectiveness of the TS (Figure 2).
- Collect final groundwater samples from wells located within and around the treatment area for laboratory analysis (Figure 2).
- Collect final performance soil samples for laboratory analysis from the saturated zone at four locations near wells MW53A, MW54A, MW55A, and IW02A (Figure 4).
- Evaluate field and laboratory data and prepare a data summary describing the supplementary site characterization and TS results to support the full-scale implementation of anaerobic-aerobic treatment at the subject facility.

1.5 Project Time Line

The TS began March 23, 2004 with baseline groundwater sampling. System construction began on March 25, 2004. Stage 1 (Anaerobic ISB) was performed between April 15, 2004 and December 3, 2004. Stage 2 (Aerobic ISB) was performed between January 6, 2005, and May 10, 2005. Although all monitoring discontinued on May 25, 2005, bioremediation activity undoubtedly continues. A more detailed timeline of the TS events is provided in Table 1, "Timeline for Sequential Aerobic Anaerobic Bioremediation Treatability Study at Site RU-C5, Hunters Point Shipyard."

2.0 Site Geology

The geologic units in Parcel C consist of unconsolidated clay, silt, and sand of the Pleistocene Age, which unconformably overlies Cretaceous chert, shale, sandstone, and serpentonite. The unconsolidated sediments are divided into separate hydrogeologic units including artificial fill, undifferentiated upper sand, Bay Mud, and undifferentiated sedimentary deposits. The TS site is immediately underlain by Artificial Fill. Undifferentiated upper sand deposits are present directly beneath the Artificial Fill. The Bay Mud is absent in this area, resulting in the undifferentiated upper sand deposits directly overlying the undifferentiated sedimentary deposits. The undifferentiated upper sand and undifferentiated sedimentary deposits generally dip in a north-northwest direction. The information presented in this section is largely derived from the Groundwater Summary Report (TtEMI, 2004).

2.1 Hydrogeology

This section describes the stratigraphy, lithology, and hydrostratigraphy of the RU-C5 vicinity. Tidal effects on groundwater levels, groundwater flow patterns, hydraulic characteristics, and groundwater quality of the A-aquifer (total dissolved solids [TDS]) also are discussed. In addition, this section summarizes the hydrogeological conceptual model for the RU-C5 vicinity. An overview of geology and hydrogeology for the TS area may be found in the Groundwater Summary Report (specifically Figure 7-2, "Cross Sections N-N' and O-O', Parcel C, RU-C5" [TtEMI, 2004]). The TS test cell cross section presented in Figure 5 reflects this information.

2.1.1 Site Stratigraphy and Lithology

This section briefly describes the stratigraphy and lithology of the RU-C5 vicinity. The thickness of overburden sediments and fill, above bedrock and across the entire parcel, range from less than 1 foot at some locations in IR06, located directly south of RU-C5, to over 60 ft to the north of RU-C5 at IR10 in Parcel B. Individual stratigraphic units and their relationship to the other units are described in the following sections.

2.1.1.1 Artificial Fill

Heterogeneous artificial fill covers all of the RU-C5 vicinity. This fill may be as thick as 30 ft in the vicinity of RU-C5 and primarily consists of silty and sandy clay with clayey sand, sand, and sandy gravel deposits. Near the separator and degreaser pit area at Building 134, the artificial fill measures approximately 20 ft thick and consists mainly of sandy clay with clayey sand or clayey gravel lenses. The artificial fill at IR25 overlies native sediments.

2.1.1.2 Undifferentiated Upper Sand

The undifferentiated Upper Sand unit is primarily made up of unconsolidated sands that are either estuarine or alluvial, and are described in the geological logs from the RU-C5 vicinity as

poorly graded sands of loose to medium density. The undifferentiated Upper Sands transition laterally into and interfinger with the Bay Mud deposits near the southwestern boundary of IR25. The undifferentiated Upper Sands can range up to 10 ft thick in some areas, but are 2 to 3 ft thick over most of RU-C5.

2.1.1.3 Bay Mud

As described above, Bay Mud deposits interfinger with undifferentiated Upper Sands at IR25. This may suggest that the southwestern boundary of IR25 is the shoreward extent of the Bay Mud deposits in the RU-C5 vicinity. Bay Mud deposits commonly consist of silty or sandy clay, may be up to 10 ft thick, and are laterally interfingered with the undifferentiated Upper Sands. Bay Mud deposits may also contain more permeable sediments, such as clayey or silty sands. In the RU-C5 area, the Bay Mud deposits are typically about 5 ft thick.

2.1.1.4 Undifferentiated Sediments

Undifferentiated sediments are present as a nearly continuous layer throughout the IR25 area, may be overlain by either undifferentiated Upper Sands or Bay Mud deposits, and lie directly on bedrock. The deposit predominantly consists of silty or clayey sands and ranges from roughly 5- to 10-ft-thick near the separator and degreaser pit at Building 134. The extent of the undifferentiated sediments is limited to the IR25 area. The undifferentiated sediments pinch out in IR10 to the northwest, IR24 to the northeast, and IR06 to the south.

2.1.1.5 Bedrock

The bedrock surface in the RU-C5 area generally slopes toward the north and parallels the 1935 shoreline. Bedrock in the RU-C5 vicinity is mainly serpentinite. Some metamorphosed basalt, sometimes described as "greenstone," has also been identified at IR06. The serpentonite is moderately-to-deeply weathered and moderately-to-intensely fractured. The greenstone is dense and relatively competent. Serpentonite and greenstone are interlayered in the IR06 area.

2.1.2 Hydrostratigraphy

This section briefly describes the hydrostratigraphy of the RU-C5 vicinity. RU-C5 hydrostratigraphy consists of two units: an A-aquifer and a bedrock water-bearing zone (WBZ). The A-aquifer is described in the following sections as an upper A-aquifer made of artificial fill and a lower A-aquifer consisting of native sediments. Portions of the shallow bedrock also are considered to be part of the A-aquifer. The hydrostratigraphic conceptual model for RU-C5 is based on the following observations:

- No continuous aquitard separating the undifferentiated Upper Sands and Bay Mud from the undifferentiated sediments below exists at IR25. Therefore B-aquifers are absent.
- Undifferentiated sediments are present only as a thin layer at IR25.

- Undifferentiated Upper Sands, Bay Mud, undifferentiated sediments, and shallow weathered or fractured bedrock are hydraulically connected.

The RU-C5 vicinity wells are listed in the Groundwater Summary Report. The individual hydrostratigraphic units and their relationship to the other units are described in the following sections.

2.1.2.1 A-Aquifer

The upper A-aquifer is made up of heterogeneous artificial fill and overlies native sediments and/or bedrock. The upper A-aquifer consists primarily of silty and sandy clay with clayey sand, sand, and sandy gravel deposits. It is continuous across the RU-C5 vicinity, and the maximum saturated thickness in the RU-C5 vicinity is approximately 25 ft. Cross sections provided in the Groundwater Summary Report show that the upper A-aquifer overlies native sediments. The upper A-aquifer is unconfined in most areas.

The lower A-aquifer is made up of native sediments from undifferentiated Upper Sands, Bay Mud, and undifferentiated sediments, and consists primarily of sandy clays, clayey sands, silty sands, and the upper weathered portion of the bedrock. The maximum thickness of the lower A-aquifer in the RU-C5 vicinity is approximately 15 ft. The upper and lower A-aquifer may exhibit unconfined conditions, or in areas where the upper A-aquifer has very low permeability materials, the lower A-aquifer may be semi-confined.

The heterogeneous nature of the artificial fill and upper A-aquifer is present at the sump and dip tank area in the northwestern portion of Building 134. Pockets of clayey sand and clayey gravel, which may be interconnected, exist in a matrix of low-permeability sandy or silty clays and may act as preferential pathways for vertical contaminant migration. A narrow vertical clayey sand body connects the dip tank area with the lower A-aquifer and upper bedrock. The low-permeability material of the upper A-aquifer, near the sump and dip tank, may cause the lower A-aquifer to be semiconfined. In areas where the lower A-aquifer is in contact with bedrock, such as at 1R25MWI5F in IR-25, the shallow weathered or fractured bedrock is considered to be part of the A-aquifer.

In addition, bailer method slug tests were performed on three monitoring wells used for the treatability study including wells IR25MW900B, IR25MW901B, and IR25MW902B. The maximum, minimum, and average hydraulic conductivity for the wells located around RU-C5 as determined using slug tests are 3.56 ft/day, 1.84×10^{-2} ft/day and 4.02×10^{-1} ft/day (4.86×10^{-3} centimeters per second [cm/sec], 252×10^{-5} cm/sec and 5.5×10^{-4} cm/sec), respectively. The hydraulic conductivity for the wells included in the treatability study test cell are 3.97×10^{-2} ft/day, 7.86×10^{-2} ft/day and 1.44×10^{-2} ft/day (5.43×10^{-5} cm/sec, 1.07×10^{-4} cm/sec and 1.97×10^{-4} cm/sec) for wells IR25MW900B, IR25MW901B, and IR25MW902B, respectively.

These determined hydraulic conductivity values are consistent with published values for silty sands (Heath, 1982). The results of the slug test are similar to the results from the aquifer test performed and reported in the Groundwater Summary Report. The hydraulic conductivity of the upper A Aquifer, measured during constant rate pump testing range from 0.81 to 4.2 ft per day.

In the western portion of IR-06, near the former tank farm, where low levels of contamination have been observed, the upper A-aquifer is unconfined. Permeable artificial fill lies directly on bedrock in this area and grades into less-permeable material downgradient, where the lower A-aquifer appears to be semiconfined. In areas where the upper A-aquifer is in contact with bedrock, the shallow weathered or fractured bedrock is considered to be part of the A-aquifer.

2.1.2.2 Bedrock Water-bearing Zone

The bedrock WBZ in the RI-C5 vicinity consists of fractured serpentinite and greenstone (metamorphic basalt), with different degrees of weathering, and is relatively shallow throughout the RU-C5 vicinity. No well penetrate the bedrock WBZ in IR-25, but bedrock WBZ monitoring well in IR-06 provide adequate hydraulic and contaminant information near the former tank farm.

The hydraulic conductivity of the bedrock WBZ ranges from 0.36 to 1.06 ft/day.

2.1.3 Tidal Effects

Tidal influence was observed during aquifer testing in July and August 2002. Prior to performing aquifer testing, tidal fluctuations were observed at rates as great as 0.2 ft during background monitoring. Tidal fluctuations less than 0.1 ft were observed in the lower A-aquifer during the recovery portion of aquifer testing. These responses suggest that the lower A-aquifer is hydraulically connected to the Bay and is semi-confined. The lack of tidal influence in the upper A-aquifer can be attributed to heterogeneities, creating isolation from the Bay, or to unconfined conditions.

2.1.4 Groundwater Flow Patterns

The groundwater flow regime of the A-aquifer in the vicinity of RU-C5 has several significant features (Groundwater Summary Report). A groundwater divide is oriented east-to-west across the northern part of IR25, near the separator and degreaser pit area. A groundwater trough runs along the southwestern edge of IR25 and may be associated with a storm drain or sanitary sewer that follows a similar course. A groundwater mound is located east of IR25. These features direct groundwater flow toward the Bay to the northeast or toward Dry Dock 3 to the southeast.

Based on Figure 3-3 of the Groundwater Summary Report, the hydraulic gradient in the vicinity of the separator and degreaser pit in Building 134, is approximately 0.01 units ft/ft. The gradient

in the vicinity of the groundwater trough near IR06 is steeper, than the gradient for most of RU-C5.

Vertical hydraulic gradients in the RU-C5 area range from 0.049 units ft/ft upward to 0.084 units ft/ft downward. The vertical hydraulic gradient near the separator and degreaser pit at Building 134 ranges from 0.049 units ft/ft upward to 0.025 units ft/ft downward. Water levels used in the vertical gradient calculations are adjusted using TDS data. This indicates the vertical transport direction from the degreaser pit area is highly variable, but that at least some transport to deeper lithologic units is possible.

In May 2004, the groundwater flow direction for the upper A-aquifer is generally toward pumping well EW01A. The lower A-aquifer generally flows northwesterly, which corresponds to the general dip of weathered bedrock based on boring logs (Appendix A, "Boring Logs") from the *Battery Overhaul Building, Submarine Base, Preliminary Data, Foundation Investigation* (Dames and Moore, 1943) and the *Diesel Overhaul & Ordnance Shop, Preliminary Data, Foundation Investigation* (Dames and Moore, 1944). Water levels in MW54A and EW01A were high in December 2004 and May 2005 due to heavy precipitation during the monitoring periods. Rain water accumulates both directly and from a down spout onto the former separator excavation, proximate to wells MW54A and EW01A. The water level data collected during the TS are provided in Table 3.

2.1.5 Hydraulic Characteristics

Detailed hydraulic conductivities, determined by constant rate pumping tests, range from 0.81 to 4.2 ft/day in the upper A-aquifer and 0.36 to 1.06 ft/day in the bedrock WBZ.

2.1.5.1 Groundwater Flow Velocity

Groundwater flow velocity near the separator and degreaser pit in Building 134 is reported to be 0.007 ft/day. This rate assumes a representative hydraulic conductivity value of 0.1 ft/day in the A-aquifer, a hydraulic gradient of 0.01 ft/ft, and an average effective porosity of 0.15 for the semi-confined lower A-aquifer.

2.1.6 Hydrogeological Conceptual Model Summary

A summary of the hydrogeological conceptual model for the RU-C5 vicinity, as reported in the Groundwater Summary Report (TtEMI, 2004), is provided below:

- The aquifer system consists of an A-aquifer and a bedrock WBZ. The A-aquifer is divided into an upper low-permeability zone and a lower zone.
- The upper A-aquifer consists of extremely heterogeneous artificial fill, primarily consisting of clayey sand lenses in a fine-grained, low-permeability matrix.
- The upper A-aquifer extends across all of the RU-C5 vicinity.

- The lower A-aquifer consists of native sediments and shallow weathered or fractured bedrock.
- The lower A-aquifer is continuous over most of the RU-C5 vicinity.
- At the separator and degreaser pit area, the lower A-aquifer is semi-confined, based upon water level measurements between monitoring wells MW56A and MW54A which were consistently different.
- A groundwater divide is present across RU-C5. Over most of RU-C5, groundwater in the A-aquifer flows northeast; however, the groundwater trough, which follows the storm drain or sanitary sewer, also directs groundwater flow where it may be captured by the sewer system.
- A representative groundwater flow velocity in the lower A-aquifer is 0.007 ft/day, based on hydraulic parameters from the 2002 aquifer test.
- Vertical gradients between the upper and lower A-aquifer are highly variable and likely result from heterogeneity in the A-aquifer.
- Significant tidal effects (groundwater level fluctuations greater than 0.10 ft) were observed in shallow bedrock (considered part of the A-aquifer) at RU-C5, where the aquifer is semi-confined. No significant tidal effects were observed in the upper unconfined A-aquifer.
- Representative aquifer hydraulic parameters for the lower A-aquifer, near the separator and degreaser pit areas, determined through the 2002 constant rate aquifer test at RU-C5 are as follows:
  - Hydraulic conductivity is approximately 0.1 ft/day (3.5×10^{-5} cm/sec)
  - Aquifer storativity is approximately 0.003
- A-aquifer TDS concentrations at IR25 vary from below 3,000 milligrams per liter (mg/L) in the west to over 10,000 mg/L in the east.

2.2 Nature and Extent of Contamination in Groundwater at RU-C5

Groundwater in RU-C5 has been impacted by VOCs and SVOCs. Total VOCs have been detected at concentrations up to 124 mg/L in the TS area. The majority (99.5 percent) of the VOCs detected in the groundwater at RU-C5 consist of chlorinated ethenes (PCE, TCE, DCE, and VC), chlorinated ethanes (monochloroethane, 1,2- DCA), and chlorobenzenes (chlorobenzene, 1,2- and 1,4-DCB, and 1,2,3- and 1,2,4-trichlorobenzene). The remainder of the VOCs include acetone, benzene, carbon disulfide, chloroform, ethylbenzene, toluene, and xylenes.

DNAPLs have been detected in the A-zone (in well MW19A), and in the B-aquifer (in well MW902B), and traces were detected in former monitoring well MW15A2 which was located in the former degreaser pit. The DNAPLs were detected after installation and development of well

MW902B and later when purging, and are considered to be reflective of residual ganglia and not indicative of a "pool" of DNAPLs.

A summary of primary contaminant concentrations is presented in Table 7-6 of the Groundwater Summary Report (TtEMI, 2004). A list of primary VOCs and SVOCs detected in the groundwater at RU-C5 is provided below with notes related to whether the compounds are biodegradable.

List of Contaminants from the Groundwater Summary Report

Contaminant	Biodegradable	Comment
Aroclor 1260	Not very biodegradable	Not mobile in groundwater.
1,2-DCB	Aerobically biodegradable	May be biodegradable anaerobically.
1,4-DCB	Aerobically biodegradable	May be biodegradable anaerobically.
PCE	Anaerobically only	Will not degrade with oxygen present. Degrades readily anaerobically.
TCE	Anaerobically preferably, but also aerobically	Degrades readily anaerobically. Can undergo co-metabolic aerobic biodegradation.
VC	Anaerobically and aerobically.	Potentially slow anaerobically. Quick aerobically.
DCE	Anaerobically preferably, but also aerobically	Degrades readily anaerobically. Can undergo co-metabolic aerobic biodegradation.
1,2-DCA	Anaerobically and Aerobically	Degrades anaerobically and aerobically.
Pentachlorophenol	Aerobically biodegradable	Most work has been done in above ground landfills. May be more difficult in subsurface.

3.0 Dechlorination of Chlorinated Ethenes Process

Relatively oxidized chlorinated organic compounds including chlorinated ethenes, ethanes and benzenes, have been shown to be degradable under anaerobic conditions. Although there are several anaerobic pathways, reductive dechlorination or chlororespiration, is the primary pathway. Reductive dechlorination of chlorinated ethenes and chlorinated benzenes occurs in a biologically mediated oxidation-reduction reaction where a chlorine atom on the chlorinated organic molecule is removed and replaced with hydrogen. The organic carbon substrate is initially degraded by fermentative bacteria, which produce molecular hydrogen (H_2) and other organic compounds. This H_2 then reacts directly with the chlorinated ethenes and chlorinated benzenes, resulting in reductive dechlorination.

Reductive dechlorination occurs only under highly reducing conditions and results in the sequential generation of more highly reduced daughter products. These daughter products include TCE, DCE, and VC from the parent compound PCE, dichloroethane (DCA), and chloroethane (CA) from the parent compound TCA, and chlorobenzene (CB) from the parent compound TCB. The reductive dechlorination of these daughter products requires progressively more reducing conditions to achieve dechlorination. Typically, methanogenic conditions are required for the final reductive dechlorination process. The final dechlorination step for chlorinated ethenes and ethanes results in the production of non-toxic ethene and ethane. However, the final dechlorination step for chlorinated benzenes results in the production of benzene, a known carcinogen.

Various parameters must be evaluated to understand and promote efficient dechlorination of chlorinated ethenes and benzenes in Site IR25 groundwater. These parameters include the availability and speciation of Dehalococcoides *sp* (DHC) microorganism, the general chemistry of the aquifer, and the availability of sufficient substrate and nutrients. The following section describes these parameters.

3.1 Chlorinated Ethenes

The chlorinated ethenes (PCE, TCE, DCE, and VC), the dechlorination process occurs in the following sequence:

$$\text{PCE} \Rightarrow \text{TCE} \Rightarrow \text{DCE (primarily cis-1,2-DCE)} \Rightarrow \text{VC} \Rightarrow \text{Ethene}$$

The dechlorination process is also illustrated on Figure 7, "Dechlorination Pathway of Chlorinated Ethenes."

Efficiency of dechlorination differs for particular compounds and for particular geochemical conditions. Transformation of DCE-to-VC and VC-to-ethene requires more strongly reducing conditions (lower oxygen-reduction potential [ORP]) than for dechlorination of PCE and TCE.

The efficiency of reductive dechlorination is directly linked to the availability of molecular hydrogen. Several hydrogen consuming processes involving inorganic compound can take place in groundwater, (*Environmental Organic Chemistry* [Schwarzenbach et al., 1993]). During the enhanced biodegradation process, reduction of these inorganic compounds occurs in a biologically mediated oxidation-reduction reaction. During this reaction, the available substrate generates hydrogen that acts as the electron donor and the inorganic chemical (i.e., O_2, nitrate [NO_3], Mn, iron [Fe], sulfate [SO_4], carbon dioxide [CO_2]) acts as an electron acceptor. The biologically mediated oxidation-reduction reaction results in the oxidation of the substrate and the reduction of the electron acceptor, the most common of which are as follows:

- Reduction of O_2 – O_2 is reduced to water (H_2O)
- Denitrification– NO_3 is reduced to nitrite and molecular nitrogen
- Mn reduction – results in the production of soluble manganese
- Reduction of ferric iron (Fe^{3+}) - is reduced to soluble ferrous iron (Fe^{2+})
- Reduction of SO_4 – is reduced to sulfide
- Reduction of CO_2 – is reduced to CH_4 (methanogenisis). (Fermentation may also result in the production of CH_4)

The oxidation reduction reactions and their redox potential (Eh) values are listed below:

O_2 Reduction

$$O_2 + 4H^+ + 4e^- \leftrightarrow 2H_2O \quad (Eh = 820 \text{ millivolts [mV]})$$

NO_3 Reduction

$$2NO_3^- + 12H^+ + 10e^- \leftrightarrow N_{2(gas)} + 6H_2O \quad (Eh = 740 \text{ mV})$$

Mn Reduction

$$MnO_{2(s)} + HCO_3 + 3H^+ + 3e^- \leftrightarrow MnCO_{3(s)} + 2H_2O \quad (Eh = 520 \text{ mV})$$

Fe Reduction

$$FeOOH_{(s)} + HCO_3^- + 2H^+ + 2e^- \leftrightarrow FeCO_3 + 2H_2O \quad (Eh = -50 \text{ mV})$$

SO_4 Reduction

$$SO_4^{2-} + 9H^+ + 8e^- \leftrightarrow HS^- + 4H_2O \quad (Eh = -220\ mV)$$

CO_2 Reduction

$$CO_2 + 8H^+ + 8e- \leftrightarrow CH_4 + 2H_2O \quad (Eh = -240\ mV)$$

Denitrification is an efficient hydrogen-consuming process; therefore, the hydrogen concentration is low during denitrification. Fe^{3+}, SO_4, and CO_2 reduction are progressively less efficient at consuming hydrogen; therefore, hydrogen concentrations can increase during these processes.

The above-mentioned processes are the most common electron-accepting processes in groundwater. The microorganisms compete with each other for available carbon sources. Because O_2 reduction is the most efficient process, O_2-reducing microorganisms initially out-compete others. The biological use of O_2 as an electron acceptor is called aerobic respiration. Once O_2 is depleted, NO_3-reducing microorganisms will predominate if NO_3 is available. Similarly, reduction of Fe^{3+} follows reduction of NO_3, followed by SO_4 reduction, and lastly methanogenesis follows SO_4 reduction. The use of inorganic electron acceptors other than O_2, such as NO_3, Fe, and SO_4, is called anaerobic respiration.

The reductive dechlorination process that results in the degradation of the chlorinated ethenes relies on the ability of microorganisms to use the chlorinated organic compounds as an electon acceptor in a process termed chlororespiration. As with other electron acceptors, the more thermodynamically favorable electron acceptors are utilized prior to the reduction of the chlorinated ethenes. Only after the more efficient electron-accepting processes in groundwater are completed, will the dehalococcoides out-compete other microorganisms and provide efficient dechlorination of chlorinated ethenes. This does not mean that groundwater has to go through all the electron-accepting process stages – O_2, NO_3, Fe, and SO_4 reduction. For example, if O_2 concentration is already low, NO_3 is hardly present (concentration less than 0.5 milligrams per liter [mg/L]), or SO_4 concentration is low then the corresponding reducing stages will not occur. Monitoring of these dissolved species is a good indicator of the conditions within the aquifer, relative to reductive dechlorination progress.

3.2 *Chlorinated Benzenes*

For chlorinated benzenes (trichlorobenzenes [TCBs], DCBs, and CB), the dechlorination process occurs in the following sequence:

$$TCB \Rightarrow DCB \Rightarrow CB \Rightarrow Benzene$$

The dechlorination process is also illustrated on Figure 8, "Dechlorination Pathway of Chlorinated Benzenes."

Reductive dechlorination of TCBs and DCBs primarily occur in anaerobic conditions with the same background groundwater chemistry requirements as those for reductive dechlorination of chlorinated ethenes. 1,2-DCB is the primary isomer (daughter product) created during the biodegradation of TCBs. 1,4-DCB is also created, but in much smaller concentration, with 1,3-DCB as a rare alternative pathway.

Highly reduced chlorinated benzenes, such as 1,2-DCB and CB have also been shown to be biodegradable under aerobic conditions. Unlike reductive dechlorination, where the chlorinated benzene is reduced to a lesser chlorinated organic and ultimately to benzene, aerobic biodegradation of the chlorinated benzene occurs by aerobic respiration. During this process, the chlorinated benzenes act as an electron donor and O_2 acts as an electron acceptor. The biologically mediated oxidation-reduction reaction results in the destruction of the chlorinated benzene and the production of CO_2 and H_2O. Benzene is not degradable anaerobically (when biostimulation is in process), but can be easily degraded aerobically by naturally occurring bacteria where it can act as an electron donor, resulting in the conversion to CO_2 and H_2O. However, since high concentrations of easily fermentable substrate compete with benzene, biodegradation of benzene is not anticipated.

3.3 Chlorinated Ethanes

The anaerobic dechlorination process for chlorinated ethanes is more complex than for chlorinated ethenes. Since 1,2-dichloroethane (1,2-DCA) comprises almost all chlorinated ethanes present at Site IR25, the dechlorination process will be discussed only for this compound. Several dechlorination pathways for 1,2-DCA are possible under anaerobic conditions, and they are illustrated on Figure 9, "Dechlorination Pathway of Chlorinated Ethanes (1,2-DCA)," and are also presented below:

1,2-DCA $\Rightarrow$ Ethene (by dichloroelimination)

1,2-DCA $\Rightarrow$ Chloroethane $\Rightarrow$ Ethene (or Ethane) (by reductive dechlorination)

The predominant degradation pathway is unclear. Reductive dechlorination, resulting in the production of chloroethane and ethane, is a potential pathway; however, the latest studies suggest that the dichloroelimination is the most likely pathway. Dichloroelimination results in the complete dechlorination of 1,2-DCA without creation of the daughter product chloroethane (*Carbon Isotopes as a Tool to Evaluate the Origin and Fate of Vinyl Chloride* [Hunkeler et al., 2002]). The non-chlorinated daughter product is ethene. Since ethene is also produced by the

reductive dechlorination of the chlorinated ethenes, it may not be possible to attribute ethene generation to dichloroelimination.

Highly reduced chlorinated ethanes, including 1,2-DCA, 1,1-DCA, and CA, can also be degraded under aerobic conditions. Unlike reductive dechlorination which results in the production of more reduced daughter products such as CA, ethane or ethene, the biodegradation pathway is most likely aerobic respiration. During this process the reduced chlorinated compound acts as an electron donor, and in the presence of O_2, is oxidized in a biologically mediated oxidation reduction reaction. The reaction results in the complete mineralization of the contaminant and in the production of CO_2 and H_2O.

4.0 Performance Boring Drilling and Temporary Well Installation

Four performance borings were drilled after each of the anaerobic and aerobic stages. The performance borings were installed to evaluate the effectiveness of the bioremediation as a treatment alternative for soils in the vicinity of target wells. The target wells (IW02A, MW53A, MW54A, and MW55A) were installed during Task 5 of CTO 0001 of this same program. The boring logs for these wells are presented elsewhere (Shaw, 2004b).

4.1 Site Preparation

On December 9, 2004, utilities were cleared outside Building 134, in the vicinity of well MW55A, where new performance borings would be drilled for soil sampling. Since all drilling inside Building 134 would be conducted in a previously excavated area, where no utilities were previously identified, no utility clearances were required. Underground Service Alert was called on December 8, 2004 and all utilities were identified by the utility contractor.

4.2 Direct Push Soil Borings

Post-anaerobic bioremediation soil borings were drilled on December 10, 2004, in selected areas near wells IW02A, MW53A, MW54A and MW55A. Borings were advanced to a total depth of 16 ft bgs with soil samples being collected continuously between 8 and 16 ft bgs. Samples for VOCs were collected using the EnCore® samplers. Three EnCore® soil samplers were collected for each sample location. Soil samples were also collected for SVOCs, TPH as diesel (TPH-d), total metals (arsenic [As], total Cr, cadmium [Cd], Mn, and mercury [Hg]), and PCBs. Samples were individually packaged in self-sealing plastic bags and shipped on ice to Applied Physics and Chemistry Laboratories (APCL) in Chino, California. Upon completion of drilling, a ¾-inch-diameter schedule 40 polyvinyl chloride (PVC) casing and screen were installed into each boring as temporary monitoring probes. These temporary monitoring probes; IW02A-BH, MW53A-BH, MW54A-BH, and MW55A-BH (shown on Figure 4), were constructed with casing and screens, a sand pack was placed, and a bentonite seal was installed and grouted in. The temporary monitoring probes were used for measuring field parameters (pH, temperature, conductivity, ORP, and DO) during the aerobic ISB evaluation. In particular was the measurement of dissolved O_2 to evaluate the radius of influence of the infused O_2, required to create aerobic conditions.

Upon completion of the aerobic ISB, a second set of four borings were drilled and soil samples were collected. These borings were abandoned upon completion of the work, using tremmied grout. The casings were cut off to approximately 5 ft bgs. Figure 4 shows the locations of the soil borings and the temporary monitoring probes.

5.0 Treatability Study Operations

5.1 Stage 1 - Anaerobic ISB

5.1.1 Anaerobic Process System

The process equipment for Stage 1 is detailed in this section. Anaerobic ISB consisted of an injection skid, a gaseous delivery system, in-well delivery and extraction equipment, and interconnecting plumbing. The injection skid consisted of a mixing pump, delivery pump, chemical eductor, and a mixing tank. The system used a recirculation loop and a regulated flow eductor to siphon the substrate (sodium lactate) from a storage drum into the process stream. The recirculating stream passed into the mixing tank for mechanical distribution of the soluble sodium lactate. After appropriate loading of sodium lactate was achieved and adequate mixing occurred, a sequence of valves were opened/closed to allow the amended groundwater to flow to a delivery pump, which transferred the water to the injection well. The plumbing on the injection skid was primarily 2-inch Schedule 80 PVC, with 2-inch PVC hose for interconnecting flexibility. The eductor system consisted of a stainless steel wand, which was inserted into the sodium lactate drum and polyspring hose for connection to the eductor. As recirculation flow rates decreased, substrate (sodium lactate) was measured and manually delivered to the injection well to reach the appropriate aquifer concentration.

The gaseous delivery system utilized was in situ Submerged Oxygen Curtain (iSOC™) technology, which is a gaseous infusion system capable of saturating groundwater with process gas without sparging. The delivery system consisted of a gas cylinder, industrial grade hydrogen for the anaerobic stage, and an iSOC™ control panel. The control panel was used to regulate gaseous pressure and flow to the iSOC™ unit. The connections between the cylinder, control panel, and iSOC™ unit was with ¼-inch polyurethane tubing. A schematic of the anaerobic ISB injection skid is provided in Figure 10, "Anaerobic ISB Injection Skid Schematic Diagram."

The in-well equipment for Stage 1 consisted of an inflatable packer, a 1-inch stainless steel injector, the iSOC™ unit for the injection well, and a submersible pump with a 1¼-inch braided vinyl discharge line for the extraction well. The inflatable packer was used to maintain a seal on the injection well during the introduction of amended groundwater. The iSOC™ unit consists of a microporous hollow fiber core within a PVC and stainless steel shell, approximately 1.5 inches in diameter and 15 inches long, with a hose barb connection at the top. The plumbing and electrical connections to the extraction well were run through a 6-inch conduit installed during the source area soil removal. A schematic of the in-well equipment for the Stage 1 anaerobic ISB is presented as Figure 11, "In-Well Equipment, Anaerobic ISB."

5.1.2 Anaerobic Process Operations

5.1.2.1 Phase 1 – Substrate Injection and Distribution

Anaerobic Phase 1 substrate injection and recirculation occurred within the treatment area between April 15, 2004 (Day 0) and June 28, 2004 (Day 75). Initially the recirculation consisted of groundwater extraction from EW01A, substrate amendment, and injection into IW02A. Extraction flow rates were initially on the order of 2 gpm. The substrate amendment consisted of the addition of sodium lactate and hydrogen gas, as described in the previous section. The sodium lactate was blended with the groundwater within the mixing tank, and the hydrogen was infused directly into the groundwater within the injection well. Sodium lactate dosing was 2 grams per liter and the hydrogen addition was 5 milliliters per minute.

Groundwater samples were collected on May 10, May 25, June 8, June 29, July 7, and July 12, 2004. The sampling in May and June indicated that substrate was not reaching monitoring well MW54A or extraction well EW01A. Additionally, the recharge of groundwater to the extraction well was limited, such that the recirculation flow rates were reduced to less than 0.1 gpm by the June sampling dates.

On June 24, 2004 (Day 70), the recirculation of groundwater between EW01A and IW02A was terminated. Groundwater amendment to MW54A was achieved by direct injection of substrate. Substrate was injected from June 24 to June 28, 2004. Approximately 1,700 gallons of groundwater were extracted from monitoring wells MW901B and MW902B, located just outside the treatment area. Wells MW901B and MW902B were chosen due to their proximity to well MW54A and due to the fact that they were capable of producing enough water for the injection. This water was amended with 5.3 gallons of 60 percent (%) sodium lactate solution, for a concentration of 2 grams per liter and gravity drained to the well over the specified four-day period.

Substrate was detected in extraction well EW01A on day 75 and there after. A 3- to 4-fold increase in the alkalinity from pre-study levels as well as a substantial increase in bromide concentration were also observed. The substrate detected in well EW01A was clearly the result of the injection in well MW54A. Alkalinity concentrations remained constant in well MW902B, indicating that the injected substrate did not travel to this well. Well MW901B was not sampled during the TS. Completion of the direct injection of amended groundwater to MW54A represented the end of the Anaerobic Phase 1 operations.

5.1.2.2 Phase 2 – Biodegradation Monitoring

Anaerobic Phase 2 biodegradation monitoring was performed between June 29, 2004 (Day 75) and November 28, 2004 (Day 225). Biweekly groundwater sampling was performed during this period. Sampling from monitoring well MW54A indicated the presence of sufficient substrate to support reductive dechlorination, yet the concentration of chlorinated ethenes was unchanged.

Hydrogen injection was implemented with the idea that increasing the availability of dissolved hydrogen may result in a subsequent increase in the degradation. An iSOC™ unit was placed in this well and hydrogen injection was performed between September 21, 2004 (Day 159) and December 3, 2004 (Day 232), which marked the end of the Anaerobic Phase 2 biodegradation monitoring period. Post-Stage 1 groundwater sampling was performed between December 6 and 9, 2004 and post-Stage 1 soil sampling was performed on December 10, 2004. The post-Stage 1 soil and groundwater sampling served as the baseline sampling for the Stage 2 operations. Table 1, "Timeline for Sequential Aerobic Anaerobic Bioremediation Treatability Study at Site RU-C5, Hunters Point Shipyard," is a project timeline which identifies the key milestones of the Anaerobic Stage 1 operations.

5.2 Stage 2 - Aerobic ISB

5.2.1 Aerobic Process System

Stage 2 Aerobic ISB injection system consisted of the same iSOC™ control panel and iSOC™ unit as was used for Stage 1; however, the gaseous delivery system was modified with a distribution header for the introduction of three additional iSOC™ units. The three additional units were self-regulating upgrade models, which did not require the iSOC™ control panel, as they were connected directly to the header. For the aerobic stage, industrial grade O_2 was used for the gaseous infusion through the iSOC™ units. A schematic of the aerobic injection system is shown in Figure 12, "Aerobic ISB Injection Skid Schematic Diagram."

The in-well equipment for Stage 2 consisted of the four iSOC™ units and associated ¼-inch polyurethane tubing. An iSOC™ unit was placed in the injection well, extraction well, and each of the shallow monitoring wells. A schematic of the in-well equipment for the Stage 2 aerobic ISB is provided in Figure 13, "In-Well Equipment, Aerobic ISB."

5.2.2 Aerobic Process Operations

The aerobic process operations consisted of O_2 addition and biodegradation monitoring. The O_2 addition at 15 mL/min was performed directly within each well using four iSOC™ units. The O_2 injection took place between January 6, 2005 (Day 266), and May 10, 2005 (Day 390). The post-Stage 2 groundwater sampling was performed between May 11 and May 18, 2005, and the post-Stage 2 soil sampling was performed on May 25, 2005. The timeline presented in Table 1 identifies the key milestones of the aerobic Stage 2 operations.

5.3 Groundwater Sampling and Monitoring

Upon completion and development of the wells, groundwater samples were collected from the 5 wells (EW01A, MW54A, MW56A, MW53A, and IW02A) located within the TS area and from 15 monitoring wells located adjacent to the TS area. Table 2 provides a list of the sampling locations, frequencies, and collection specifics.

During sampling events, groundwater was purged from wells using a low-flow peristaltic pump. During purging, groundwater was routed through the flow cell of a Yellow Springs Instruments (YSI) Water Surveyor, which analyzed for real-time field parameters including DO, pH, ORP, temperature, and specific conductance (SC).

After the groundwater quality parameters stabilized samples were collected in bottles and immediately packed on ice in coolers. Field sample collection logs are presented in Appendix I. The samples were then processed and shipped to APCL located in Chino, California, under proper chain-of-custody procedures (Appendix B, "Chains of Custody"). The chain-of custody forms are provided in Appendix B. The groundwater samples were analyzed for the VOCs, SVOCs, PCBs, TPH-d, metals (arsenic [As], Cd, Cr, Mn, and Hg) and one or more of the parameters indicative of biodegradation including NO_3, sulfide, SO_4, Fe^{2+}, alkalinity, chemical O_2 demand, total organic carbon (TOC), CH_4, ethane, ethene, and volatile organic acids (VOAs). The initial samples provided a baseline for evaluation of the biodegradation processes during the ISB TS.

5.4 Soil Sampling

Shaw collected soil samples from four locations within the treatment zone area. Soil samples were collected after the completion of the anaerobic stage and after the completion of the aerobic stage. Soil samples were submitted for analysis of VOCs, SVOCs, PCBs, TPH-d, and metals (As, total Cr, Cd, Mn, and Hg). Samples for VOCs were collected using EnCore® soil samplers. Samples were individually packaged in self-sealing plastic bags for shipment on ice to APCL in Chino, California. Three EnCore® soil samplers were collected for each sample location. Soil samples were also collected for SVOC, TPH-d, total metals (As, Cr, Cd, Mn, and Hg), and PCBs.

5.5 Waste Management

Both solid wastes (drill cuttings) and liquid wastes were generated during the ISB pilot study.

5.5.1 Solid Waste

All waste soil removed as cuttings from the performance borings were contained in steel 5-gallon buckets located adjacent to the substrate tank in Building 134. The waste soil was sampled and submitted for characterization on May 31, 2005. The analytical results showed that the soil can be classified as nonhazardous. The soil was disposed of at a CERCLA approved Titled D treatment, storage and disposal facility.

5.5.2 Liquid Waste

Wastewater includes water generated during well development and purge water generated during sample collection. Wastewater was stored in a 1,000-gallon poly tank located inside Building 134. Wastewater characterization samples were collected on May 31, 2005. The analytical results showed that the wastewater was nonhazardous. The wastewater was discharged under permit to the POTW.

6.0 Treatability Study Monitoring Results

Site characteristics that influence or result from ISB include site geology and hydrogeology, chemistry of the soil and groundwater, availability of substrate, and presence and viability of DHC and other organisms.

Monitoring results discussion in Sections 6.2 applies only to treatment area wells (EW01A, MW54A, MW56A, MW53A, and IW02A). Discussion for outside of treatment area wells is presented in Section 6.3.

All groundwater chemistry data are summarized in Appendix C, "Groundwater Analyses Data Summary Table for the Treatment Area" and Appendix D, "Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area" and presented graphically in figures of Appendix F, "Chemical Data Graphs." All soil chemistry data are summarized in Appendix E, "Soil Analyses Data Summary Table." Original laboratory analytical reports are presented in Appendix G, "Laboratory Analytical Reports."

6.1 Groundwater Results for the Locations Within Treatment Area

6.1.1 Biostimulation Results

A Roche Real-Time LightCycler polymerase chain reaction (PCR) instrument was used to determine the presence of and quantify DHC in groundwater. The cells in all organisms (animals, plants, fungi, and bacteria) contain deoxyribonucleic acid (DNA) that is specific to that organism. Analysis of DNA samples allows for the identification of the source organism. The favored target in DNA identification for bacteria is the 16S ribosomal DNA gene because it is a conserved gene, which is very specific to each prokaryote. The PCR analysis is a method of copying a specific sequence of DNA into a quantity that can be detected and quantified. If the 16S rDNA in DHC is located, the reaction creates multiple copies using temperature cycles. During this reaction, a genetic fluorescent tag specific for the region attaches to each copied strand of DNA, and fluorescence is detected by the instrument. A DHC species 16S rDNA (positive control), a DHC-negative bacterial species (negative control), and a deionized H_2O (blank) are analyzed to verify the test results. Evaluation of DHC population is discussed in Section 7.5.

6.1.2 Field Parameters and General Chemistry Results

General chemistry parameters evaluated during the ISB TS included both field and laboratory measurements and analyses. Field parameters such as pH, ORP, DO, SC, and temperature were collected during each sampling event by using a YSI Water Surveyor meter with a flow-through cell. These parameters were collected during well purging, as part of the groundwater

stabilization monitoring performed prior to sampling. Groundwater was analyzed for other general chemistry parameters such as NO_3 and SO_3 (in the laboratory by EPA Method 300.0), sulfide (in the laboratory by EPA Method 376.2), alkalinity (in the laboratory by EPA Method 310.1), and Fe^{2+} (in the field by Hach Method 8051). All obtained parameters provided important information as to the feasibility and progress of biodegradation.

Field measurements and the results of field analyses are included in Appendix I, 'Field Sample Collection Logs". All groundwater chemistry data are summarized in Appendix C, "Groundwater Analyses Data Summary Table for the Treatment Area" and presented graphically in the figures of Appendix F, "Chemical Data Graphs." Original analytical reports for the laboratory analyses are presented in Appendix G, "Laboratory Analytical Reports."

6.1.2.1 pH

The pH of the aquifer in treatment area decreased by 0.55 standard units (SU) from the average 7.65 SU to about 7.10 SU during Stage 1. The highest pH was measured in well EW01A (8.0 SU) during baseline sampling and the lowest pH was measured in well MW54A (6.6 SU) in a middle of Stage 1.

By the end of Stage 2, average pH increased in the treatment area by 0.38 SU to approximately 7.48 SU.

Appendix F, Figure F1 illustrates pH measurements in treatment area wells.

The pH of the aquifer remained near neutral throughout the pilot study, well within the range that is favorable to biodegradation.

6.1.2.2 Specific Conductance

The SC of groundwater in the TS area increased (wells EW01A, MW53A, and IW01A) during the study following the increase in solubility of inorganics such as Fe. The SC fluctuated but remained relatively unchanged by the end of Stage 1 in wells MW54A and MW56A. The lowest SC (0.46 milliSiemens per centimeter [mS/cm]) was measured in well IW02A during the sampling in the beginning of Stage 1 and the highest SC (18.5 mS/cm) was measured in well MW54A toward the middle of Stage 1. However, the overall highest SC was measured in the deeper aquifer well MW56A where it fluctuated between 17 to 20 mS/cm.

The SC of the groundwater remained relatively unchanged in the TS area during Stage 2 though decreasing slightly in all wells (with the exception of MW56A) right after the start of O_2 injection.

Appendix F, Figure F2 illustrates SC measurements in treatment area wells.

6.1.2.3 Temperature

The rate of increase of the microorganism population can be affected by temperature. Microbial growth rates are reduced by low temperature and increased by higher temperature. In addition, microbial metabolism may slightly increase temperature. During the TS, the groundwater temperature remained favorable for microorganism growth. The highest temperature (18.5 degrees Celsius [°C]) was measured in well MW54A in the middle of Stage 1 and the lowest temperature (14.2°C) was measured in well EW01A during the background sampling for Stage 1. On average, groundwater temperature increased by 1.5°C following the seasonal change in air temperature. Groundwater temperature decreased slightly during Stage 2 returning close to the pre-system operation background values. The change in temperature may be attributed to seasonal changes. Since groundwater is extracted and reinjected, air temperature will affect the groundwater temperature.

Appendix F, Figure F3 illustrates temperature measurements in treatment area wells.

6.1.2.4 Dissolved Oxygen

Establishment of substantially reducing anaerobic conditions is essential for the reductive dechlorination of the chlorinated ethenes. Initial DO concentration in the groundwater indicated aerobic conditions with the highest measurement of 10.4 mg/L (well EW01A). Following the substrate injection, DO concentration in treatment area decreased rapidly (less than 30 days) to less than 1 mg/L indicating the establishment of anaerobic conditions.

Following the beginning of O_2 injection (Stage 2) DO concentrations increased significantly, reaching up to 43.1 mg/L in well MW54A, and remain high by the end of Stage 2. DO values remained unchanged in well MW56A.

A detailed discussion of DO values, including measurements in monitoring point (MP) wells, is presented in Sections 7.1.1.1 and 7.2.1.1.

Appendix F, Figure F4 illustrates DO measurements in treatment area wells.

6.1.2.5 ORP

ORP is an important water chemistry parameter, providing a measurement of the oxidizing or reducing nature of the water. Groundwater exhibiting ORP values greater than -50 mV are not favorable to reductive dechlorination of chlorinated ethene and complete reductive dechlorination to ethene can only be achieved under highly reducing conditions (ORP ~ -240 mv).

As with oxygen the ORP decreased dramatically after the introduction of the substrate (sodium lactate). Prior to the beginning of Stage 1 the ORP values were in the range of -7 to +53 mV (with the highest ORP value in well EW01A). Upon injection of the substrate, the ORP values

plunged to as low as –326 mV (well EW01A). The ORP remained low during the anaerobic stage.

Following O_2 injection (Stage 2) ORP increased significantly, reaching up to 128 mV in well MW54A, and remained high by the end of Stage 2. ORP values remained unchanged in well MW56A.

High variability in ORP values have been observed in all applications. There are many factors influencing ORP in groundwater, including advection, bacterial activity, stage of degradation of chlorinated organics, and temperature. Sampling variability is also an important factor. Groundwater in the treatment area can slow the ORP sensor response, which was observed due to ferrous sulfide specks settling on the sensor. Another factor contributing to the variability was the ORP sensor calibration, performed only at +235 - +250 mV, yet the instrument was used to measure high negative ORP.

A detailed discussion of ORP values, including measurements in MP wells, is presented in Sections 7.1.1.1 and 7.2.1.2.

Appendix F, Figure F5 illustrates ORP measurements in treatment area wells.

6.1.2.6 Nitrate

NO_3 was detected at low concentrations (up to 8.9 mg/L, well MW54A) with the higher values in the deeper aquifer (up to 21.6 mg/L in well MW56A). The low concentration of NO_3 in groundwater is favorable for anaerobic biodegradation of the chlorinated ethenes. The results of NO_3 analyses are presented in Appendix C.

6.1.2.7 Ferrous Iron

All Fe^{2+} analyses were conducted at the field office using a Hach DR 820 portable colorimeter. No Fe^{2+} was observed in the background samples collected prior to system startup. Subsequent to substrate injection, a significant increase in Fe^{2+} was observed in wells in the treatment area. The presence of Fe^{2+} is evidence that microbial activity has proceeded through Fe reducing conditions. The highest Fe^{2+} value (16.5 mg/L) was detected in well MW54A in the middle of Stage 1.

A detailed discussion of Fe^{2+} results is presented in Sections 7.1.1.4 and 7.2.1.5.

The Fe^{2+} concentration graph is shown on (Appendix F, Figure F6).

6.1.2.8 Sulfate and Sulfide

Background SO_4 concentrations in the TS area groundwater were not high. They ranged from 67 to147 mg/L in the shallower wells and it was 362 mg/L in deeper (MW56A) well.

Upon introduction of the substrate, the SO_4 was utilized by the microorganisms thereby producing sulfide. Nearly all the SO_4 in groundwater was reduced below method detection limits to sulfide. Sulfide may be in the form of solid ferrous sulfide or as hydrogen sulfide gas. No substantial odor indicative of sulfide gas was observed during sampling events. However the correspondence between SO_4 and sulfide concentrations is clearly noted on (Appendix F, Figure F7) where the graph for well MW53A is displayed as an example.

Generally, the reduction of SO_4 to sulfide occurs at an ORP value of approximately -240 mV. Appendix F, Figure F8 illustrates the applicability of this general concept to treatment area with an example of the SO_4 ORP correspondence for wells MW53A and MW54A. Due to the interference from other ions, SO_4 analyses by the ion scan method tend to have elevated reporting limits. Data points in the 25-50 mg/L range on the graph may actually have been reported as non-detected values but are plotted as a half of the reporting limit to reduce the noise associated with analytical reporting at or near the reporting limit. Because the data are used primarily to indicate establishment of sulfate reducing conditions, no additional evaluation of the sulfate data is necessary for this investigation.

A detailed discussion of SO_4 results is presented in Sections 7.1.1.5 and 7.2.1.6.

SO_4 concentration graphs for all treatment area wells are shown on (Appendix F, Figure F9). The establishment of SO_4 reducing conditions created an environment favorable for the anaerobic biodegradation of the less oxidized chlorinated ethenes including TCE and DCE.

6.1.3 Volatile Organic Acids and Alkalinity

Volatile organic acids, or otherwise known as metabolic acids, are necessary for ISB to proceed efficiently. VOAs were quantified in the laboratory.

6.1.3.1 Volatile Organic Acids

The microorganisms degrade sodium lactate to acetic and propionic acids (also called acetate and propionate) in a fermentation reaction. The fermentation of lactate and propionate produce hydrogen ions that are utilized in the reduction of the chlorinated ethenes. The concentration of these VOAs was monitored during the TS to ensure the availability of substrate to promote biodegradation. VOAs were not detected in treatment area wells prior to substrate injection.

The biodegradation of the chlorinated ethenes is expected to continue as long as these hydrogen-donating compounds (lactate and propionate) are present in the aquifer. The main VOA, propionic acid, has been detected in treatment area wells at concentrations up to 520 mg/L in well MW53A. Though the highest VOA concentration was detected in well MW54A following direct lactate injection in this well (1,600 mg/L of propionic acid).

The presence of propionic acid in the wells indicated that a hydrogen source was available for biodegradation of the chlorinated ethenes (see Appendix F, Figure F10).

Propionic acid was consumed by the bacteria by the end of Stage 1, except in groundwater around well MW54A where it was present at the beginning of Stage 2 (the next analysis was performed at the end of Stage 2 and indicated no remaining propionic acid).

6.1.3.2 *Alkalinity*

Alkalinity is the quantitative capacity of water to neutralize an acid; that is, the measure of how much acid can be added to a liquid without causing a significant change in pH. Alkalinity is not the same as pH because water does not have to be strongly basic (high pH) to have high alkalinity.

Total alkalinity values in the TS area groundwater prior to the start up ranged from 231 mg/L in well EW01A to 633 mg/L in well MW53A. Total alkalinity increased after the substrate injection began reaching 1,130 mg/L in well MW53A on Day 40. The highest total alkalinity value (1,420 mg/L) was detected in wells MW54A and EW01A two and a half weeks after lactate injection into well MW54A. By the end of Stage 2 total alkalinity concentration was similar in all treatment area well at 700-800 mg/L. Total alkalinity concentration graphs for all treatment area wells are shown on (Appendix F, Figure F11).

Similar to the Treasure Island ISB pilot study there is a correspondence between alkalinity and VOA values. The slope value is close to the one established at Treasure Island although correlation between total alkalinity and propionate (see Appendix F, Figure F12) is not high.

6.1.4 *Total Organic Carbon*

Just a small amount of TOC was present in groundwater and available to the bacteria prior to beginning of the TS. TOC concentration ranged from 6.8 mg/L in well IW02A to 109 mg/L in well MW54A. After the lactate injection TOC concentration increased greatly reaching 457 mg/L in well MW53A on Day 40. TOC concentration was even higher (873 mg/L) in well MW54A right after lactate injection into this well. Organic carbon was continually utilized by the bacteria during Stage 1 and as expected, the concentration of organic carbon decreased during the TS. By the end of Stage 1, TOC concentration reached baseline levels in the treatment area wells, except well MW54A where it was still in the 300-400 mg/L range.

Utilization of the remaining TOC continued during Stage 2. TOC was still detected in the groundwater of well EW01A at 100 mg/L by the end of Stage 2.

The TOC concentration graph is shown on (Appendix F, Figure F13).

6.1.5 Volatile Chlorinated Solvents

6.1.5.1 Chlorinated Ethenes

Reduction of chlorinated ethenes in the TS area groundwater progressed with different efficiencies in different parts of the treatment area. It took an approximately 3 months from the beginning of substrate injection to reduce most of the chlorinated ethenes around injection well IW02A and the well closest to it (MW53A). Chlorinated ethene reduction progressed differently in the other wells. The chlorinated ethene reduction is discussed in detail in Section 7.1.2.1.

Concentrations of chlorinated ethenes and ethene are graphed for each well on (Appendix F, Figures F14 through F18), and their molar concentrations on (Appendix F, Figures F19 through F23 [for Stage 1 only]) and on (Appendix F, Figures F24 through F28).

6.1.5.2 Chlorinated Ethanes

1,2-DCA was detected in all treatment area wells during the baseline sampling. 1,2-DCA concentration in groundwater was reduced around wells IW02A, MW53A, and EW01A in 3 to 5 months. The 1,2-DCA reduction is discussed in details in Section 7.1.2.3.

Concentration of 1,2-DCA are graphed for each well on (Appendix F, Figures F29 and F30).

6.1.6 Dissolved Gasses

6.1.6.1 Ethene and Ethane

Ethene and ethane are the products of reductive dechlorination. Ethene is generated during reductive dechlorination when VC loses its only chlorine atom. Groundwater was analyzed for ethene throughout the pilot study to confirm that VC is really being dechlorinated and not decreasing by some other mechanism, such as evaporation.

In three of the treatment area wells (IW02A, MW53A, and EW01A) significant rise in ethene concentration occurred when the VC concentration reached its maximum. In each of these wells ethene concentration peaked approximately 30 days after the VC concentration reached its maximum, with the highest value of ethene being 2,600 micrograms per liter (µg/L) detected in injection well IW01A (although ethene had another peak at 4,100 µg/L in this well at the end of Stage 1). Production of ethene is a strong indication that the bacteria at IR25 can dechlorinate VC, thereby completing total dechlorination of PCE.

Ethane was detected in treatment area wells, mostly within wells IW02A and MW53A. The highest concentration of ethane being 210 µg/L, detected in well MW53A around the midpoint of Stage 1.

Concentrations of ethene and ethane (ethane only on molar concentration figures) are graphed for each well on (Appendix F, Figures F14 through F28).

Discussion for ethene and ethane detections in wells MW54A and MW56A is presented in Section 7.1.2.1.

6.1.6.2 Methane

Upon the depletion of SO_4, CO_2 may be used as an electron acceptor. Also, microbial organisms may generate energy by fermentation. Both of these processes result in the production of CH_4 as a metabolic byproduct. Some concentration of CH_4 was detected in all treatment area wells during baseline sampling, up to 680 µg/L in well MW54A. The highest concentration of CH_4 was detected in well MW53A (16,000 µg/L) close to the end of Stage 1.

The concentration of CH_4 is presented on (Appendix F, Figure F31).

6.1.7 Semivolatile Organics

6.1.7.1 Chlorinated Benzenes

Reduction of chlorinated benzenes in the TS area groundwater progressed with different efficiencies within the different wells of the study area. Only a trace concentration of trichlorobenzenes was detected in treatment area wells. DCBs were detected in all wells with the highest concentration being 32,800 µg/L (1,2-DCB, well MW54A). It took approximately three months from the beginning of substrate injection to reduce most of the 1,2-DCB around injection well IW02A and the well closest to it (MW53A). The reduction of chlorinated benzenes progressed differently in the other wells and is discussed in details in Sections 7.1.2.2 and 7.2.2.1.

The concentrations of chlorinated benzenes are graphed for each well on Figures F32 through F36, and their molar concentrations on Figures F37 through F41.

6.1.7.2 Diesel Range Organics

Diesel range organics (diesel) were detected in all treatment area wells during the baseline sampling. Following the system startup diesel concentrations increased in all wells reaching levels of 15,000 µg/L (MW53A) to 80,000 µg/L (MW54A). Indigenous Bacteria used diesel as a food source consuming it faster during Stage 1 and slower during Stage 2. At the end of Stage 2 only a small concentration of diesel was detected in wells MW53A and IW02A (130 and 230 µg/L, respectively). High concentrations remain in wells EW01A and MW54A.

The concentration of diesel in treatment area wells is presented on (Appendix F, Figures F42 through F46 [with diesel concentration on the right axis]).

6.1.7.3 Phenols

The following four phenol compounds were detected in treatment area wells EW01A and MW54A: phenol, 2,4-dimethylphenol, 3,4-methylphenol (m,p-Cresol), and 2-methylphenol

(o-Cresol). Only a trace concentration of phenols were detected in other three treatment area wells. The highest detected concentration of phenols was 4,610 µg/L of 2,4-dimethylphenol (MW54A, background sampling).

It is possible for phenols to degrade aerobically. The discussion of phenols degradation during Stage 2 is presented in Section 7.2.2.2 and the concentration of phenols in treatment area wells is presented on (Appendix F, Figures F42 through F46 [with phenol concentration on the left axis]).

6.1.7.4 PCBs

No PCBs were detected in groundwater above the reporting limit. On several sampling occasions a trace concentration of Aroclor-1260 was detected.

The results for Aroclor 1260 in treatment area wells are presented in Appendix C.

6.1.8 Dissolved Metals

During the biological reduction of the organics, the lowered oxidation reduction potential during the anaerobic stage or the higher oxidation-reduction potential in the aerobic stage may result in changes in the concentrations of inorganics in the aquifer. In addition, other changes in the groundwater chemistry resulting from the biological processes, such as pH change and production of biological surfactants, may produce changes in inorganic chemistry. Although these parameters were not evaluated regularly during Stage 1 of the pilot test baseline conditions were established prior to the beginning of Stage 1 and were measure again after the completion of the Stage 1 and Stage 2. Baseline samples were not collected for metals from MW54A because of the small amount of water collected during that event.

The metals that were evaluated include As, Cd Cr, Mn, and Hg. All groundwater samples for metal analysis were collected using 0.45 micrometer (µm) filter.

Appendix F, Figures F47 through F49 present the change in dissolved As, Cd, Cr, Mn, and Hg concentrations. Data reported in yellow indicates that the parameter was not detected at the reporting limit shown in yellow. Data shown in brown indicates the estimated concentration of the parameter at a concentration below the method detection limit. Data presented in black is the detected concentration of that parameter.

6.1.8.1 Arsenic

The potential for As mobility was evaluated because the more reduced form or As (As^{3+}) is more mobile than the more oxidized form (As^{5+}). The creation of reducing conditions therefore could result in higher dissolved phase As.

In general, the concentration of As is low. After the end of Stage 1 the concentration of As increased in well EW01 (from 3.4 µg/L to 28.6 µg/L); however, the concentration of As in other

wells in treatment area decreased. At the end of Stage 2 As concentration decreased in all treatment area wells. The highest concentration of As after Stage 2 is in well EW01A (11.3 µg/L) and it is near As's average background concentration in treatment area.

The concentration of As in treatment area wells is presented on (Appendix F, Figure F47).

6.1.8.2 Cadmium

Changes in aquifer chemistry were considered to potentially result in the increased dissolved phase concentration of Cd.

For all sampling events Cd was not detected in any wells in the treatment area above the reporting limit.

The concentration of Cd in treatment area wells is presented on (Appendix F, Figure F47).

6.1.8.3 Chromium

The potential for increased dissolved Cr was evaluated because the oxidized form of Cr is more soluble than the reduced form. Therefore, the establishment of more oxidizing conditions during the Stage 2 could produce higher dissolved phase concentrations of Cr. This is considered unlikely however because the conversion of Cr III to Cr VI occurs generally under more oxidizing conditions than were established during Stage 2.

Cr concentrations increased in well EW01A and decreased in MW56A during Stage 1. The concentration of Cr in and around the treatment area remained low during Stage 1. The highest reported concentration of Cr at the end of Stage 1 was 27.7 µg/L (EW01A). The majority of the reported concentrations were below the reporting limit.

Cr concentration did not increase during Stage 2, instead it decreased in well EW01A to 9.9 µg/L, making it the highest Cr concentration in treatment area after the completion of Stage 2.

The concentration of Cr in treatment area wells is presented on (Appendix F, Figure F48).

6.1.8.4 Manganese

The potential for increased dissolved Mn was evaluated because the reduced form of Mn may be more soluble than the more oxidized form. The establishment of reducing conditions therefore, could potentially result in higher dissolved-phase Mn.

After the end of Stage 1 the concentration of Mn increased in all wells in the treatment area including wells IW02A, MW53A, and EW01A. The concentration of Mn also increased in deeper well MW56A (1,890 µg/L to 6,390 µg/L). The cause for the increase in this location is

not determined because substrate does not appear to have migrated there. The cause for the substantial increase in Mn concentration at EW01A relative to the other wells is not determined. Possibly, the material used to backfill the excavation at that location may have contained higher amounts of Mn than the aquifer matrix in the treatment area.

After the end of Stage 2 the concentration of Mn decreased in most wells with the highest concentration of 17,200 µg/L still in well EW01A.

The concentration of Mn in treatment area wells is presented on (Appendix F, Figure F48).

6.1.8.5 Mercury

The potential for increased dissolved-phase Hg was evaluated because SO_4-reducing bacteria may increase biologic uptake of Hg and potentially result in a decrease of dissolved-phase Hg during the anaerobic stage. The transition from anaerobic to aerobic conditions are considered to potentially result in the increase in dissolved-phase Hg.

The highest reported concentration of Hg prior to Stage 1 was 0.13 µg/L (IW02A and MW53A). All reported concentrations were below the method reporting limit. In general Hg concentrations remained the same or decreased slightly during Stage 1.

Mercury concentration increased in all wells during Stage 2 however still remaining low. The highest Hg concentration in treatment area wells after the Stage 2 was 0.42 µg/L (MW53A).

The concentration of Cr in treatment area wells is presented on (Appendix F, Figure F49).

6.2 Results for Groundwater for the Locations Outside of Treatment Area

Groundwater was collected and analyzed for 15 wells at three events (background, end of Stage 1, and end of Stage 2 events). Analytical results for outside wells are tabulated in Appendix D and the well locations are shown on Figure 2. Analytical results for wells adjacent to the TS area are also shown on Figures F51 through F53.

Wells located adjacent to degreaser pit/treatment area (MW11A, MW900B, MW902B, MW15F, MW55A, MW57A, and MW904B) have many of the same analytes detected in treatment area wells. The highest concentrations of all analytes were detected in well MW902B (up to an approximately 130,000 µg/L of total chlorinated ethenes, 86,000 µg/L of chlorinated ethanes, 57,000 µg/L of total chlorinated benzenes, 79,000 µg/L of phenols, and 117,000 µg/L of TPH-d). The results do not indicate that the contamination dispersed during the TS due to the injection and extraction activities in treatment area. Changes in concentrations may have been due to the other factors like groundwater movement due to infiltration of rain water. Appearance of VOCs in well MW904B in May 2005 is believed to be due to natural movement of the contamination plume. Well MW904B is located directly down gradient from the degreaser pit area and the

contamination should eventually reach the well taking into account high VOC concentration already detected in nearby shallower wells MW55A and MW57A.

An increase in chlorinated ethenes, 1,2-DCA, and dichlorobenzenes concentration in well MW902B after the anaerobic stage might possibly suggest that it was caused by injection of 1,700 gallons of water in well MW54A, which may have raised groundwater level in MW54A enough to create an artificial hydraulic gradient towards MW902B. However the water level in the extraction well EW01A location was completely drawn down at the time of the injection, which would have created a substantial gradient in that direction. The fact that substrate was encountered in the extraction well after the injection into MW54A and the fact that the extraction hole had a capacity for approximately 1,000 gallons suggests that most of the injected water went to the EW01A location.

Post-aerobic stage sampling at MW902B showed contaminant concentrations in line with pre-treatment sampling (actually slightly lower than the pre-treatment sampling). We believe that the concentration changes observed in MW902B were due to groundwater movement, not due to the injection and extraction performed as part of the TS. Water movement in the direction of MW902B may have been the result of meteoric water entering the subsurface at the extraction well location due to the removed asphalt cap and gravel backfill which would allow for easy percolation into the ground.

A steady decrease in chlorinated ethenes, 1,2-DCA, and dichlorobenzenes in well MW900B might suggest enhanced bioremediation due to the influence of substrate injection in the TS area. However, well MW902B located almost halfway between MW900B and the TS area does not show this trend. Also, alkalinity concentrations (provided in the table of Appendix D) in wells adjacent to TS area remain steady, showing no influence of substrate injection.

Additional justification for contaminant transport due to hydraulic gradient was that there was no increase in contaminant levels (rather a decrease) in wells MW55A and MW57A despite the fact that MW55A is located closer to TS area than MW904B and MW57A is adjacent to MW904B. We maintain our conclusion that the contamination appearing in well MW904B (Figure F53) is due to natural down gradient movement of the contamination plume.

Detections of Fe^{2+}, ethene and VC in some of the wells adjacent to treatment area (including background sampling prior to any activities in treatment area) indicate biodegradation of chlorinated ethenes. All wells with ethene detections also indicated diesel detections, and no ethene detections without the presence of diesel, which suggests utilization of diesel as carbon source by DHC bacteria.

Site contaminants of interest were either not detected or detected just at trace concentrations in nine sampled wells located outside of degreaser pit area (wells MW51A, IR06MW44A, MW42B, MW37A, MW37B, MW17A, MW38B, MW39A, and MW39B).

6.3 Soil Samples Results

Soil samples were collected at four locations (near wells IW02A, MW53A, MW54A, and MW55A). At each location soil samples were collected twice, the first time after the completion of Stage 1 (during the installation of O_2 injection monitoring points) and the second time after the completion of Stage 2. Most soil samples were taken from the interval 13 to 16 feet bgs. Soil samples at these locations were also collected during wells installation conducted under CTO 0001. The results for soil samples from wells installation are included in this report as baseline data.

Analytical data are tabulated in Appendix E, Appendix F (Figures F57 and F58), and the well locations are shown on Figure 4.

Results for soil sample analyses indicate high dispersion of the contamination horizontally (results for MW54A-BH) as well as vertically (results for MW55A-BH). A relative proportion of the analytes detected in both soil samples collected at well MW54A location is similar to one in DNAPL sample.

6.4 Data Quality Assessment

A total of 198 groundwater samples, 9 soil samples, 19 groundwater field duplicates, 2 soil field duplicates and 39 trip blanks were collected under CTO 004 at Remedial Unit C5 in Building 134 from March 2004 through May 2005.

The groundwater and soil samples were analyzed for one or more of the following parameters:

- VOCs by EPA Methods 5035/5030/8260B
- SVOCs by EPA Method 8270C
- PCBs by EPA Method 8082
- Dissolved metals (As, Cr, Cd, Mn, and Hg) by EPA Methods 6010B/6020A/7470A
- TPH extractable (TPH-e) by EPA Method 8015B
- NO_3 and SO_4 by EPA Method 300.0/9056
- Chemical O_2 demand by EPA Method 410.4
- Sulfide by EPA Method 376.2

- Alkalinity by EPA Method 310.1
- Dissolved gases (CH_4, ethane, and ethene) by R.S. Kerr 175 (U.S. EPA R.S. Kerr, 1994)
- TOC by EPA Method 415.1
- DHC by Polymerase Chain Reaction analysis
- Acetate and propionate by High Performance Liquid Chromatography using an ultra-violet detector
- Bromide by Ion Selective Probe and/or EPA Method 300.0/320.1

A complete set of analytical data is presented in Appendix H, "Data Quality Assessment." The Shaw Project Chemist completed a Level III data review of all the analytical data. The findings of the data validation process are presented in Appendix H.

Based on the validation findings, all data were found to be indicative of acceptable analytical method performance. The anomalies noted in Appendix H did not invalidate the data for its intended use.

7.0 Discussion of TS Results

The TS was conducted from April 2004 until May 2005. During this TS soil and groundwater were analyzed in five separate sampling stages including baseline, anaerobic system operation and monitoring during (Stage 1), post-anaerobic stage, aerobic system operation and monitoring (Stage 2), and post-aerobic stage. Samples were analyzed for a wide variety of parameters that provide information on the change in geochemical conditions and contaminant concentrations during the ISB process. The results of those analyses are described in detail in Section 4.0. The analytical results are included in Appendix C. The data are presented graphically in Appendix F, "Chemical Data Graphs." The following sections provide a discussion of the results of the analyses. Conclusions and recommendations based on these results are included in Section 8.0.

7.1 Summary of Stage 1 TS – Anaerobic Bioremediation

Stage 1 of the TS was conducted from April 15 to December 10, 2004. Previous investigation determined that chlorinated organics were present in the area of the degreaser pit and oil/water separator pits.

A DNAPL was detected in samples collected from well MW902B in November 2002. Analysis of the DNAPL revealed that it consisted primarily of chlorinated benzenes (1,2-DCB [48 %] and 1,4-DCB [11 percent]). The predominant chlorinated ethane constituents were PCE (12 percent) and TCE (1.5 percent). The remainder of the DNAPL consisted of various chlorinated and non chlorinated organics, with a large portion of the mass believed to be attributable to petroleum hydrocarbons and moisture. The fraction of each organic compound detected in the DNAPL is presented in Figure 6.

Baseline groundwater analysis was conducted in the TS area during March 2004 prior to the beginning of the TS. The data confirmed that soil and groundwater in the TS area had been affected by a mixture of chlorinated and non-chlorinated organics, primarily chlorinated ethenes, chlorinated ethanes and chlorinated benzenes. The data indicated that biodegradation of the chlorinated ethenes and potentially chlorinated ethanes was occurring prior to the initiation of the pilot test, as indicated by the presence of ethene in several of the wells.

Groundwater samples in Stage 1 were collected between April 15 to December 9, 2004, from wells in the treatment area, including MW53A, MW54A, EW01A and IW02A. Changes in groundwater chemistry were observed shortly after substrate delivery. However, because groundwater was being recirculated from April 15 to June 10 in wells IW02A and MW53A, and from June 24 to June 26 in wells MW54A and EW01A, changes in groundwater chemistry during these period cannot be solely attributed to biodegradation. However changes in groundwater chemistry subsequent to these time periods can be attributed to the ISB process in

the respective wells. Although groundwater recirculation in IW02A and MW53A occurred for approximately 50 days, groundwater recirculation rates were very slow (as low as 0.05 gpm). Minimal influx of contaminants occurred during this period due to the low permeability soils and limited groundwater recharge. Therefore, a substantial amount of the change in groundwater chemistry in these wells during this time is considered to be the result of the ISB process.

In addition to the groundwater chemistry, samples were collected and analyzed for the presence of dechlorinating organisms. Although many organisms participate in the anaerobic biodegradation of the contaminants, only one microorganism, DHC, has been identified as the organism responsible for the complete reductive dechlorination of chlorinated ethenes. Groundwater analysis conducted prior to the TS confirmed the presence of DHC in the TS area. Because DHC was determined to be present, and because complete reductive dechlorination to ethene was observed, bioaugmentation with a known dechlorinating culture was not required. Based on site chemistry and biology, the TS was conducted to evaluate anaerobic ISB by stimulation of the indigenous dechlorinating culture.

The purpose of Stage 1 was to evaluate the potential for anaerobic ISB to treat the chlorinated organics observed in the TS area. These chlorinated organics primarily consisted of chlorinated ethenes including PCE, TCE, DCE and VC, chlorinated benzenes including 1,2-DCB and 1,4-DCB, and chlorinated ethanes mainly 1,2-DCA. Lower concentrations of other chlorinated organics were observed in the TS area and were monitored during the TS.

Anaerobic biodegradation of the chlorinated ethenes (PCE, TCE, DCE, and VC), ethanes (TCA, DCA, CA) and chlorinated benzenes (1,2,4-TCB, 1,2-DCB, 1,3-DCB, 1,4-DCB, CB) occurs primarily by reductive dechlorination. Other biotic and abiotic pathways are possible. The reductive dechlorination process is a biologically mediated oxidation reduction reaction where a chlorine atom on the "parent" compound is replaced by a hydrogen atom resulting in the generation of energy for the organism and the change of the chemical to a more reduced "daughter" compound. For chlorinated ethenes, the reductive dechlorination process of PCE results in sequential production and subsequent reduction of TCE, DCE, and VC to ethene and ethane, as shown in Figure 7.

The chlorinated ethane reductive dechlorination process results in the sequential production and subsequent reduction of TCA, DCA, and CA to ethane (Figure 9). The chlorinated benzene reductive dechlorination process results in the sequential production and subsequent reduction of TCB, DCB, and CB to benzene (Figure 8). Notably the complete reductive dechlorination of the chlorinated ethenes and ethanes results in the production of non toxic ethene or ethane. However, the reductive dechlorination of chlorinated benzenes results in the production of benzene. Benzene is not degraded further by the reductive process, however it is readily

degraded under aerobic conditions. Benzene may also be utilized as an electron donor and readily degraded in the presence of sufficient electron acceptors including O_2, Fe^{3+} and SO_4.

As discussed previously, anaerobic biodegradation was stimulated by the addition of an easily fermentable substrate (sodium lactate) and hydrogen gas. The fermentation of lactate and propionate results in the generation of hydrogen. The indigenous organisms use the hydrogen from the fermentation process and the hydrogen added directly to the groundwater to reduce the chlorinated organics as well as various other electron acceptors.

The data indicate that the addition of substrate resulted in the establishment of conditions conducive to the reductive dechlorination of the chlorinated ethenes, ethanes, and benzenes. The following section presents a discussion of the results.

7.1.1 Evaluation of Geochemical Changes

The primary geochemical parameters evaluated during Stage 1 include field and laboratory analytical parameters. Significant field parameters include DO, ORP, pH, and conductivity. Significant geochemical analytical parameters measured in the laboratory include alkalinity, Mn, Fe^{2+}, SO_4, and CH_4.

Only a small amount of the substrate that is delivered to the aquifer is utilized for degradation of the chlorinated organics. The remainder of the substrate causes substantial geochemical changes in the aquifer. The change in these parameters document the establishment of conditions conducive to anaerobic biodegradation of the chlorinated organics. Indigenous microorganisms that reduce other electron acceptors such as Fe^{3+} and SO_4, compete with the dechlorinating organisms for use of the hydrogen generated by fermentation of the substrate (sodium lactate). Therefore, additional substrate is added to account for this hydrogen demand. Primary electron acceptors and their reduced form are presented below:

Electron Acceptors and Reduction Product

Electron Acceptor	Reduced form
Oxygen (O_2)	Water (H_2O), Carbon Dioxide (CO_2)
Nitrate (NO_3^-)	Nitrogen (N_2), Nitrite (NO_2^-)
Manganese (Mn^{7+})	Manganese (Mn^{4+}, Mn^{2+})
Ferric Iron (Fe^{3+})	Ferrous Iron (Fe^{2+})
Sulfate (SO_4^-)	Sulfide (HS^-)
Carbon Dioxide (CO_2)	Methane (CH_4)

Complete degradation of the chlorinated organics requires highly reducing conditions. The reduction of more thermodynamically favorable electron acceptors must be achieved to accomplish reductive dechlorination. Therefore, the change in these electron acceptors and their products are monitored during the anaerobic ISB process.

7.1.1.1 Oxygen & Oxidation Reduction Potential

During the ISB TS, the changes in electron acceptors and their reduction products were consistent with changes associated with anaerobic ISB. O_2 was quickly removed from the aquifer as the ORP rapidly dropped approximately +50mV to between -100 mV and -300 mV. The low ORP is favorable for the complete reductive dechlorination of VC to ethene.

7.1.1.2 pH

A noticeable drop in pH from an ambient level of approximately 7.5 to 8.0 to approximately 6.5 to 7.2 was observed during the Stage 1 of the TS. The drop in pH is typical of that observed during the introduction of an organic acid and the production of metabolic acid during increased biodegradation. Despite the observed pH changes at the onset of Stage 1, the pH of the aquifer remained near neutral throughout the TS, well within the range favorable to both anaerobic and aerobic ISB (4.5 to 8.5).

7.1.1.3 Specific Conductance

The SC of the aquifer increased slightly, as measured in wells IW02A and MW53A from about 3 mS/cm to about 5 mS/cm. However, the SC increased substantially in wells EW01A and MW54A to about 15 mS/cm. The SC of H_2O is associated with the amount of dissolved solids or ionic species in the H_2O. The higher SC in MW54A and EW01A, as compared to IW02A and MW53A, is reflected in the higher concentration of dissolved solids in the first two wells. The substantial increase in SC in MW54A and EW01A corresponds to the large increase in Fe^{2+} after substrate injection. Notably, the SC decreased in MW54A after addition of hydrogen and removal of Fe^{2+}.

7.1.1.4 Ferrous Iron

Fe^{2+} concentrations increased to approximately 2 mg/L in wells IW02A and MW53A and remained at that concentration for the duration of Stage 1. However, after injection of substrate into well MW54A the Fe^{2+} concentration increases substantially to over 14 mg/L and 16 mg/L in wells EW01A and MW54A, respectively. The decrease in Fe^{2+} concentration is associated with the addition of hydrogen during and subsequent to substrate distribution. During injection of substrate into IW02A, hydrogen was delivered constantly for approximately two months, thereby distributing substrate and hydrogen to IW02A and MW53A. However, because substrate was not distributed to MW54A during this injection, no hydrogen was delivered to that location. The subsequent injection of substrate directly into MW54A included only minor amounts of

hydrogen initially. On day 159 a constant supply addition of hydrogen was added to well MW54A. The addition of hydrogen resulted in the rapid removal of Fe^{2+} from solution.

The mechanism for Fe^{2+} removal is not clear and has not been described in the literature. However the investigators for this project have observed Fe^{2+} removal at other ISB projects, notably the anaerobic ISB project at Naval Station Treasure Island. A potential mechanism for ferrous removal is the reduction of amorphous ferrous sulfide (FeS) generated during this process to insoluble pyrite (FeS_2). The data indicate that almost all the sulfate reduced to sulfide in Stage 1 was later reoxidized to sulfate in Stage 2. It is considered unlikely however, that pyrite would be quickly reoxidized under aerobic conditions, as was observed during the TS, therefore, another mechanism for Fe removal is likely. The presence of these highly reduced compounds may provide a potential source for abiotic reductive dechlorination of the chlorinated ethenes.

7.1.1.5 Sulfate

Upon reduction of Fe^{3+} to Fe^{2+}, sulfate was reduced to sulfide as anticipated. Sulfide was observed in groundwater samples however, sulfide rapidly combines with Fe^{2+} to form a dark colored amorphous ferrous sulfide precipitate or with hydroben to for hydrogen sulfide gas that may be removed from the groundwater. Therefore, it is not possible to determine the stoichiometric conversion of sulfate to sulfide from groundwater samples alone. However, for the purposes of this investigation, the establishment of sulfate reducing conditions is sufficient.

7.1.1.6 Methanogenesis

Under highly reducing conditions, CO_2 is used as an electron acceptor and is converted to CH_4. Methanogenesis occurs after utilization of all other available electron acceptors such as sulfate and chlorinated organics. During the TS CH_4 generation was observed as anticipated. The highest concentrations of CH_4, up 12 mg/L and 16 mg/L, were observed in IW02 and MW53A, respectively. Lower CH_4 concentrations up to 2 mg/L and 1 mg/L, were observed in MW54A and EW01A, respectively. CH_4 generation occurred in wells IW02A and MW53A shortly after reduction of sulfate and after complete degradation of the chlorinated organics.

7.1.1.7 Total Organic Carbon

Total organic carbon (TOC) was measured during the TS to evaluate if the injected substrate was available to enhance anaerobic biodegradation. The TOC analysis indicated that substrate was effectively distributed throughout the TS area. Once distributed organic carbon was utilized by the organism resulting in the reduction in TOC concentration. The TOC data indicate that substrate was completely utilized in each of the TS wells except EW01A by the end of Stage 1. The TOC data indicates that substrate utilization is fairly rapid, however sufficient substrate was available for complete reductive dechlorination. The residual TOC in EW01 is considered the result of higher initial concentrations and potential competition with TPH at that location.

7.1.1.8 Volatile Organic Acids

VOAs, including propionic and acetic acids, account for most of the organic alkalinity in natural waters. Because lactate degrades rapidly to propionate and acetate, alkalinity was measured to as a cost-effective method for determining the concentration of organic acids present in the TS area. Alkalinity concentrations were compared to VOA analysis. The comparison confirmed that alkalinity is an effective surrogate for more expensive VOA analysis. A discussion on the concentration changes in the VOA propionic acid are discussed in the following section.

7.1.1.9 Propionic Acid

During anaerobic biodegradation, sodium lactate was introduced into the aquifer. Sodium lactate is degraded by indigenous microorganisms primarily to propionic acid and acetic acid and lesser amounts of other volatile organic acids. The conversion of lactate to propionic acid results in the production of hydrogen that is used by the microorganisms for reduction of electron acceptors, reductive dechlorination, and methanogenesis. Propionic acid is further degraded by the microorganisms resulting in the production of additional hydrogen for the reductive dechlorination process. Propionic acid was therefore measured to assure that sufficient substrate was available to enhance the anaerobic biodegradation process.

The analysis confirmed that propionic acid was distributed throughout the TS study area and was present in wells IW02A, MW53A and MW54A for the majority of Stage 1 but had been completely degraded in these wells prior to Stage 2. Propionic acid was present in the well EW01A for the duration of Stage 1. The rate of substrate utilization was substantially higher in well MW54A than in other wells. This result in conjunction with the minor amount of CH_4 production indicates that a large amount of substrate utilization and subsequent hydrogen generation at that location is going towards rapid degradation of the chlorinated organics. The data indicate that lactate and propionate are effective substrates for enhancement of anaerobic ISB at this site.

7.1.2 Chlorinated Organics

During Stage 1, the concentration of chlorinated organics was measured in the TS performance monitoring wells to determine biodegradation rates and confirm the degradation of the contaminants. Chlorinated organics degraded during Stage 1 of the TS primarily consisted of chlorinated ethenes (PCE, TCE, DCE, and VC), chlorinated ethanes (1,2-DCA) and chlorinated benzenes (1,2,4-TCA, 1,2-DCB, and 1,4-DCB). The following section described the degradation of the chlorinated organics.

7.1.2.1 Chlorinated Ethenes Biodegradation (PCE, TCE, DCE, and VC)

The rate of degradation of the chlorinated ethenes was generally similar in each of the TS performance monitoring wells. In wells IW02A, MW53A, and EW01A complete reductive dechlorination of PCE, TCE, DCE, and VC to ethene and ethane was observed. Degradation of

chlorinated ethenes in wells IW02A and MW53A began during substrate distribution and they had completely degraded in MW53A within 60 days of the beginning of substrate injection and within 90 days in IW02A. The anticipated sequential reductive dechlorination process that results in transformation of PCE to TCE to DCE to VC to ethene was observed in each of these wells. In addition, reduction of ethene to ethane was also observed. Chlorinated ethenes were degraded to below method detection limits.

Chlorinated ethene degradation was delayed in wells MW54A and EW01A because substrate was not delivered to those locations until approximately 60 days after substrate distribution in the previously discussed wells. However, after substrate distribution reductive dechlorination was rapidly initiated.

In well EW01A, PCE and TCE were completely degraded to more reduced compounds within 30 days and complete degradation of the remaining chlorinated ethenes was accomplished within 90 days of substrate distribution. As in the previously discussed wells, chlorinated ethenes were degraded to ethene and further degraded to ethane. Chlorinated ethenes were degraded below method detection limits. The longer degradation rates in EW01 may be attributed to the material in this area consisting of fill material from other portions of HPS used as backfill in the separator tank excavation. Fill material from other areas would not be anticipated to have developed a population of chlorinated solvent degrading organisms. Therefore, degradation would depend on migration of dechlorinating organism from outside the fill material into that location. This appears to have occurred rather rapidly.

Contaminant dilution was not a contribution factor during re-circulation, since groundwater extracted from well EW01A had higher concentrations of chlorinated VOCs than groundwater sampled from injection well IW02A prior to the recirculation. However, dilution may be a contribution factor during direct injection of substrate-amended groundwater into well MW54A (performed from day 70 through 71). Approximately 1,700 gallons groundwater amended with the sodium lactate solution (as described in Section 5.1.2.1) were injected into well MW54A. A significant decrease in the concentration of chlorinated ethenes and benzenes was observed in this well on day 75, which can be partially attributed to dilution, especially taking into account very low permeability of soil in the vicinity of the well. However, groundwater used for this injection was derived from wells MW902B and MW901B (the only wells in the vicinity capable of producing the required groundwater volume) which had chlorinated VOC contamination in range of that in well MW54A (data for well MW902B is provided in the table of Appendix D). In conclusion, dilution may have had a factor in this TS investigation, but due to the use of contaminated, site-derived groundwater for the substrate injections and recirculation, the effects were minimal.

Chlorinated ethenes biodegradation in MW54A appear to be occurring as indicated by the presence of ethene and ethane at that location. However, PCE and TCE remained present in the groundwater samples during the anaerobic stage. In addition, although DCE and VC were present, the sequential reductive progression was demonstrated at that location during Stage 1. Groundwater analysis confirmed that sufficient substrate was available for enhancement of reductive dechlorination. Notably however, the observed substrate utilization rate was much higher in well this well than in other wells, indicating a highly active microbial community. To assure that conditions were appropriate for biodegradation, a constant supply of hydrogen gas was delivered to MW54A from day 159 to day 232. CH_4 analysis indicated that the majority of the hydrogen generated during substrate utilization was being applied to dechlorination of the contaminants rather than methanogenesis.

The continued presence of parent products (i.e., PCE, TCE, 1,2- and 1,4-DCB, and 1,2-DCA) indicated that a source of these contaminants must be present near MW54A. Potential continual sources considered include very high adsorbed phase organics or DNAPLs. There are several possible causes for the VOC concentrations observed in MW54A including variability in sampling and potential DNAPL near that location. The very high VOC concentrations in soil and groundwater observed in the baseline sampling may indicate that DNAPLs are present in this location. PCE was detected at a concentration of 32.6 mg/L which as approximately 7.5 % of the solubility of pure free-phase PCE. Generally, dissolved phase concentrations in excess of 1% of the solubility may indicate the presence of free-phase contaminants therefore the observed concentration indicates a DNAPL may be present at that location. The highest concentration of PCE (669 mg/kg) was also observed in the boring adjacent to this well. DNAPLs have been observed in nearby wells including MW902A (Figure 6).

During post anaerobic stage sampling, a DNAPL was observed in MP MW54A-BH installed approximately 1-foot from MW54A. The DNAPL is considered to represent a continuing source of contaminants resulting in a constant influx of parent compounds into the monitoring well during purging for sample collection. Although the parent compounds are present in the sample, their presence does not indicate that ISB is not occurring at that location. In fact, the presence of degradation products including ethene and ethane indicates that complete reductive dechlorination is occurring, however, because of the constant influx, a mass balance cannot be achieved and therefore biodegradation rates cannot be established.

A mass balance on chlorinated ethenes was evaluated during Stage 1 to determine treatment effectiveness. Because chlorinated ethene degradation does not change the molar concentration of total chlorinated ethenes, the total chlorinated ethene molar concentration would remain constant unless another source of chlorinated ethenes was present. The molar change in chlorinated ethene concentration is depicted in Figures F19 through F23.

The molar concentration of chlorinated ethenes increased in wells IW02A and MW53A during the degradation of the chlorinated ethenes. Because degradation of dissolved-phase alone cannot account for this increase, another source of chlorinated ethenes must be present. Likely sources include adsorbed-phase chlorinated ethene and DNAPLs. If DNAPL were present complete degradation of the chlorinated ethenes would not occur band it would be expected that residual chlorinated organics would be present after complete substrate utilization. Because complete degradation of the chlorinated ethenes occurred and because the total concentrations are not excessively high, the additional concentration is likely the result of degradation of adsorbed-phase chlorinated ethenes or the dissolution of adsorbed-phase chlorinated ethenes followed by rapid degradation of the chlorinated ethenes in the dissolved-phase. This indicates that the ISB process is not only treating dissolved-phase organics but adsorbed-phase as well.

7.1.2.2 Chlorobenzenes Biodegradation (1,2,4-TCB, 1,2-DCB, 1,3-DCB, 1,4-DCB, and CB)

As discussed above, chlorinated benzenes (1,2-DCB and 1,4-DCB) account for the majority (59 %) of the chlorinated organics observed in the DNAPL at RU-C5. Because the DNAPL contains both 1,2-DCB and 1,4-DCB, these compounds are considered parent compounds and not the result of degradation of 1,2,4-trichlorobenzene, based upon the mechanism shown in Figure 8.

The degradation of chlorinated benzenes was monitored during Stage 1. As with the chlorinated ethenes, chlorinated benzene degradation was anticipated to occur by reductive dechlorination. During this process, more oxidized compounds such as 1,2,4-trichlorobenzene would be reduced to less chlorinated organic compounds such as 1,2-DCB, 1,3-DCB, and 1,4-DCB which would eventually be reduced to CB and ultimately benzene. Unlike chlorinated ethenes degradation, which results in the production of a relatively non-toxic compound (ethene), reductive dechlorination of chlorinated benzenes results in the production of benzene, a known carcinogen. Benzene and chlorobenzene concentration comparison in the TS wells is shown on Figures F54 through F56 (Appendix F).

As with the chlorinated ethenes, chlorinated benzene degradation was observed to occur upon the addition of substrate. As anticipated, the degradation of 1,2-DCB and 1,4-DCB resulted in the production of CB. Degradation of 1,2-DCB occurred approximately twice as fast as that of 1,4-DCB, based upon data for the period between day 25 and day 173, the period during which most of the 1,2-DCB degradation occurred. Degradation of 1,2-DCB to CB occurred within 120 days after substrate delivery in wells IW02A, MW53A and EW01A. Degradation of 1,4-DCB to CB was observed in wells IW02A and MW53A within 150 days of substrate distribution and in well EW01A within 210 days of substrate distribution. The relatively slower degradation rate in EW01A is consistent with slower observed chlorinated ethene degradation and is considered to be partially attributable to a reduced dechlorinating microbial population in the backfill material derived from other sites at HPS.

As with the chlorinated ethenes, the biodegradation of chlorinated benzenes in well MW54A was not measurable. Although CB was present indicating that reductive dechlorination of the DCB was occurring at that location, parent compounds 1,2-DCB and 1,4-DCB remained present at relatively stable concentrations. As with the chlorinated ethenes, the continued presence of parent compounds at MW54A is considered to be attributable to DNAPL near that location.

Near stoichiometric concentrations of CB were generated during the reduction of 1,2-DCB and 1,4-DCB. CB was observed to be recalcitrant under anaerobic conditions. During the reductive dechlorination process a minor increase (~40 µg/L) in benzene concentration was observed, relative to initial concentrations which were up to 320 µg/L in well MW54A. Benzene degradation was not anticipated under enhanced anaerobic biodegradation and accordingly, benzene concentrations did not decrease during the anaerobic stage.

7.1.2.3 Chlorinated Ethanes

Chlorinated ethanes comprised less than 1% of the DNAPL observed at MW902B however, 1,2-DCA was detected in MW54A at concentrations in excess of 50 mg/L. 1,2-DCA degradation can occur under both anaerobic and aerobic conditions. Under anaerobic conditions 1,2-DCA degradation is anticipated to occur by reductive dechlorination where chlorine atoms are replaced by hydrogen resulting in more reduced compounds including CA and ultimately ethane (Figure 9). As with the chlorinated ethenes the reductive dechlorination process results in the production of a relatively non toxic compound, ethane.

Degradation of 1,2-DCA was monitored during the Stage 1. Rapid degradation of 1,2-DCA was observed in wells IW02A, MW53A and EW01A. Degradation of 1,2-DCA occurred in wells IW02A and MW53A in approximately 90 days, approximately 60 days prior to the same degradation in EW01A. This difference is attributable to the approximately 60 day delay in distribution of substrate to EW01A.

Notably, the degradation of 1,2-DCA is not accompanied by the increase in daughter products including CA or ethane. Ethane is present in wells however, the increase in ethane corresponds to a decrease in ethene concentration. Transformation of ethene to ethane can occur under very reducing conditions.

Various biotic and abiotic mechanisms can result in the degradation of 1,2-DCA. Dichloroelimination is a potential biological pathway that would not result in the production of chloroethane. During this process, both chlorine atoms are removed from the 1,2-DCA resulting in the production of ethane rather than CA. In addition, ethene can be produced rather than ethane. Although this is a potential biodegradation pathway, the ethane is presently considered attributable to degradation of ethene. No data was collected during the pilot test to evaluate if the ethene observed is attributable to degradation of the chlorinated ethenes or ethanes.

As with the other chlorinated organics, the degradation of 1,2-DCA could not be quantified at MW54A. Fluctuations in 1,2-DCA concentrations mirrored that of other chlorinated organics. As with the other contaminants, the persistence of 1,2-DCA is attributed to DNAPL located adjacent to that well.

7.1.3 Other Chemicals of Concern

Other contaminants have been detected in the groundwater during the pilot test including benzene and naphthalene. The concentration of benzene and naphthalene were typically low (<75 µg/L) relative to the high concentration of chlorinated ethenes, ethanes and benzenes.

7.1.4 Vertical Migration

Of particular concern during the pilot test was the potential for contaminants to migrate deeper into the aquifer. The vertical migration of contaminants in the treatment area was evaluated in MW56A and MW15F. The data from well MW56A (provided in Figures F16 and F50 and the table of Appendix C) do not indicate the vertical transport of contaminants from the treatment zone. Reductive dechlorination was occurring in the lower A-aquifer before the start of the TS. Background data collected from well MW56A show high concentrations of vinyl chloride (820 µg/L) and ethene (721 µg/L). The concentration of chlorinated ethenes in MW56A decreased gradually over time (Figure F16), not rapidly and in succession as in reductive dechlorination. Figure F50 shows concentrations of chlorinated ethenes, ethanes, and benzenes together exhibiting a similar pattern of gradual reduction. These gradual concentration changes are consistent with advective transport of contaminants through the well. The data from well MW15F (provided in the table of Appendix D) show similar gradual concentration changes indicative of horizontal groundwater migration. Also there was no change in the alkalinity concentrations in wells MW56A and MW15F after the substrate addition, which provides evidence that substrate transfer to these wells was not occurring.

7.2 Summary of Stage 2 Aerobic ISB

Stage 2 was conducted from January 6 to May 25, 2005. The aerobic stage was conducted after completion of the anaerobic stage (Stage 1) and after post Stage 1 soil and groundwater sampling was performed. As described above, the introduction of a fermentable substrate in Stage 1 established highly reducing conditions. This resulted in the biodegradation of the chlorinated organics including chlorinated ethenes, ethanes and benzenes. The establishment of highly reducing conditions also had a substantial impact on the geochemical conditions in the aquifer. Notably electron acceptors including O_2, Mn, Fe^{3+}, sulfate and CO_2 were reduced to CO_2 reduced Mn, Fe^{2+}, sulfide, and CH_4.

The purpose of the aerobic ISB process was to degrade those organic compounds that are aerobically biodegradable and to immobilize any metals potentially mobilized during Stage 1.

Chlorinated organic compounds evaluated during the aerobic stage include CB resulting from the reductive dechlorination of 1,2-DCB and 1,4-DCB. In addition, aerobic biodegradation of non chlorinated organics including benzene, TPH, phenols, and PAHs was evaluated.

The aerobic ISB process consists of biostimulation of the indigenous aerobic heterotrophic microorganisms by the addition of O_2. These microorganisms utilize reduced contaminants (i.e., benzene, CB, phenol) as an electron acceptor and carbon donor, and O_2 as an electron acceptor. These microorganisms create a biologically mediated oxidation reduction reaction, resulting in the generation of energy used by the organism for its life processes. The reaction results predominantly in the production of CO_2 and H_2O, with small amounts of chloride in the case of chlorinated compound degradation. The process is identical to eating and breathing that we do to live.

As with the anaerobic substrate distribution, only a portion of the O_2 is utilized in the biodegradation of the contaminants. A large O_2 demand was created by the establishment of highly reducing conditions to achieve the degradation in Stage 1. The O_2 demand comes in the form of reduced electron acceptors such as Mn, Fe^{2+}, sulfide, and CH_4 produced during the reduction of Fe^{3+}, sulfate and CO_2 as discussed above. In addition, any residual organic carbon remaining from Stage 1 will be aerobically degraded and therefore act as a sink for O_2.

Aerobic biostimulation was conducted by the addition of O_2 to each of the wells in the TS. The addition of O_2 changed the highly reducing conditions established during Stage 1 to more oxidizing conditions conducive to the aerobic biodegradation of the organics. iSOC™ technology was used to introduce O_2 to the wells. iSOCs were used because they are a passive system capable of infusing groundwater with very high concentrations of gas without sparging, which can result in the physical removal of the contaminants. Although sparging may be an effective technology for full-scale remediation, sparging was not selected for this TS because of the difficulty of attributing contaminant loss to biodegradation rather than physical removal processes.

The establishment of aerobic conditions produced substantial changes in groundwater geochemistry and contaminant concentrations. The following sections describe these changes.

7.2.1 Geochemical Changes

7.2.1.1 Oxygen

As expected the iSOC™ units substantially increased O_2 concentrations in each well. At sea level, the maximum dissolved concentration of O_2 in equilibrium with air is approximately 8 mg/L. However, groundwater in equilibrium with pure O_2 under the same conditions can reach dissolved concentrations in excess of 40 mg/L. The iSOC™ units effectively infused the groundwater with O_2 to concentrations in excess of 40 mg/L. Increased DO concentrations were

observed immediately after addition of the O_2. The presence of high concentrations of O_2 demonstrated that O_2 is present in the groundwater and is available for aerobic biodegradation of the organics.

7.2.1.2 Oxidation-Reduction Potential (ORP)

As anticipated, the addition of O_2 resulted in a rapid increase in ORP. ORP values increased from lower than -300 mV to over +100 mV. ORP stabilized rapidly in each of the wells, and after the initial increase remained relatively constant for the remainder of the aerobic stage.

7.2.1.3 pH

The pH of the aquifer rose slightly during the aerobic stage, remaining slightly above neutral. The pH of the aquifer remained within the range favorable for ISB (4.5 to 8).

7.2.1.4 Specific Conductance

The SC remained relatively constant at approximately 5 mS/cm in wells MW53A and IW02A. The SC decreased from a maximum of approximately 15 mS/cm to approximately 5 mS/cm in wells MW54A and EW01A. The reduction in SC in these wells began with the introduction of hydrogen during the anaerobic stage. The SC in all wells remained constant during the aerobic stage.

7.2.1.5 Ferrous Iron

Under aerobic conditions, Fe^{2+} is not stable and is anticipated to precipitate as insoluble Fe^{3+}. As anticipated, the concentration of Fe^{2+} in wells IW02A and MW53A reduced during the aerobic stage. However, the concentration of Fe^{2+} increased in wells MW54A and EW01A during the aerobic stage. The presence of ferrous Fe with elevated O_2 concentrations indicate that disequilibrium conditions exist in the area of those wells. The elevated Fe^{2+} at MW54A and EW01A is considered to be due to limited delivery of O_2 away from the wells thereby allowing reducing conditions to persist immediately outside the well.

7.2.1.6 Sulfate

The first inorganic parameter expected to be oxidized during the addition of O_2 is sulfide. Sulfide is produced during the anaerobic stage by the reduction of sulfate. Sulfate was measured during the Post-Stage 1 and Post-Stage 2 sampling events. The data indicated that the sulfate concentrations had returned to their Pre-Stage 1 concentrations in each of the wells in the TS area. The data indicate that oxidation of sulfide represents a significant O_2 demand during transition to aerobic conditions. However, sufficient O_2 was delivered to overcome this demand.

7.2.1.7 Methane

As discussed above, CH_4 can be generated from the reduction of CO_2 and is the most reduced organic compound present. Because CH_4 is highly reduced it is readily utilized as an electron donor in the presence of O_2. Therefore, CH_4 is readily biodegraded under aerobic conditions.

During Stage 1 of the TS CH_4 concentrations in wells IW02A and MW53A increased substantially (from below detection limits to 12 mg/L and 16 mg/L, respectively). The concentration of CH_4 in the wells MW54A and EW01A remained relatively low (~1 mg/L and 2 mg/L respectively). With the addition of O_2 during Stage 2, the concentration of CH_4 in both wells IW02A and MW53A decreased substantially (~ 2 and 3 mg/L, respectively). The data indicate that indigenous methanotrophic bacteria are degrading the available CH_4.

The concentration of CH_4 in well EW01A increased during Stage 2. Although elevated concentrations of O_2 were observed in this well CH_4 concentration continued to rise during Stage 2. Because CH_4 is readily degradable aerobically, the data indicate that substantially reducing conditions must occur near the well. The data corresponding with the Fe^{2+} results also indicated that reducing conditions may still be present in the area of this well. Post-Stage 2 TOC analysis confirmed that organic carbon had been degraded in all other TS wells, however organic carbon was still present at relatively high concentrations in EW01A. This organic carbon may have been a continuing source for CH_4 generation.

The sulfate analysis indicates that O_2 was utilized for the oxidation of sulfide in this well, and therefore, oxidation reduction conditions should not support methanogenesis. Potentially, sulfide may be oxidized more rapidly than CH_4 resulting in the presence of previously generated CH_4 with sulfate. Additionally, elevated TOC remains in the area of EW02A. Because a substantial amount of carbon remains in the area of this well, CH_4 may continue to be generated in the aquifer in areas outside the influence of the O_2 delivery system. This result suggests that the iSOCs were not effective for delivery of O_2.

CH_4 concentrations remained very low in well MW54A during both the aerobic and anaerobic stages of the TS. As discussed above, the indigenous organisms use more thermodynamically favorable electron acceptors before using CO_2 as an electron acceptor in methanogenesis. Chlorinated organics are used as electron acceptors in the biodegradation process. These chlorinated organics are more favorable electron acceptors than CO_2. Therefore, the organisms will not use the delivered hydrogen for methanogenesis until the chlorinated organics are depleted, as was observed in IW02A and MW53A. A DNAPL has been observed adjacent to well MW54A. The ongoing analytical data confirm that the DNAPL represents a continuing source of chlorinated organics to the aquifer at that location. Because there is a continuing source of chlorinated organics, the methanogenic conditions were not achieved. These data, in

conjunction with the substrate utilization data indicate that the indigenous cultures were actively degrading the chlorinated organics at that location.

7.2.1.8 Total Organic Carbon

TOC had been depleted in all the TS wells except EW01A prior to the end of Stage 1. The TOC concentration in that well was in excess of 300 mg/L at the end of Stage 1. TOC was persistent at that location through Stage 2 with concentrations of approximately 100 mg/L remaining at the end of Stage 2. The TOC data indicate that highly aerobic conditions established in other TS wells were not established very far outside this well. The carbon appears to be utilized for continuing reduction of Fe^{3+} to Fe^{2+} and generation of CH_4, both indicative of continued reducing conditions in the area of this wells.

7.2.2 Organics

The purpose of Stage 2 of the TS was to evaluate the aerobic ISB of potentially residual chlorinated organics and other non chlorinated organics which would not be treated during Stage 1. The following sections describe the results of the aerobic ISB TS Stage 2.

7.2.2.1 Chlorinated Organics

During Stage 1 chlorinated organics including chlorinated ethenes and 1,2-DCA were degraded to ethene and ethane and therefore did not require additional treatment. However, complete reductive dechlorination of chlorinated benzenes results in the generation of benzene, which is highly toxic and not amenable to enhanced anaerobic ISB. Complete reductive dechlorination of 1,2-DCB and 1,4 DCB was not observed during Stage 1, and CB was accumulated. Some benzene was produced, but the quantities were minimal. CB has been reported to be biodegradable under aerobic conditions; therefore the aerobic ISB of CB was monitored during Stage 2.

Aerobic biodegradation of CB was observed in wells IW02A and MW53A during Stage 2. CB decreased in concentration from 4220 µg/L to 316 µg/L in well IW02A and from 3040 µg/L to 386 µg/L in well MW53A. CB concentrations in these wells were continuing to decline at the completion of Stage 2 and are expected to continue to further decline with the addition of O2.

The concentration of CB in well EW01A initially appeared to decrease, however, continued monitoring during Stage 2 did not indicate that CB was degrading in that area. The continual presence of CB at this location is considered to be attributed to the inability to establish oxidizing conditions conducive to aerobic biodegradation in that area. This is further indicated by the presence of elevated TOC, CH_4 and Fe^{2+} also observed in that well.

Because a DNAPL is believed to be present near MW54A, 1,2-DCB and 1,4-DCB, and other chlorinated organics were not completely degraded in this well during Stage 1. As during

Stage 1, the DNAPL present near MW54A continued to be a source of contaminants during Stage 2. Therefore, determination of the degradation of CB and other chlorinated organics was not possible at this location.

7.2.2.2 Non Chlorinated Organics

The DNAPL observed in well MW902B consisted primarily of a mixture of chlorinated organics. However, non chlorinated organics comprised approximately 26 percent of the DNAPL. The degradation of non chlorinated organics was also evaluated as part of the TS.

The reductive dechlorination of chlorinated benzenes (1,2-DCB, 1,4-DCB) results in the production of benzene. The data indicated that benzene was generated along with CB during Stage 1. Benzene is readily degraded to CO_2 and H_2O under aerobic conditions and would be expected to degrade rapidly during Stage 2. With the addition of O_2 in Stage 2 benzene concentrations decreased rapidly at rates similar to CB reductions. Significantly reduced benzene concentrations of 6.9 and 1.7 µg/L were observed in wells MW53A and IW02A, respectively, at the end of Stage 2 monitoring. It is anticipated that benzene degradation would continue to concentrations below detection limits if the aerobic stage were to be continued.

Benzene degradation was not observed in well EW02A and MW54A. As with CB, the continued presence of benzene in well EW02A is considered to be the result of inability to establish aerobic conditions at that location. The continued presence of benzene in well MW54A is attributed to the presence of a DNAPL adjacent to that location.

Minor amounts of extractable organics were observed in the TS wells. These organics include phenol, 1,4-dimethylphenol, 3,4-methyphenol (m, p-cresol), 2 methylphenol (o-cresol), and TPH-d. The compounds were not considered to be degradable by enhanced anaerobic ISB process in Stage 1 but were considered to be degradable under aerobic conditions. Aerobic degradation of these compounds results in the production of CO_2 and H_2O.

An order of magnitude reduction in TPH was observed in well IW02A (from 2,690 µg/L to 213 µg/L) and well MW53A (from 1,920 µg/L to 130 µg/L). The reduction of TPH concentration indicates that establishing aerobic conditions resulted in the aerobic ISB of TPH

The concentration of phenols including 2,4-dimethylphenol, 3,4-methylphenol, and 2-methyphenol decreased substantially in wells IW02A and MW53A. These compounds were reduced to concentrations below method detection limits. The reduction of these compounds indicates that aerobic ISB is an effective treatment of phenols.

TPH and phenol degradation was not observed in wells EW01A and MW54A. As with other aerobically biodegradable contaminants, the continued presence of these compounds at EW02 is considered attributable to the inability to establish conditions conducive to aerobic

biodegradation of the organics. The continued presence of the compounds at MW54A is considered attributable to the presence of a DNAPL at that location providing a continual source of organics.

7.3 Evaluation of Large Diameter Well for Enhancement of Groundwater Extraction

One of the goals of the TS was to evaluate the applicability of installing a large diameter well to enhance groundwater extraction. Prior to initiation of the TS the degreaser pits, sumps and separator pits were excavated. Soils inside the building were excavated to the top of the water table. The separator pit outside the building extended well below the water table. The removal of the separator pit produced a large excavation that allowed for evaluation of the large diameter well.

Once the separator was excavated, a plastic liner was placed in the bottom of the excavation to reduce the possibility of vertical migration of DNAPLs potentially present but not observed in the area of the separator. A well casing consisting of slotted PVC was placed in the excavation which was subsequently backfilled with high-permeability rock to create a large diameter extraction well. Details of the well construction were provided in the report for CTO 001 (Shaw, 2004b).

Initially groundwater extraction rates were relatively high, in excess of 2 gpm. The high initial extraction rates were the result of dewatering of the high permeability fill material. After approximately 1,800 gallons of water in the excavation were removed maximum groundwater extraction rates declined dramatically. To address the lower extraction rates, the electric submersible pump used for recirculation during Stage 1 was replaced with a low flow pneumatic pump. Ultimately, maximum extraction rates decreased to approximately 0.05 gpm. The maximum sustainable extraction rates were determined to be insufficient to distribute substrate throughout the aquifer during the TS.

Based on the maximum sustainable extraction rates observe during the TS, large diameter wells at RU-C5 are considered ineffective for enhancement of groundwater extraction for recirculation and substrate distribution. The well did create a large depression in the groundwater table and may be effective for control of lateral groundwater flow.

7.4 Evaluation of Extent of Aerobic Conditions

During Post-Stage 1 sampling, monitoring points were installed in borings adjacent to each of the TS monitoring wells. The purpose of these points was to evaluated the radius of influence of O_2 delivery system. During regular sampling events groundwater from each monitoring point was measured in the field for O_2, pH, and ORP.

The data from the monitoring points indicate that, although high concentration of O_2 were established in each of the wells, aerobic conditions were only established in a small area around the well. The lack of distribution of aerobic conditions is considered attributable to a combination of several factors including low permeability sediments, low hydraulic gradient, high chemical and biological O_2 demand established in Stage 1 and highly active microbial population. Because the contaminants observed in the TS are readily biodegradable, it is likely that the addition of O_2 resulted in exponential growth of the microbial population. Since the organisms use O_2 and contaminants in their life processes, the organisms prefer to grow next to the wells where both food and O_2 are present in high concentrations. Therefore, high rates of O_2 utilization would prevent O_2 from extending very far from the source. Also, because of the low hydraulic gradient and low permeability of the sediments, there is very little potential for advective transport of the O_2 containing groundwater.

Stage 2 of the TS demonstrated that, with the addition of O_2, the indigenous microbial population will degrade the observed contaminants. The O_2 delivery system used for the TS was effective at delivering O_2 without the potential for physical removal such as a sparging system. This was appropriate for the TS evaluating aerobic biodegradation, but is not an effective mechanism for a larger scale applications. A more aggressive O_2 delivery system, such as a biosparging system, would be more effective for delivery of O_2 over larger areas.

7.5 Evaluation of Dehalococcoides sp Population

Groundwater samples collected during baseline and Post-Stage 1 (anaerobic ISB) and Post-Stage 2 (aerobic ISB) were analyzed for the presence of DHC. Analysis was conducted at Shaw's Technology Development Laboratory in Knoxville, TN. Analysis was conducted by quantitative Polymerase Chain Reaction, which identifies and quantifies organism (DHC) specific DNA thereby quantifying the size of the DHC population in the groundwater at the site.

The Polymerase Chain Reaction analysis confirmed that DHC is present in the aquifer at the TS area prior to the beginning of the TS. The concentration of DHC in baseline groundwater samples collected in wells IW02A and MW53A was 120 cells/mL and 450 cells/mL. Baseline samples from wells MW54A and EW01A were not analyzed for DHC.

Groundwater samples from each TS performance monitoring well were analyzed for DHC after completion of Stage 1. DHC was not detected in groundwater samples collected from wells MW53A and EW01A during this sampling event. DHC was detected in groundwater samples collected from IW02A (1,020 cells/mL) and MW54A (1,200 cells/mL).

Groundwater samples collected from the TS performance monitoring wells during the post aerobic stage also were analyzed for the presence of DHC. DHC was detected in all

groundwater samples at concentration of 200 cells/mL (IW02A), 12 cells/mL (MW53A), 42 cells/mL (MW54A), and 283 cells/mL (EW01A).

Because DHC is considered the organism that is responsible for the complete reductive dechlorination of the chlorinated ethenes, it was anticipated that the DHC concentration would increase during the anaerobic biodegradation stage (Stage 1) and that Post-Stage 1 concentrations of DHC would be higher than baseline concentrations. Because DHC are strict anaerobes, it was anticipated that the concentration of DHC would decrease in all wells during the aerobic stage and that Post-Stage 2 concentrations of DHC would be lower than in Post-Stage 1 concentrations.

Only the DHC concentrations in groundwater samples from IW02A and MW54A matched the anticipated change in DHC concentrations, assuming baseline DHC concentrations in MW54A to be at or near that of IW02A (120 cells/mL) or MW53A (450 cells/mL). During Stage 1 DHC concentrations in groundwater did increase approximately one order of magnitude in well IW02A, and between 2-fold and an order of magnitude in MW54A. However, DHC concentrations in groundwater decreased to below detection limits (1 cell per milliliter [cell/mL]) in well MW53A. During Stage 2 DHC concentrations decreased approximately one order of magnitude in wells IW02A and MW54A as expected; however, DHC concentrations increased in wells MW53A and EW01A.

The increase in DHC concentration in EW01A during the aerobic stage may be due to the persistence of reducing conditions at that location during Stage 2. If reducing conditions persisted, as indicated by the geochemical and VOC analysis described above, DHC could remain present at that location at elevated concentrations. However, the change in DHC concentration in well MW53A is the reverse of anticipated concentrations.

The cause of the discrepancy between anticipated and observed DHC concentrations is considered to be primarily the result of aquifer conditions and sampling procedures. The observed DHC concentrations in the TS area are extremely low for a site undergoing active biodegradation. For example, during the ISB TS at Naval Station Treasure Island (NSTI) DHC concentrations increased from near detection limits to over 1 million cells/mL within the same timeframe as the RU-C5 TS (less than six months). Notably, the degradation rates at RU-C5 are similar or faster than those observed at NSTI. This indicates that either only a small DHC population is necessary to attain these dechlorination rates or that the size of the DHC population measured in groundwater is not indicative of the overall in situ DHC populations. Another possibility is that abiotic reactions resulting from interactions resulting with biologically reduced inorganic compounds may be partially responsible for the degradation.

Microorganisms tend to adsorb to solid surfaces such as the aquifer matrices rather than float freely in the groundwater. There are presently no effective procedures available for easily extracting organisms from solid samples. Therefore, DHC analysis is only conducted on water samples. Because most of the DHC is adsorbed on the aquifer matrix, the DHC population in groundwater represents only that which sloughs off the aquifer material during sampling and is therefore only a small fraction of the total DHC in the aquifer.

Because DHC is adsorbed on the aquifer matrix it is likely that the type of aquifer material controls the amount of DHC that can be collected during sampling. Fine grained, low permeability aquifer such as those encountered at RU-C5 are anticipated to more strongly retain the microbial population than coarse-grained higher permeability aquifers such as those encountered at NSTI.

It is likely that a DHC population in the TS area is much higher than indicated by the groundwater analysis. However, since there are presently no standard methods for collection and analysis of biota samples it is not possible to determine and compare DHC data from different sites. An accurate determination of the DHC population is more of an academic than design question. The data indicate that the DHC is present in the aquifer and the population, whatever size it is, is capable of complete dechlorination of the contaminants observed at RU-C5.

7.6 Evaluation of Metals in Groundwater

During the biological reduction of the organics, the lowered oxidation reduction potential during the anaerobic stage or the higher oxidation-reduction potential in the aerobic stage may result in changes in the concentrations of inorganics in the aquifer. In addition, other changes in the groundwater chemistry resulting from the biological processes, such as pH change and the production of biological surfactants, may produce changes in inorganic chemistry. Although these parameters were not evaluated regularly during Stage 1 of the pilot test, baseline conditions were established prior to the beginning of Stage 1 and were measured again after the completion of the anaerobic stage. Baseline samples were not collected for metals from MW54A because of the limited amount of water available for collection during that event. The metals that were evaluated included As, Cd Cr, Mn, and Hg. The following section describes the results of those analyses.

The potential for As mobility was evaluated because the reduced form of As (As^{3+}) is more mobile than the oxidized form (As^{5+}). The creation of reducing conditions therefore could result in higher dissolved phase As. As concentration remained relatively low in all wells during the TS. The highest concentration of As was in EW01A (28.6 µg/L). In general the concentrations of As was slightly higher after the ISB process. The elevated concentration of As in EW01A is considered to be due to persistent reducing conditions at that location. It is anticipated that As concentrations would decrease as more oxidizing conditions are established.

The potential for increased dissolved Mn was evaluated because the reduced form of Mn (Mn^{4+} and Mn^{2+}) may be more soluble than the more oxidized form (Mn^{7+}). The establishment of reducing conditions therefore, could potentially result in higher dissolved phase Mn. The concentration of Mn increased in all wells in the treatment area including wells EW01A, IW02A, MW53A. The cause for the substantial increase in Mn concentration at EW01A relative to the other wells is not determined. Possibly, the material used to backfill the excavation at that location may have contained higher amounts of Mn than the aquifer matrix in the treatment area.

The potential for increased dissolved phase Hg was evaluated because sulfate reducing bacteria may increase biologic uptake of Hg and potentially result in a decrease of dissolved-phase Hg during the anaerobic stage. The transition from anaerobic to aerobic conditions are considered to potentially result in the increase in dissolved-phase Hg.

The potential for increased dissolved Cr was evaluated because the oxidized form of Cr (Cr^{6+}) is more soluble than the reduced form (Cr^{3+}). Therefore, the establishment of more oxidizing conditions during the aerobic-phase could produce higher dissolved-phase concentrations of Cr. This is considered unlikely however because the conversion of Cr^{3+} to Cr^{6+} occurs generally under more oxidizing conditions than will be established during the aerobic stage. Cr concentrations increased in EW01A and decreased in MW56A during Stage 1. The concentration of Cr in and around the treatment area remained low during Stage 1. The highest reported concentration of Cr was 38 µg/L (EW01). The majority of the reported concentrations were below detection limits.

In general, Hg concentrations remained the same or decreased slightly during Stage 1. The highest reported concentration of Hg was 0.13 µg/L. All reported concentrations were below method detection limits.

Changes in aquifer chemistry were considered to potentially result in the increased dissolved phase concentration of Cd. Cd was not detected in any samples in the treatment area above method detection limits.

The change in As, Mn, Cr, Hg, and Cd concentration during Stage 1 Anaerobic are presented in Figures 47, 48, and 49 of Appendix F. Data reported in yellow indicates that the parameter was not detected at the method detection limit shown in yellow. Data shown in brown indicates the estimated concentration of the parameter at a concentration below the method detection limit. Data presented in black are the detected concentrations of that parameter.

8.0 Conclusions and Recommendations

The TS conducted at RU-C5 successfully evaluated the anaerobic and aerobic ISB processes for treatment of contaminants observed at RU-C5. The following conclusions are based on an evaluation of the results of the Stage 1 Anaerobic ISB and the Stage 2 Aerobic ISB.

8.1 Design Information

The large diameter extraction well at RU-C5 was inefficient for distribution of substrate by groundwater recirculation. Substrate distribution was accomplished by bulk extraction and injection.

Substrate injection was accomplished at relatively high flow rates with minimal pressures. However, heterogeneities in the aquifer hydraulic conductivity prevented adequate distribution using one injection well alone. Adequate substrate distribution for this TS was accomplished by injecting amended groundwater into both the injection well and monitor well. Distribution was considered adequate if substrate (sodium lactate) was observed in each of the TS performance monitoring points (i.e., IW2, MW53, MW54 and EW01). Since sodium lactate was observed in these wells and subsequent biological degradation occurred, substrate distribution was considered effective.

The radius of influence of the substrate injection system was highly variable because of the heterogenous nature of the sediments at the TS area. Sodium lactate distribution was observed to be about 5 feet from IW02 to MW52A and about 12 feet from MW54 to EW01. It is anticipated that further distribution may be achieved with longer injection rates and higher pressures.

The iSOCs were determined to be effective for increasing O_2 concentration within the wells in which they were installed. However, because of site conditions, including high biological and chemical oxygen demand of the aquifer and low permeability of the aquifer matrix, the iSOCs are not considered an effective mechanism for distribution of O_2 over larger areas. It is anticipated that, based upon oxygen concentrations in the monitoring points, oxygen delivery was limited to less than one foot from the injection wells. Other technologies such as biosparging, hydrogen peroxide, ozone, or solid O_2 release compounds may be more effective for larger area O_2 delivery at HPS.

Hydrogen was efficiently delivered to the aquifer using iSOC™ technology. Hydrogen distribution appears to be more extensive than O_2 distribution using the iSOCs.

Sodium lactate is a highly effective substrate for enhancement of anaerobic biodegradation of the chlorinated organics at RU-C5. The aquifer appears to be sufficiently buffered to use lactic acid as a more cost effective substrate.

A DNAPL was observed in a monitoring point adjacent to MW54A. The DNAPL prevented the determination of degradation rates at that location. Although biodegradation was confirmed by the presence of dechlorination daughter products and ethane.

Substrate distribution and groundwater extraction may be enhanced by fracturing of the aquifer matrix.

8.2 Stage 1 - Anaerobic Biodegradation Conclusions

The dechlorinating microorganism DHC is present in all wells in the treatment area. The DHC is capable of rapid and complete reductive dechlorination of the chlorinated ethenes.

Biostimulation is sufficient for complete biodegradation. It is likely that this strain of DHC is present elsewhere at HPS and therefore bioaugmentation is not required for treatment of the chlorinated organics at HPS. If DHC is not present at other locations, enrichment and distribution of a culture from site RU-C5 would be preferable to introduction of a non-indigenous culture.

The addition of sodium lactate rapidly stimulated biodegradation of the chlorinated ethenes. Sodium lactate is a highly effective substrate for anaerobic dechlorination of the chlorinated organics at RU-C5.

Hydrogen addition resulted in the removal of Fe^{2+} from solution. It is anticipated that reduced inorganic species, such as ferrous sulfide, may provide an abiotic process that contributes to the reductive dechlorination of the chlorinated organic compounds. However, no data was collected during this investigation to evaluate those potential pathways.

The complete reductive dechlorination pathway from PCE to ethene and ethane was observed. The data confirm that degradation at RU-C5 does not stall at cis-1,2-DCE or at VC, but results in the complete degradation to non-toxic ethene and ethane.

Complete degradation of chlorinated ethenes to below detection limits was observed in all TS performance monitoring wells except for MW54A, which was adjacent to an observed DNAPL source. Degradation rates were very high with complete degradation occurring within sixty days of substrate distribution.

Reductive dechlorination of 1,2-DCB, and 1,4-DCB occurred rapidly upon distribution of substrate. 1,2-DCB and 1,4-DCB was degraded to CB and benzene.

Only minor amounts of CB degraded to benzene in Stage 1. CB and benzene are recalcitrant under anaerobic conditions established in Stage 1.

Complete degradation of 1,2-DCA was observed in all TS performance monitoring wells except MW54A. Unlike degradation of chlorinated ethene and chlorinated benzene, the 1,2-DCA degradation process does not appear to be by reductive dechlorination. Chloroethane was not observed as a degradation product as 1,2-DCA degraded. A possible degradation process is dichloroelimination which may result in the direct production of ethene rather than chloroethane. Substantial ethene and ethane were generated during Stage 1 however no data is available to determine if the ethene results from degradation of chlorinated ethenes or ethanes.

The presence of DNAPL adjacent to MW54A prevented determination of degradation rates of the organics at that location. The presence of ethene and absence of CH_4 in monitoring well MW54A indicates that complete degradation of the chlorinated ethenes, and potentially chlorinated ethanes, is occurring at that location.

The persistence of chlorinated organics in MW54A is considered to be the result of DNAPLs adjacent to this monitoring well. DNAPLs were observed in MP MW54A-BH located 1-foot from monitoring well MW54A.

No rebound of chlorinated ethenes or benzenes was observed during the duration of the TS. A small rebound in 1,2-DCA concentration was observed during Stage 2. The cause of the rebound of 1,2-DCA is undetermined.

The increase in total molar concentration of chlorinated ethenes during Stage 1 indicates that the ISB process is degrading another source of chlorinated ethenes other than that observed in the dissolved phase. The most likely source is adsorbed phase contaminants.

The establishment of reducing conditions increased the dissolved concentration of Mn. Dissolved Mn is likely to precipitate as ambient conditions return to the site. No significant concentrations of other metals were mobilized during this TS.

The soils analyses are inconclusive as to degradation processes. In general, concentrations of adsorbed phase contaminants were substantially lower in the TS wells, including MW54A. However, because of the highly heterogeneous nature of the aquifer matrix, the range of contaminant concentrations naturally varied widely. Therefore, although contaminant concentrations decreased substantially, it is not possible to determine the amount due to biodegradation and natural sampling variability.

8.3 Conclusions Stage 2- Aerobic Biodegradation

The addition of O_2 resulted in the oxidation of sulfide and Fe^{2+} returning sulfate to pre TS concentrations.

CH_4 generated during Stage 1 was degraded aerobically during Stage 2.

CB generated during Stage 1 by the reductive dechlorination of 1,2-DCB and 1,4-DCB was degraded during Stage 2. The most likely mechanism is aerobic respiration which will result in the production of CO_2, H_2O and chloride ions.

Benzene generated during Stage 1 by the reductive dechlorination of CB was degraded aerobically during Stage 2. The most likely mechanism is aerobic respiration which results in the production of CO_2 and H_2O.

Phenols and TPH observed in the groundwater were degraded under aerobic conditions. The most likely process is aerobic respiration.

8.4 Recommendations

An evaluation of the nature and extend of DNAPLs at RU-C5 should be conducted as part of any future remedial design.

Techniques for treatment of the DNAPLs should be evaluated. Most applicable techniques are those that could enhance the ISB processes already occurring at the site such as increasing the solubility of the DNAPL using higher concentrations of substrate. In addition, DNAPL recovery and substrate distribution may be enhanced by fracturing of the aquifer matrix. This process could potentially enhance DNAPL mobility which would be undesirable, however fracturing appears to be limited to about 15 feet radially based on previous treatability studies. Substrate or zero valent iron injection that begins below the contaminated portion of the aquifer and proceeds upward minimizes the potential to mobilize DNAPL. Also, excavation is an effective method to remove DNAPL from aquifer material for shallow to moderate depths.

An evaluation of the process by which Fe^{2+} is removed from the groundwater during hydrogen addition should be conducted. This process may represent a significant abiotic pathway for enhancement of the biodegradation process.

If biodegradation is the selected remedial technology, the following should be considered:

- Further evaluation of the biodegradation pathway of 1,2-DCA
- Alternate techniques for substrate and O_2 delivery
- Alternate lower cost substrates should be evaluated including lactic acid

8.5 Summary

The sequential anaerobic-aerobic bioremediation TS conducted at RU-C5 demonstrated a process by which a mixture of chlorinated and non chlorinated organic contaminants could be treated to commonly applied remedial goals. The sequential anaerobic aerobic ISB process utilizes only food grade substrates and non toxic gases to enhance indigenous natural capacity to degrade organic compounds. The byproducts of the ISB process are those compounds common to all living things, namely CO_2 and H_2O and minor amounts of chloride. Notably, the indigenous microbial population is highly effective at degradation of chlorinated organics thus negating the need for introduction of a dechlorinating culture. The TS demonstrated a remedial process that was conducted in situ without removal of existing structures. The techniques demonstrated at RU-C5 should be considered in the Parcel C feasibility study, and can be applied at other sites around HPS and at other naval facilities.

9.0 References

Dames and Moore, Civil Engineers, 1943, *Battery Overhaul Building, Submarine Base, Preliminary Data, Foundation Investigation*, August-September 1943

Dames and Moore, Civil Engineers, 1944, *Diesel Overhaul & Ordnance Shop, Preliminary Data, Foundation Investigation*, June 12.

Hunkeler, D.; Aravena, R.; and Cox, E., 2002, *Carbon Isotopes as a Tool to Evaluate the Origin and Fate of Vinyl Chloride.* Laboratory Experiments and Modeling of Isotope Evaluation, Environmental Science and Technology, 36:3378-3384.

IT Corporation, 2001, *Draft Treatability Study Report, Soil Vapor Extraction Treatability Study, Building 134, Parcel C, Hunters Point Shipyard, San Francisco, California*, December 31.

PRC Environmental Management, Inc., 1996, *Draft Final Parcel B Remedial Investigation Report, Hunters Point Shipyard, San Francisco, California*, June 3.

San Francisco Redevelopment Agency, 1997, *Hunters Point Shipyard Redevelopment Plan, City and County of San Francisco*, June 14.

Schwarzenbach, R.P.; Gschwend, P.M.; and Inboden, D.M., 1993, *Environmental Organic Chemistry*, New York: John Wiley and Sons, Inc.

Shaw Environmental, Inc., 2004a, *Final Project Plans, In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study, Remedial Unit C5, Building 134, Hunters Point Shipyard, San Francisco, California*, June.

Shaw Environmental, Inc., 2004b, *Construction Report, Well Decommissioning/Installation and Site Excavation, In Support of Anaerobic-Aerobic Bioremediation at RU-C5, Building.134, Hunters Point Shipyard, San Francisco, California*, June.

Tetra Tech EM, Inc., 1998, *Draft Final Parcel C Feasibility Study, Hunters Point Shipyard, San Francisco, California*, April 6.

Tetra Tech EM, Inc., 2000, *Final Field Sampling Plan and Quality Assurance Plan [FSP/QAPP] for Phase I Groundwater Data Gaps Investigation [GDGI], Hunters Point Shipyard, San Francisco, California*, July 31.

Tetra Tech EM, Inc., 2001, *Field Sampling Plan/Quality Assurance Program Plan Addenda for Phase II Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California,* January 8.

Tetra Tech EM, Inc., 2002, *Draft Parcel B Construction Summary Report, Hunters Point Shipyard, San Francisco, California*, November 18.

Tetra Tech EM, Inc., 2004, *Parcel C Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation, Hunters Point Shipyard, San Francisco, California*, May 11.

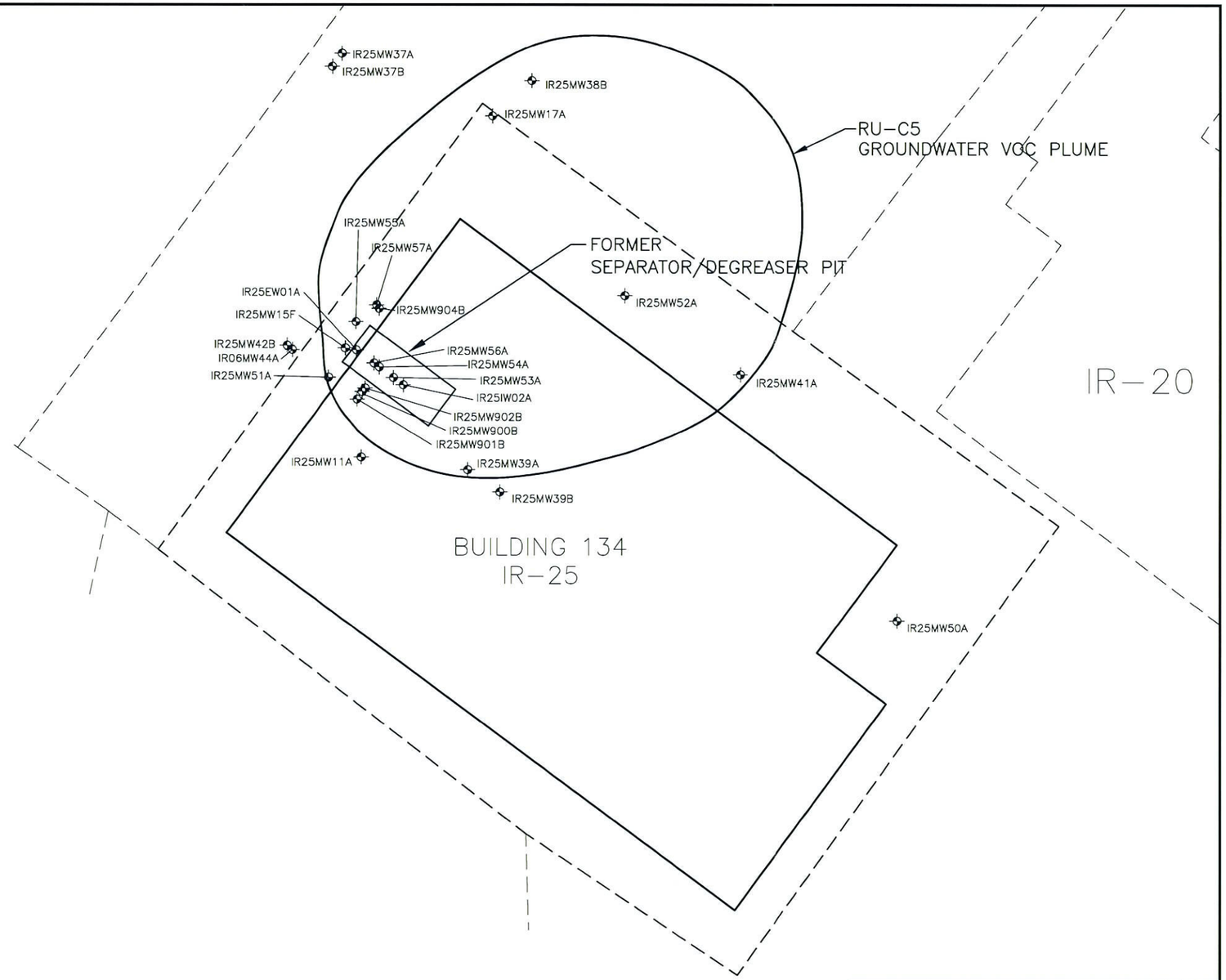
U.S. Environmental Protection Agency, R.S. Kerr Environmental Research Laboratory, 1994, *Standard Operating Procedures, Dissolved Methane by EPA SOP 175*, Revision 0.

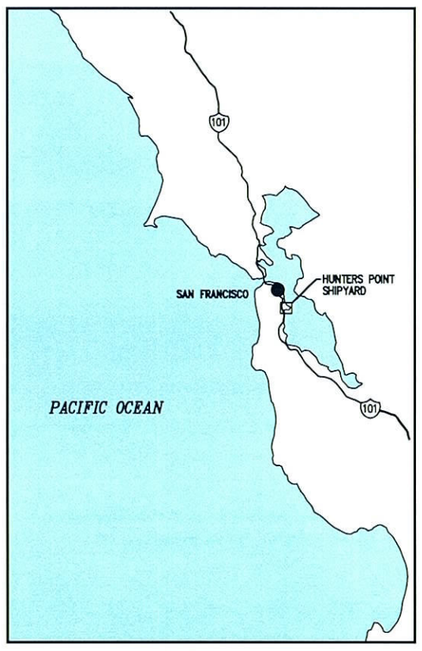
U.S. Environmental Protection Agency, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,* EPA/540/G-89/004, OSWER Directive 9355.3-01, October.

Figures

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
---	HYBASE-10-03	CONCORD	B. JENSEN	11-9-05	W.A.	11-9-05	D.C.	11-9-05	102569-B22

NOT TO SCALE





NOT TO SCALE

SOURCE: PARCEL B FEASIBILITY STUDY, FINAL REPORT,
HUNTERS POINT SHIPYARD, U.S. DEPARTMENT OF THE NAVY,
EFA WEST, NOVEMBER 26, 1996.

Shaw® Shaw Environmental, Inc.

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 1

SITE LOCATION MAP
IR-25, BUILDING 134, PARCEL C

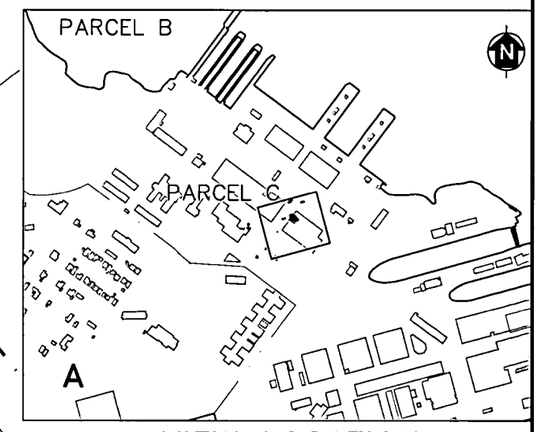
RU-C5
HUNTERS POINT SHIPYARD SAN FRANCISCO, CA

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Conc.	SJZ 11/10/05	WA 11/10/05	DC 11/10/05	102569-B11

LEGEND

- IR25MW37A — MONITORING WELL
- IR BOUNDARY
- PARCEL BOUNDARY
- TREATABILITY STUDY AREA

IR25MW37A
IR25MW37B
IR25MW38B
IR25MW17A
PARCEL B
FORMER SEPARATOR
IR10
IR25MW55A
IR25MW57A
IR25MW904B
IR25MW42B
IR06MW44A
IR25EW01A
IR25MW15F
IR25MW56A
IR25MW54A
IR25MW51A
IR25MW902B
IR25MW901B
IR25MW53A
IR25IW02A
IR25MW900B
IR25
IR25MW52A
IR06MW40A
IR25MW11A
IR06MW47F
IR25MW39A
IR25MW39B
FORMER DEGREASER PIT
WALL
BUILDING 134
LOCKWOOD ST.
IR25
PARCEL C
IR25MW41A



VIEW LOCATION

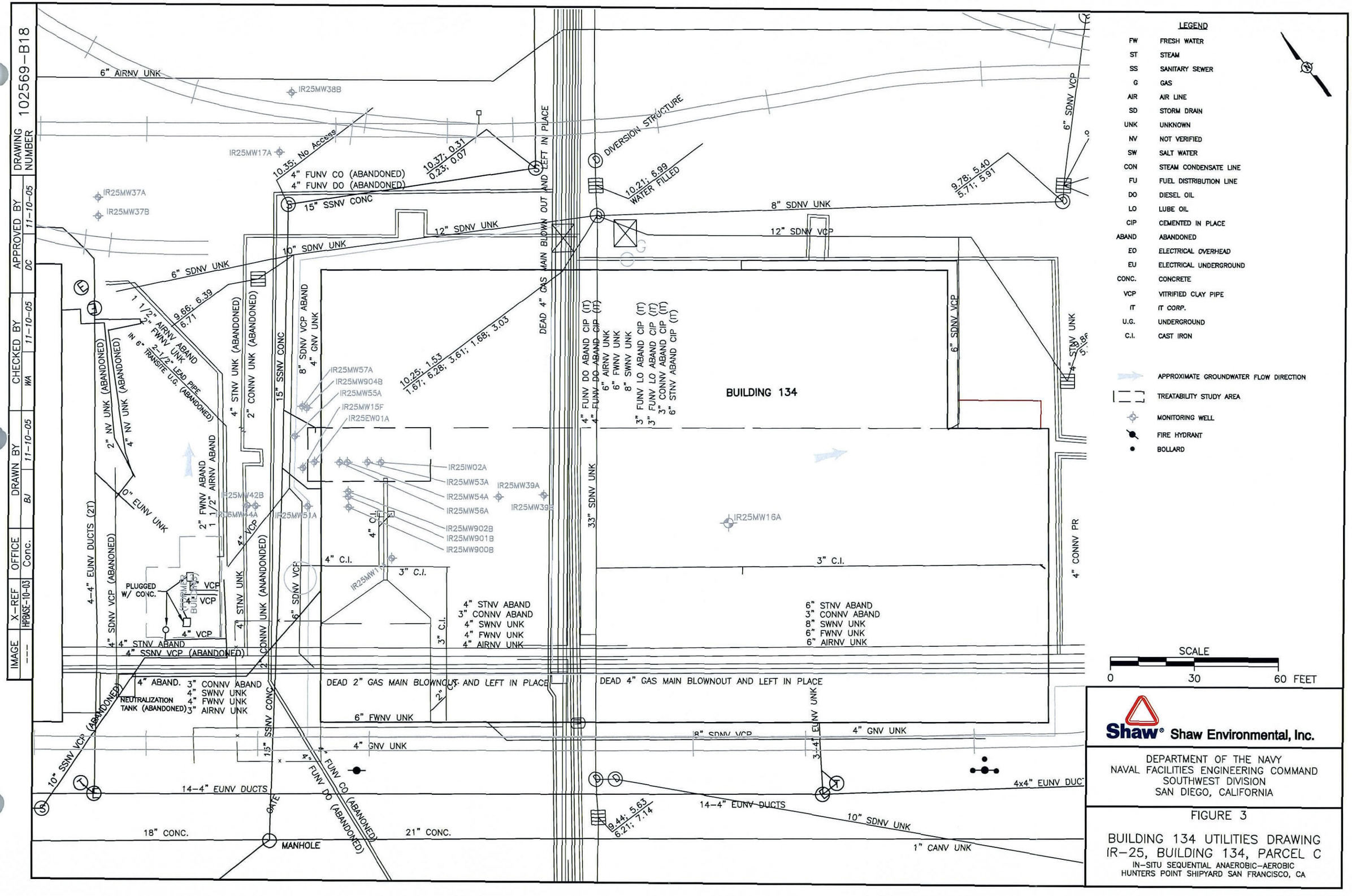
SCALE
0 30 60 FEET

Shaw® Shaw Environmental, Inc.

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 2

TREATABILITY STUDY AREA
GROUNDWATER MONITORING
WELL LOCATIONS
RU-C5
HUNTERS POINT SHIPYARD SAN FRANCISCO, CA



Shaw® Shaw Environmental, Inc.

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 3

BUILDING 134 UTILITIES DRAWING
IR-25, BUILDING 134, PARCEL C
IN-SITU SEQUENTIAL ANAEROBIC-AEROBIC
HUNTERS POINT SHIPYARD SAN FRANCISCO, CA

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	HPBASE-10-03	Conc.	BJ 11-10-05	WA 11-10-05	DC 11-10-05	102569-B18

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Conc.	MJV 11-8-05	W.A. 11-8-05	D.C. 11-8-05	102569-B13

SEPARATOR

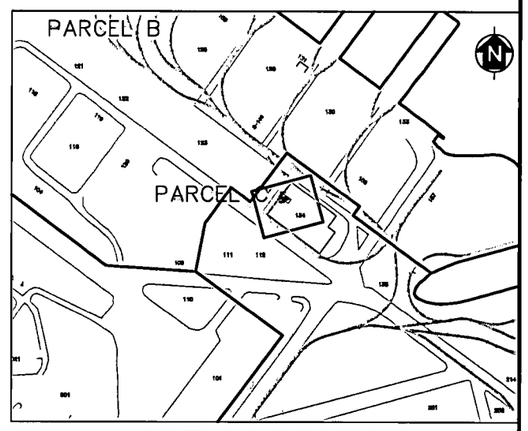
IR25MW57A
IR25MW904B
IR25MW55A
IR25MW55A-BH
IR25MW55A-BH (MP)
IR25MW42B
IR06MW44A
IR25MW15F
IR25EW01A
IR25MW51A
IR25MW56A
IR25MW54A
IR25MW54A-BH (MP)
IR25MW54A-BH
IR25MW53A
IR25MW902B
IR25MW901B
IR25MW53A-BH
IR25MW900B
IR25IW02A
IR25IW02A-BH
IR25MW53A-BH (MP)
IR25IW02A-BH (MP)
DEGREASER PIT
IR25MW11A

LEGEND

IR25MW57A	EXISTING WELL
IR25MW53A-BH	SOIL BORING LOCATIONS APPROXIMATE (POST AEROBIC STAGE 2)
IR25MW53A-BH (MP)	PROBES (TEMPORARY 3/4" WELL) AND SOIL BORINGS (POST ANEROBIC STAGE 1)
	TREATABILITY STUDY AREA

NOTE:

LOCATION AND EXTENT OF WALLS, SUMPS AND DOORS ARE APPROXIMATE.



VIEW LOCATION

SCALE
0 10 20 FEET

Shaw® Shaw Environmental, Inc.

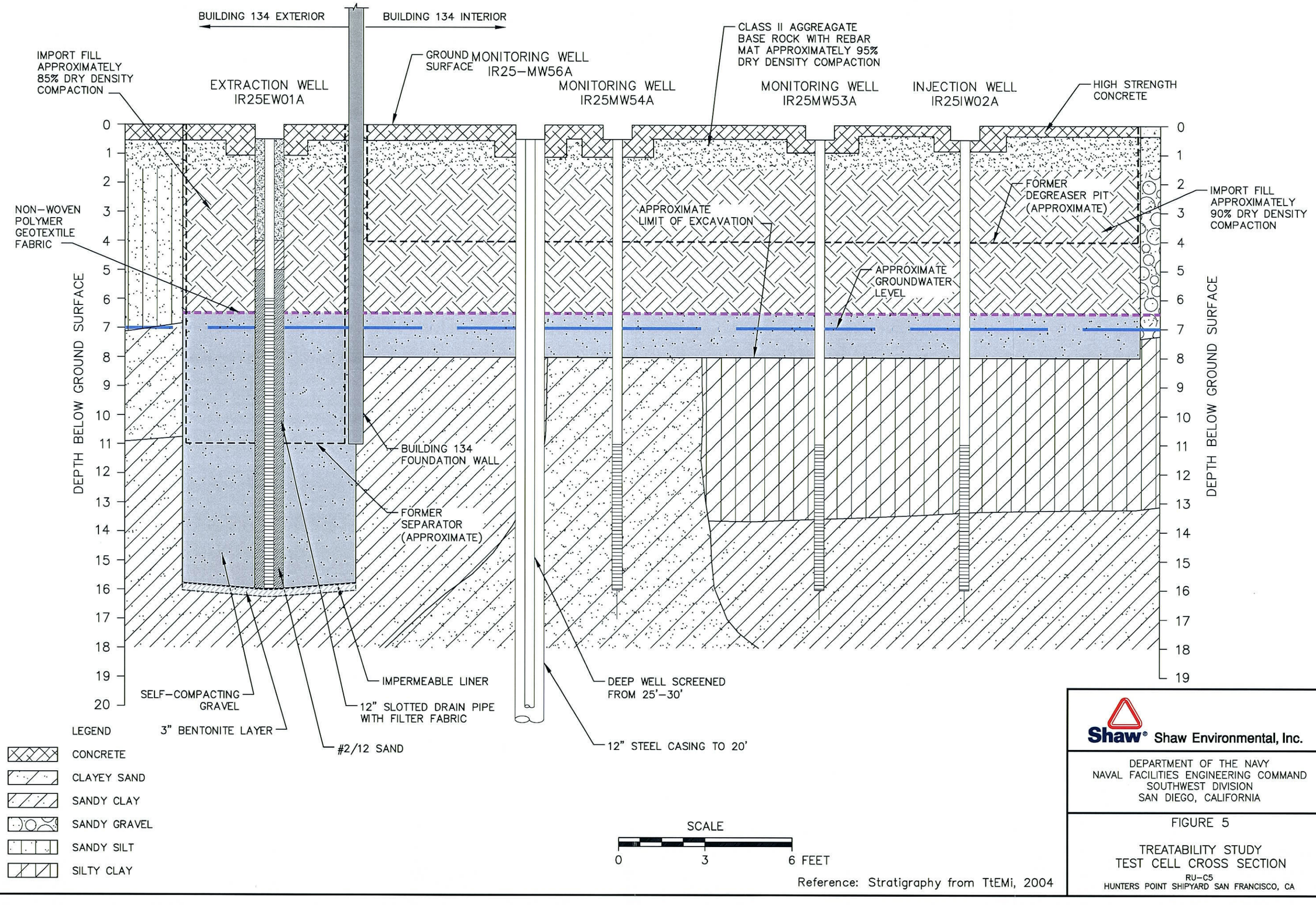
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 4

MONITORING PROBE, WELL, AND SOIL BORING LOCATIONS

RU-C5
HUNTERS POINT SHIPYARD SAN FRANCISCO, CA

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY		APPROVED BY		DRAWING NUMBER
---	---	CONCORD	SCHAEFFER	11/8/05	WA	11/8/05	DC	11/8/05	102569-B21



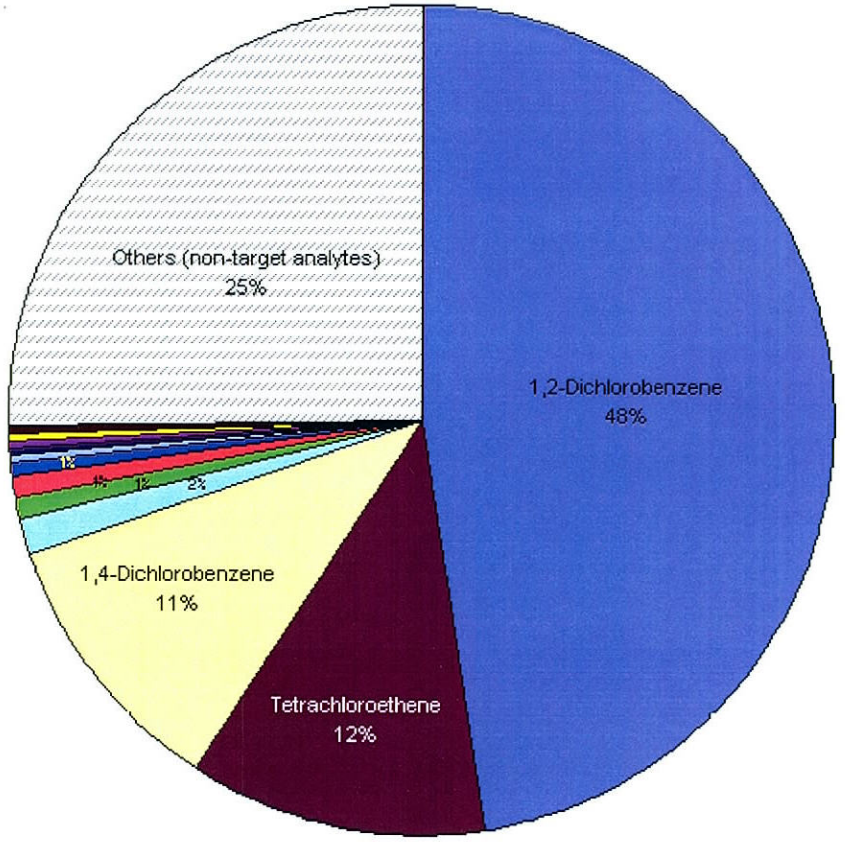
Reference: Stratigraphy from TtEMi, 2004

Shaw® Shaw Environmental, Inc.

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 5

TREATABILITY STUDY
TEST CELL CROSS SECTION
RU-C5
HUNTERS POINT SHIPYARD SAN FRANCISCO, CA

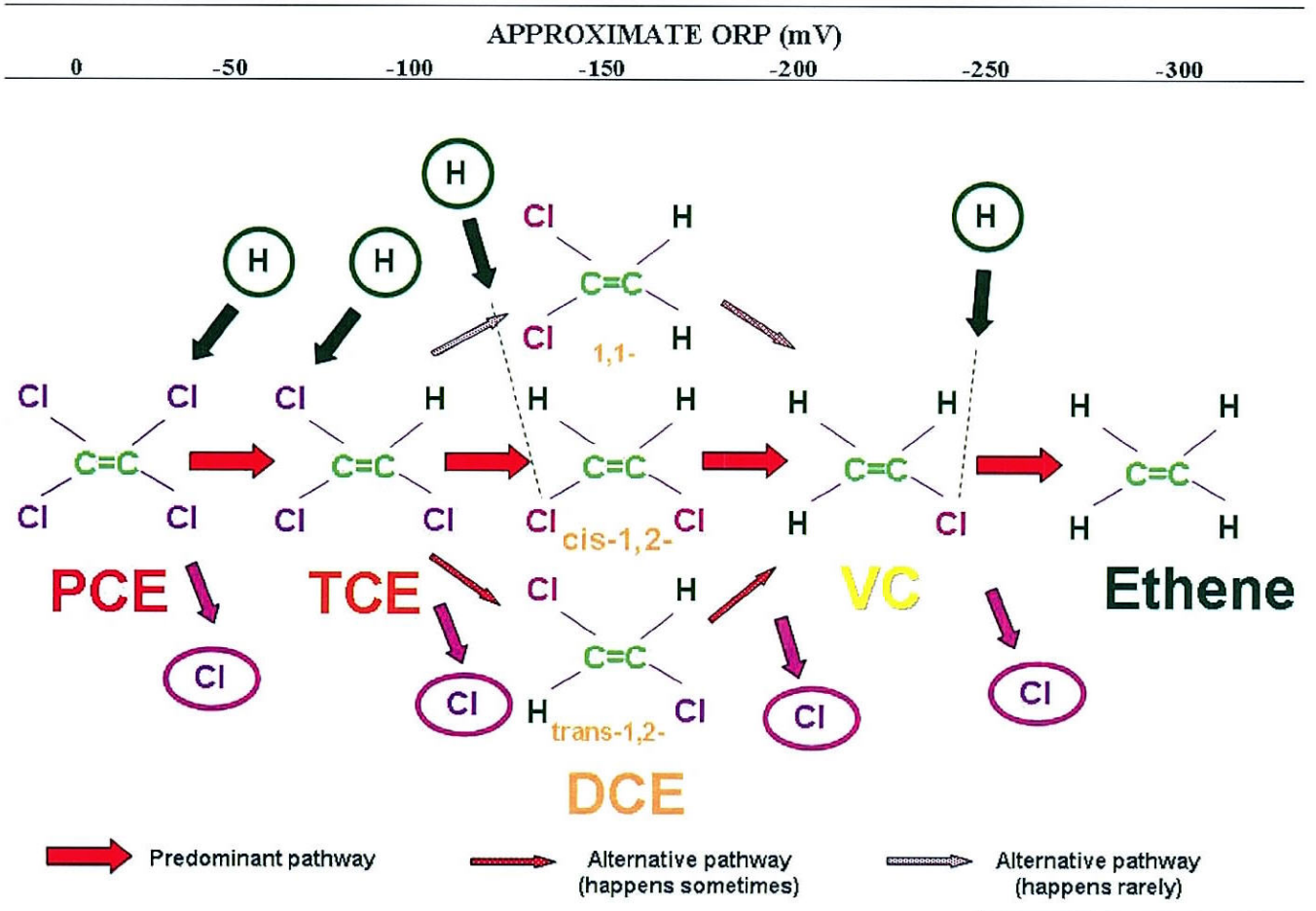


Analyte	Concentration, mg/kg	Percentage (by weight)
1,2-Dichlorobenzene	476,000	48%
Tetrachloroethene	115,000	12%
1,4-Dichlorobenzene	106,000	11%
Trichlorothene	15,000	1.5%
1,3-Dichlorobenzene	8,000	0.8%
1,2,4-Trichlorobenzene	7,000	0.70%
1,2-Dichloroethane	5,000	0.50%
Naphthalene	5,000	0.50%
2-Methylnaphthalene	3,200	0.32%
cis 1,2-Dichloroethene	1,900	0.19%
Chlorobenzene	1,200	0.12%
1,2,4-Trimethylbenzene	1,000	0.10%
Acenaphthene	870	0.09%
Dibenzofuran	840	0.08%
Xylene	500	0.05%
p-Isopropyltoluene	360	0.04%
1,3,5-Trimethylbenzene	340	0.03%
Toluene	330	0.03%
Others (non-target analytes)	252,460	25%
Total:	1,000,000	100%

Note: Other analytes include non-VOC and non-SVOC analyses target analytes (including petroleum hydrocarbons, etc. and moisture)

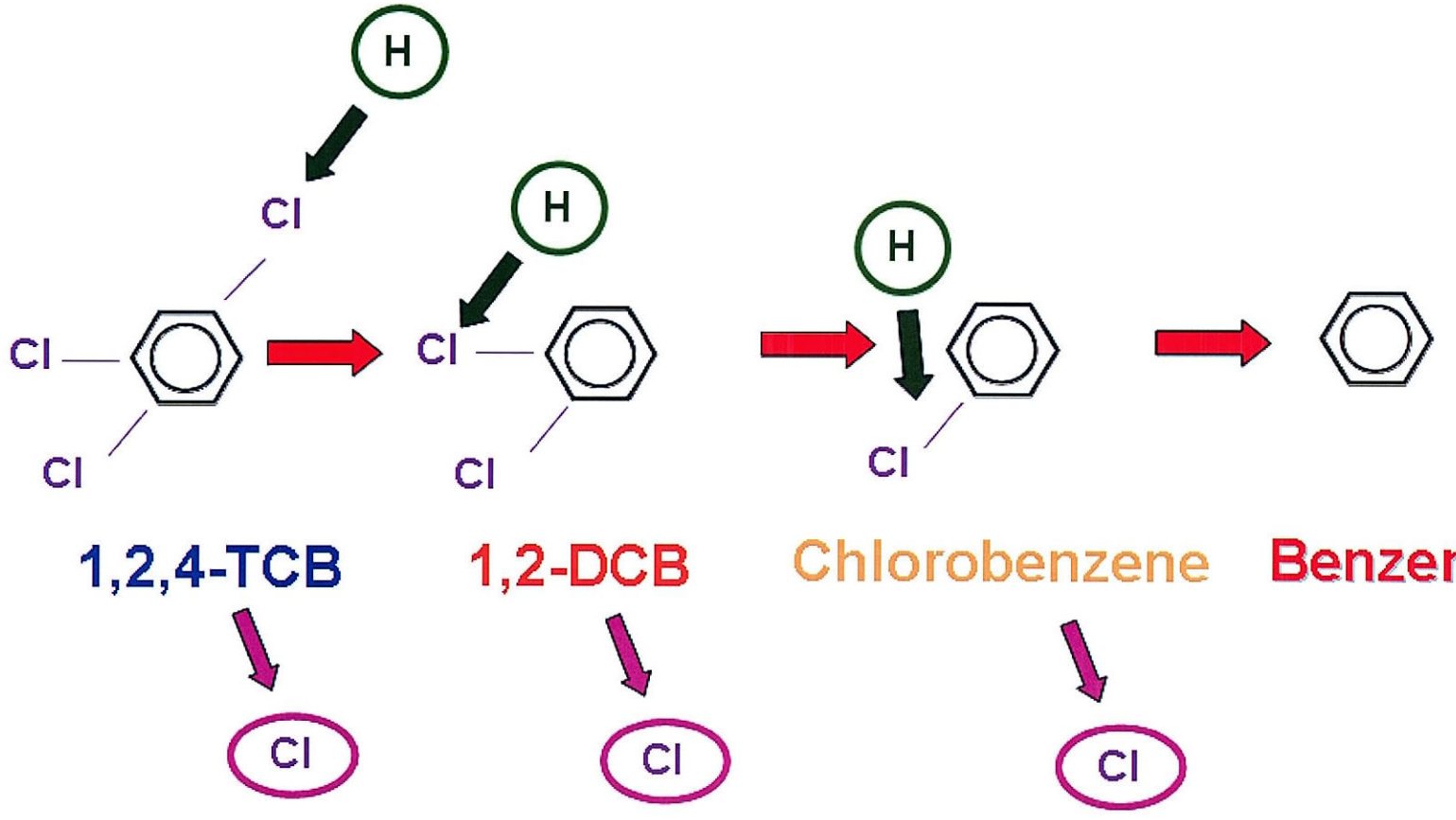
Shaw® Shaw Environmental, Inc.

Figure 6
Fraction of Organics in DNAPL (Well IR25MW902A)



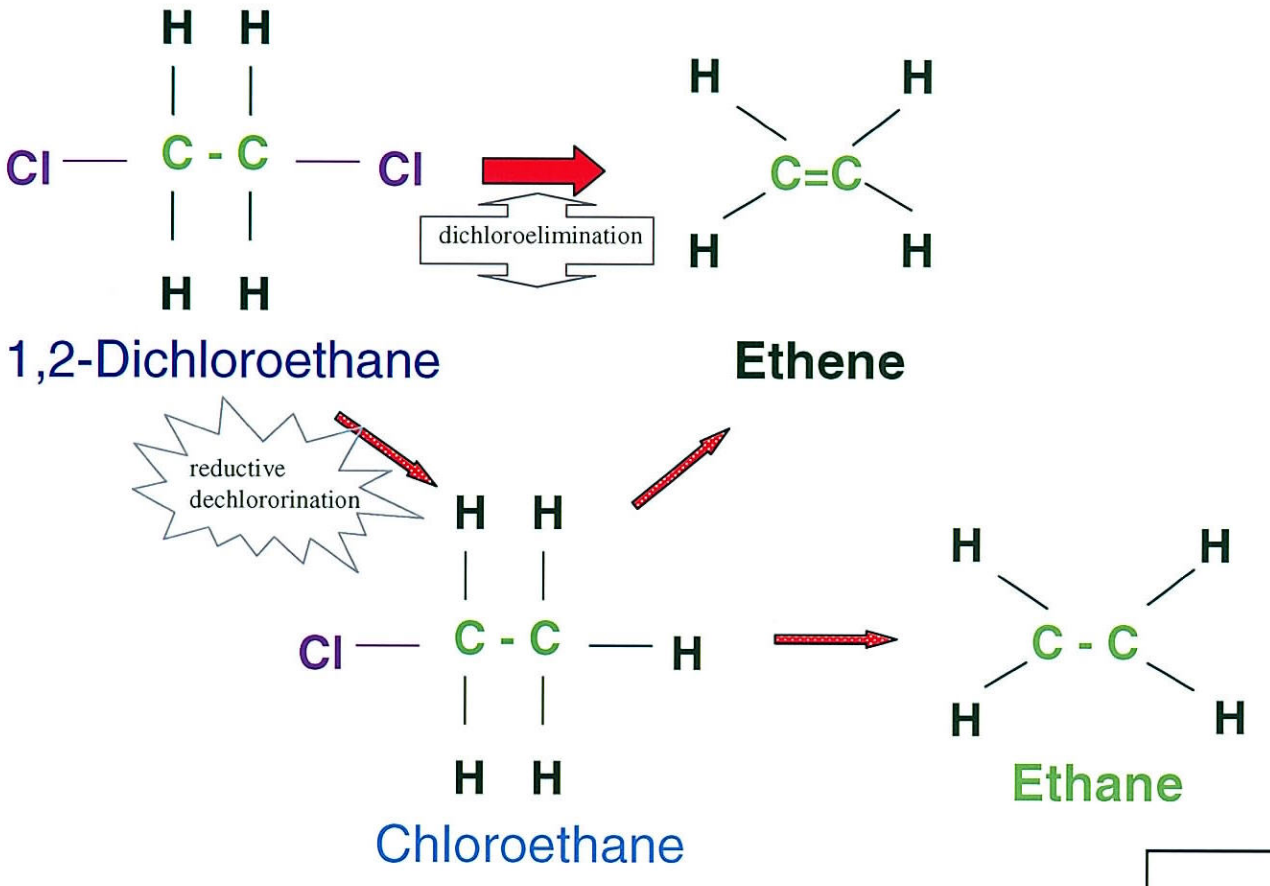
Shaw® Shaw Environmental, Inc.

Figure 7
Dechlorination Pathway of
Chlorinated Ethenes



Shaw® Shaw Environmental, Inc.

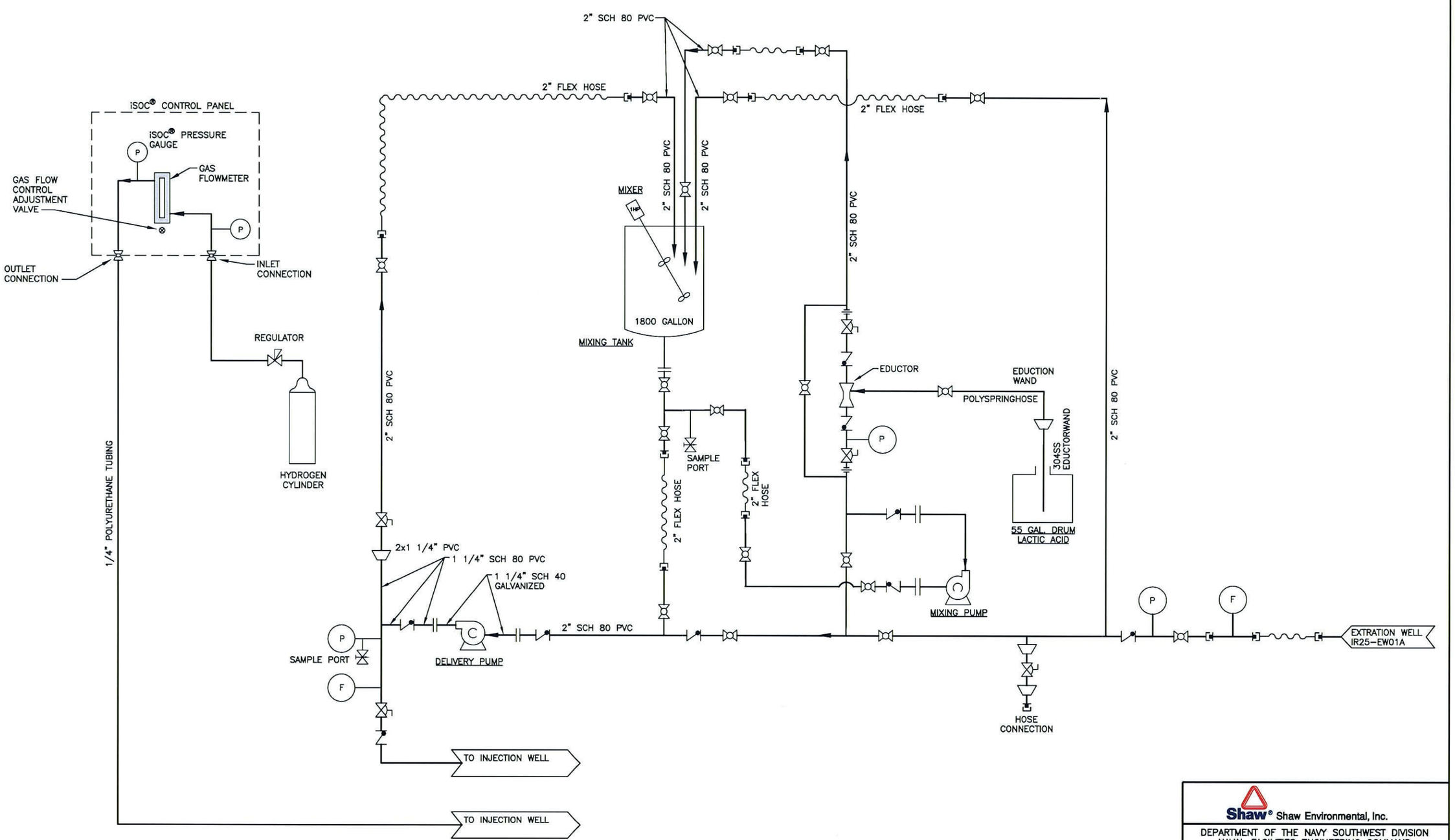
Figure 8
Dechlorination Pathway of
Chlorinated Benzenes



Shaw® Shaw Environmental, Inc.

Figure 9
Dechlorination Pathway of
Chlorinated Ethanes (1,2-DCA)

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	-	Concord	SJZ 11/10/05	DC 11/10/05	WA 11/10/05	102569-D3



Shaw® Shaw Environmental, Inc.

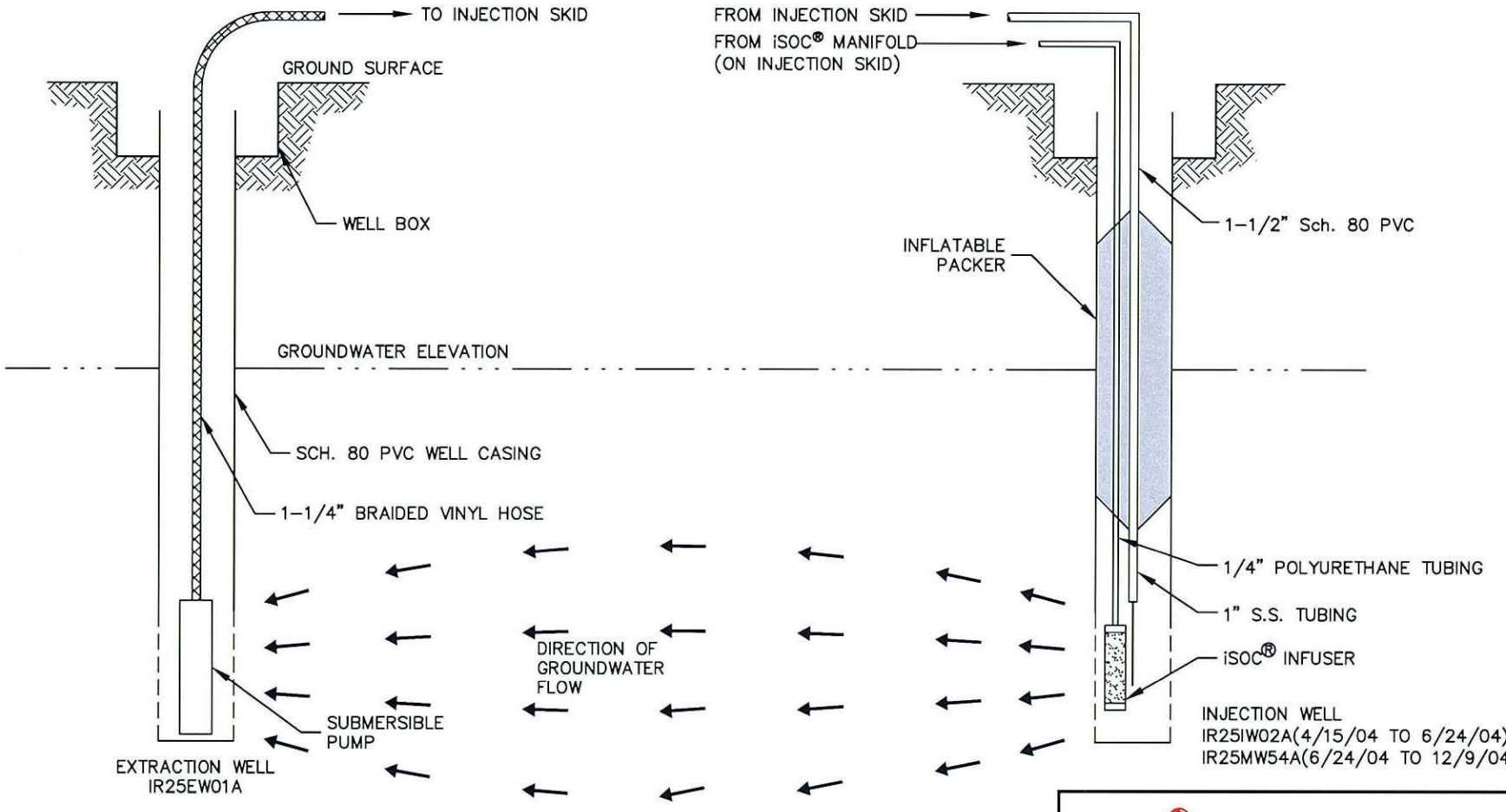
DEPARTMENT OF THE NAVY SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE 10

ANAEROBIC ISB INJECTION SKID SCHEMATIC DIAGRAM

HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
---	---	Concord	SJZ	11/10/05	DC	11/10/05	WA	11/10/05	102569-A8



Shaw® Shaw Environmental, Inc.

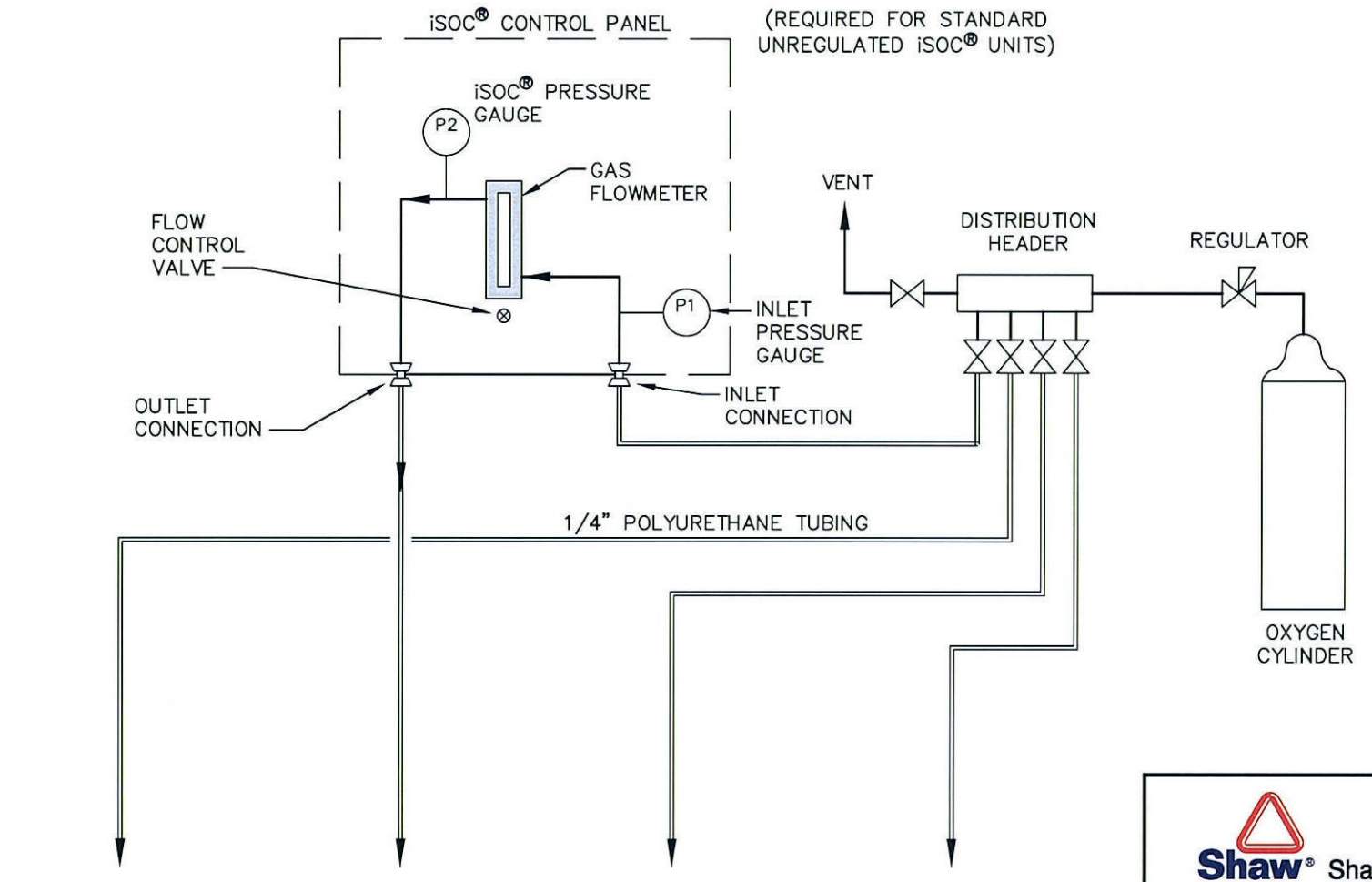
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 11

IN-WELL EQUIPMENT
ANAEROBIC ISB

HUNTERS POINT NAVEL SHIPYARD
SAN FRANCISCO, CALIFORNIA

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
---	---	Concord	SJZ	11/10/05	DC	11/10/05	WA	11/10/05	102569-A9



Shaw® Shaw Environmental, Inc.

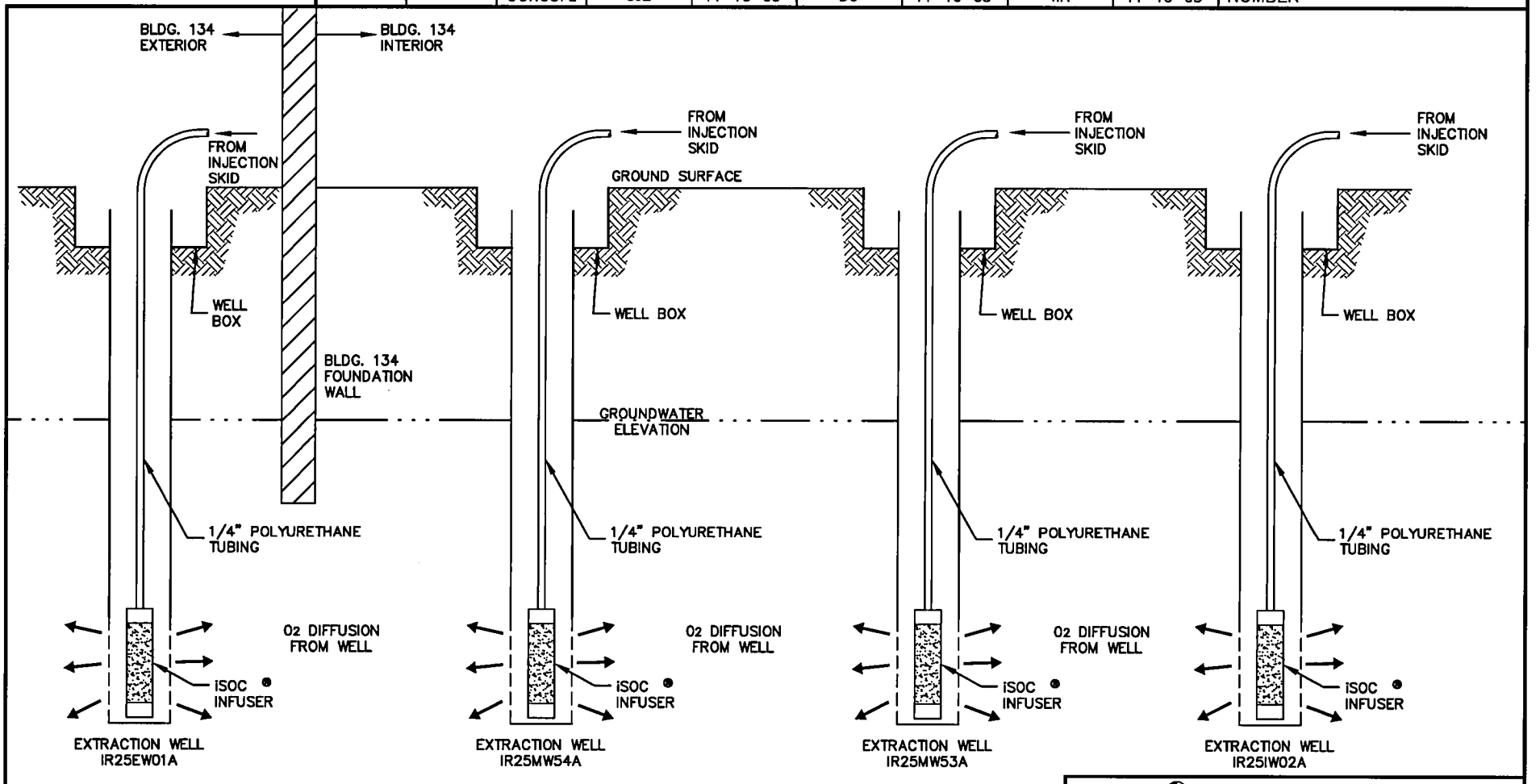
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 12

AEROBIC ISB INJECTION SKID
SCHEMATIC DIAGRAM

HUNTERS POINT NAVEL SHIPYARD
SAN FRANCISCO, CALIFORNIA

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
---	---	Concord	SJZ	11-10-05	DC	11-10-05	WA	11-10-05	102569-A10



Shaw® Shaw Environmental, Inc.

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST DIVISION
SAN DIEGO, CALIFORNIA

FIGURE 13

IN-WELL EQUIPMENT
AEROBIC ISB

HUNTERS POINT NAVEL SHIPYARD
SAN FRANCISCO, CALIFORNIA

Tables

Table 1. Timeline for Sequential Aerobic Anaerobic Bioremediation Treatability Study at Site RU-C5, Hunters Point Shipyard

Stage	Date	Day of Study	Event
Pre-operation activities	3-23-04 – 3-25-04	-23 to -21	Baseline groundwater sampling
	3-25-04	-21	Begin system construction
Stage 1	4-15-04	0	Begin re-circulation IR25EW01A - IR25IW02A with lactate and hydrogen injection (start of Stage 1)
	6-24-04	70	End re-circulation IR25EW01A - IR25IW02A with lactate and hydrogen injection
	6-24-04 – 6-25-04	70 to 71	Lactate injection into IR25MW54A
	9-21-04	159	Begin hydrogen injection into IR25MW54A
	12-3-04	232	Stop hydrogen injection into IR25MW54A
	12-6-04 – 12-9-04	235 to 238	Collection ofafter stage 1 (Stage 2 baseline) groundwater samples
	12-10-04	239	Installation of mps and collection of after stage 1 (Stage 2 baseline) soil samples
Stage 2	1-6-05	266	Installation of ISOCs – begin oxygen injection (start of Stage 2)
	5-10-05	390	Finish oxygen injection
	5-11-05 – 5-18-05	391 to 398	Collection ofpost Stage 2 groundwater samples
	5-25-05	405	Collection ofpost Stage 2 soil samples

Table 2
Groundwater Sampling Locations and Frequency

Aqueous Sample Container	3X40 mL V	3X40 mL V	1X1 L A	1X1 L A	1X1 L A	1X0.5 L HDPE	1X0.5 L HDPE	NA	1X0.5 L HDPE	1X0.5 L HDPE	1X0.5 L HDPE	1X0.25 L HDPE	1X250 mL HDPE	1X0.5 L HDPE	1X0.5 L HDPE
Aqueous Preservative	HCL to pH<2, 4 +/- 2° C		4 +/- 2° C			HNO_3 to pH<2	4 +/- 2° C	NA	4 +/- 2° C	4 +/- 2° C	NaOH + zinc acetate	4 +/- 2° C	H_2SO_4 to pH<2	Phosphoric acid, 4 +/- 2° C	4 +/- 2° C
Extraction Holding Time	NA	NA	7 days	7 days	7 days	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Analysis Holding Time	14 days, 7 days if not preserved	14 days	40 days	40 days	40 days	6 mos. 28 days for mercury	28 days/ 48 hours for NO_3	NA	28 days	14 days	7 days	28 days	28 days	28 days	28 days
Analytical Parameter	VOCs (EPA 8260B)[1]	Methane, ethane, ethene (RSK SOP 175)	TPH- E as diesel, (EPA 8015B)	SVOCs (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (EPA 6010B/6020A/7000)	Anions; Nitrate, Sulfate (EPA 300.0/9056)	Ferrous Iron by Hach 8146[2]	Bromide by Ion Selective Probe and/or EPA 300.0/320.1	Alkalinity (EPA 310.1)	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1\9060)	Acetate and Propionate	Dihalococcoides (DHC)
Sample Location	Baseline, Stage I and Stage 2, Groundwater Sampling														
IR25IW02A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25EW01A	X	X	X	X	X	X	X	X	X	X	X	X	X		
IR25MW54A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW53A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW55A	X	X	X	X	X	X	X	X	X	X	X				
IR06MW44A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW17A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW37A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW37B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW38B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW42B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW11A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW15F	X	X	X	X	X	X	X	X	X	X	X				
IR25MW39A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW39B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW51A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW900B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW901B[3]															
IR25MW904B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW902B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW56A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW57A	X	X	X	X	X	X	X	X	X	X	X				

Table 2 (Continued)
Groundwater Sampling Locations and Frequency

Aqueous Sample Container	3X40 mL V	3X40 mL V	1X1 L A	1X1 L A	1X1 L A	1X0.5 L HDPE	1X0.5 L HDPE	NA	1X0.5 L HDPE	1X0.5 L HDPE	1X0.5 L HDPE	1X0.25 L HDPE	1X250 mL HDPE	1X0.5 L HDPE	1X0.5 L HDPE
Aqueous Preservative	HCL to pH<2, 4 +/- 2° C		4 +/- 2° C			HNO_3 to pH<2	4 +/- 2° C	NA	4 +/- 2° C	4 +/- 2° C	NaOH + zinc acetate	4 +/- 2° C	H_2SO_4 to pH<2	Phosphoric acid, 4 +/- 2° C	4 +/- 2° C
Extraction Holding Time	NA	NA	7 days	7 days	7 days	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Analysis Holding Time	14 days, 7 days if not preserved	14 days	40 days	40 days	40 days	6 mos. 28 days for mercury	28 days/ 48 hours for NO_3	NA	28 days	14 days	7 days	28 days	28 days	28 days	28 days
Analytical Parameter	VOCs (EPA 8260B)[1]	Methane, ethane, ethene (RSK SOP 175)	TPH- E as diesel, (EPA 8015B)	SVOCs (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (EPA 6010B/6020A/7000)	Anions; Nitrate, Sulfate (EPA 300.0/9056)	Ferrous Iron by Hach 8146[2]	Bromide by Ion Selective Probe and/or EPA 300.0/320.1	Alkalinity (EPA 310.1)	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1\9060)	Acetate and Propionate	Dihalococcoides (DHC)
Anaerobic Stage 1 (Phases 1 and 2) Groundwater Sampling															
Weekly for 1 Month and Biweekly for 5 Months															
IR25IW02A	X	X	X		X		X	X	X	X	X		X	X	
IR25EW01A	X	X	X		X		X	X	X	X	X		X	X	
IR25MW54A	X	X	X		X		X	X	X	X	X		X	X	
IR25MW53A	X	X	X		X		X	X	X	X	X		X	X	
IR25MW56A	X								X						
IR25MW55A									X						
IR06MW44A									X						
IR25MW17A									X						
IR25MW37A									X						
IR25MW37B									X						
IR25MW38B									X						
IR25MW42B									X						
IR25MW11A									X						
IR25MW15F									X						
IR25MW39A									X						
IR25MW39B									X						
IR25MW51A									X						
IR25MW900B									X						
IR25MW901B[3]															
IR25MW904B									X						
IR25MW902B									X						
IR25MW57A									X						
Post Anaerobic Stage 1 Groundwater Sampling															
IR25IW02A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25EW01A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW54A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 2 (Continued)
Groundwater Sampling Locations and Frequency

Aqueous Sample Container	3X40 mL V	3X40 mL V	1X1 L A	1X1 L A	1X1 L A	1X0.5 L HDPE	1X0.5 L HDPE	NA	1X0.5 L HDPE	1X0.5 L HDPE	1X0.5 L HDPE	1X0.25 L HDPE	1X250 mL HDPE	1X0.5 L HDPE	1X0.5 L HDPE
Aqueous Preservative	HCL to pH<2, 4 +/- 2° C		4 +/- 2° C			HNO_3 to pH<2	4 +/- 2° C	NA	4 +/- 2° C	4 +/- 2° C	NaOH + zinc acetate	4 +/- 2° C	H_2SO_4 to pH<2	Phosphoric acid, 4 +/- 2° C	4 +/- 2° C
Extraction Holding Time	NA	NA	7 days	7 days	7 days	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Analysis Holding Time	14 days, 7 days if not preserved	14 days	40 days	40 days	40 days	6 mos. 28 days for mercury	28 days/ 48 hours for NO_3	NA	28 days	14 days	7 days	28 days	28 days	28 days	28 days
Analytical Parameter	VOCs (EPA 8260B)[1]	Methane, ethane, ethene (RSK SOP 175)	TPH- E as diesel, (EPA 8015B)	SVOCs (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (EPA 6010B/6020A/7000)	Anions; Nitrate, Sulfate (EPA 300.0/9056)	Ferrous Iron by Hach 8146[2]	Bromide by Ion Selective Probe and/or EPA 300.0/320.1	Alkalinity (EPA 310.1)	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1\9060)	Acetate and Propionate	Dihalococcoides (DHC)
Post Anaerobic Stage 1 Groundwater Sampling (continued)															
IR25MW53A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW55A	X	X	X	X	X	X	X	X	X	X	X				
IR06MW44A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW17A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW37A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW37B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW38B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW42B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW11A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW15F	X	X	X	X	X	X	X	X	X	X	X				
IR25MW39A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW39B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW51A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW900B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW901B[3]															
IR25MW904B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW902B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW56A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW57A	X	X	X	X	X	X	X	X	X	X	X				
Aerobic Stage 2 Phase 1 (Respiration) Groundwater Sampling															
Weekly Sampling for three weeks, then Biweekly Sampling for four months (Total of 11 sampling events))															
IR25IW02A	X	X[4]		X	1st event only										
IR25EW01A	X	X[4]		X	1st event only										
IR25MW54A	X	X[4]		X	1st event only										
IR25MW53A	X	X[4]		X	1st event only										
IR25MW56A	X														

Table 2 (Continued)
Groundwater Sampling Locations and Frequency

Aqueous Sample Container	3X40 mL V	3X40 mL V	1X1 L A	1X1 L A	1X1 L A	1X0.5 L HDPE	1X0.5 L HDPE	NA	1X0.5 L HDPE	1X0.5 L HDPE	1X0.5 L HDPE	1X0.25 L HDPE	1X250 mL HDPE	1X0.5 L HDPE	1X0.5 L HDPE
Aqueous Preservative	HCL to pH<2, 4 +/- 2° C		4 +/- 2° C			HNO_3 to pH<2	4 +/- 2° C	NA	4 +/- 2° C	4 +/- 2° C	NaOH + zinc acetate	4 +/- 2° C	H_2SO_4 to pH<2	Phosphoric acid, 4 +/- 2° C	4 +/- 2° C
Extraction Holding Time	NA	NA	7 days	7 days	7 days	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Analysis Holding Time	14 days, 7 days if not preserved	14 days	40 days	40 days	40 days	6 mos. 28 days for mercury	28 days/ 48 hours for NO_3	NA	28 days	14 days	7 days	28 days	28 days	28 days	28 days
Analytical Parameter	VOCs (EPA 8260B)[1]	Methane, ethane, ethene (RSK SOP 175)	TPH- E as diesel, (EPA 8015B)	SVOCs (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (EPA 6010B/6020A/7000)	Anions; Nitrate, Sulfate (EPA 300.0/9056)	Ferrous Iron by Hach 8146[2]	Bromide by Ion Selective Probe and/or EPA 300.0/320.1	Alkalinity (EPA 310.1)	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1\9060)	Acetate and Propionate	Dihalococcoides (DHC)
Sampling Location	Post Aerobic Stage 2 Groundwater Sampling														
IR25IW02A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25EW01A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW54A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW53A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IR25MW55A	X	X	X	X	X	X	X	X	X	X	X				
IR06MW44A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW17A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW37A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW37B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW38B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW42B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW11A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW15F	X	X	X	X	X	X	X	X	X	X	X				
IR25MW39A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW39B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW51A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW900B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW901B[3]															
IR25MW904B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW902B	X	X	X	X	X	X	X	X	X	X	X				
IR25MW56A	X	X	X	X	X	X	X	X	X	X	X				
IR25MW57A	X	X	X	X	X	X	X	X	X	X	X				

1 Includes oxygenated additives and naphthalene

2 Field test

3 Groundwater level measurements only

4 Includes methane only

Table 3
Groundwater Elevations RU-C5 Building 134

Well Number	Top of casing elevation (feet msl)	Water elevation (feet below top of casing)											
		Pre Anaerobic Stage Sampling			Pre Aerobic Stage Sampling				Final sampling Event				
Date		3/23/04	3/24/04	3/25/04	12/6/04	12/7/04	12/8/04	12/9/04	5/11/05	5/12/05	5/16/05	5/17/05	5/18/05
IR25EW01A	10.81		3.49					2.36				4.18	
IR25IW02A	10.73			2.41			3.07					4.10	
IR25MW11A[1]	10.45			2.13			2.79			1.17			
IR25MW15F	10.50	3.15					2.84				3.20		
IR25MW17A	10.31		2.99			2.93				1.03			
IR25MW37A	10.07		2.75		3.29					0.79			
IR25MW37B	10.21		2.89		3.43					0.93			
IR25MW38B	10.44		3.12			3.06							3.12
IR25MW39A	11.21			2.89		3.83			3.77				
IR25MW39B	11.25			2.93		3.87				1.97			
IR25MW42B	10.01	2.66				2.63			2.57				
IR06MW44A	9.81	4.06				2.43			3.27				
IR25MW51A	10.47			2.15				2.02	3.03				
IR25MW53A	11.07			2.75			3.41					4.44	
IR25MW54A	11.12			2.80				2.67				4.49	
IR25MW55A[2]	10.39		2.40		3.61								3.87
IR25MW56A	11.1			2.78				2.65				4.47	
IR25MW57A	9.21		1.89		2.43								2.69
IR25MW900B	11.02			2.70			3.36				3.72		
IR25MW901B	10.98			2.66									NM
IR25MW902B[2]	11.02			2.70			3.36				3.72		
IR25MW903B	10.48												
IR25MW904B	10.43		3.11		3.65								3.91

Notes:
1. Light Non-Aqueous Phase Liquid (LNAPL) encountered during sampling.
2. Dense Non-Aqueous Phase Liquid (DNAPL) encountered during sampling.
NM = Not Measured

Photos

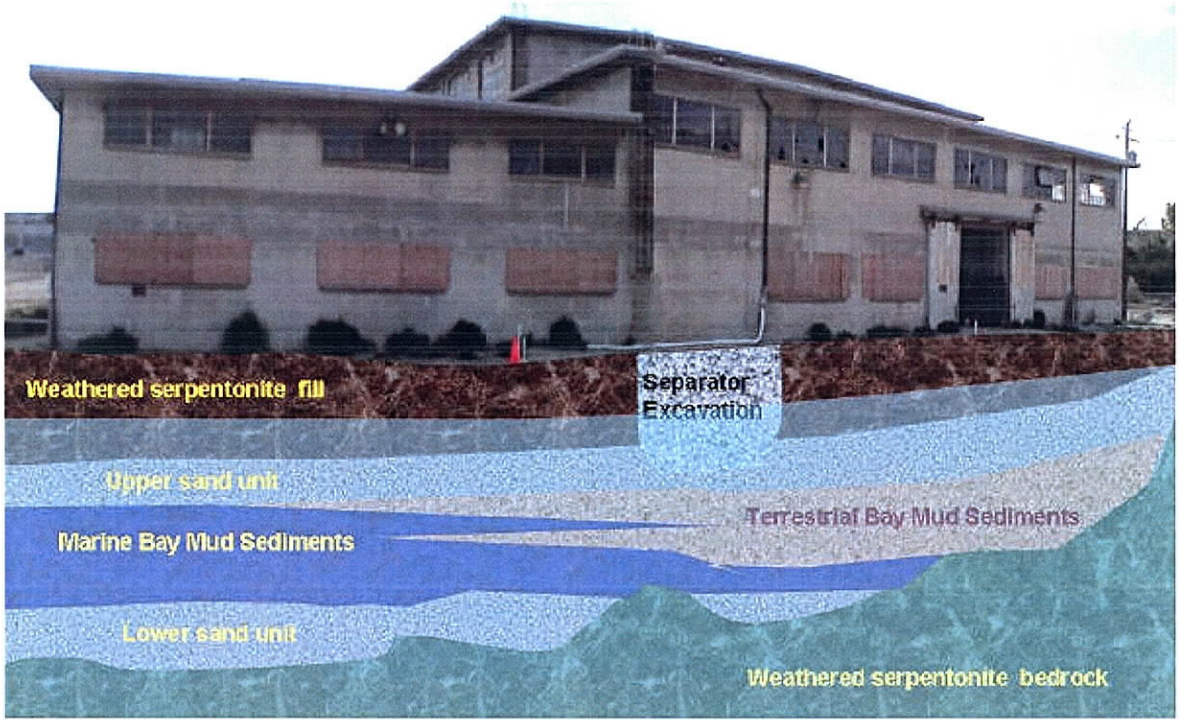


Photo No. 1: Exterior of Building 134 and conceptual cross section.

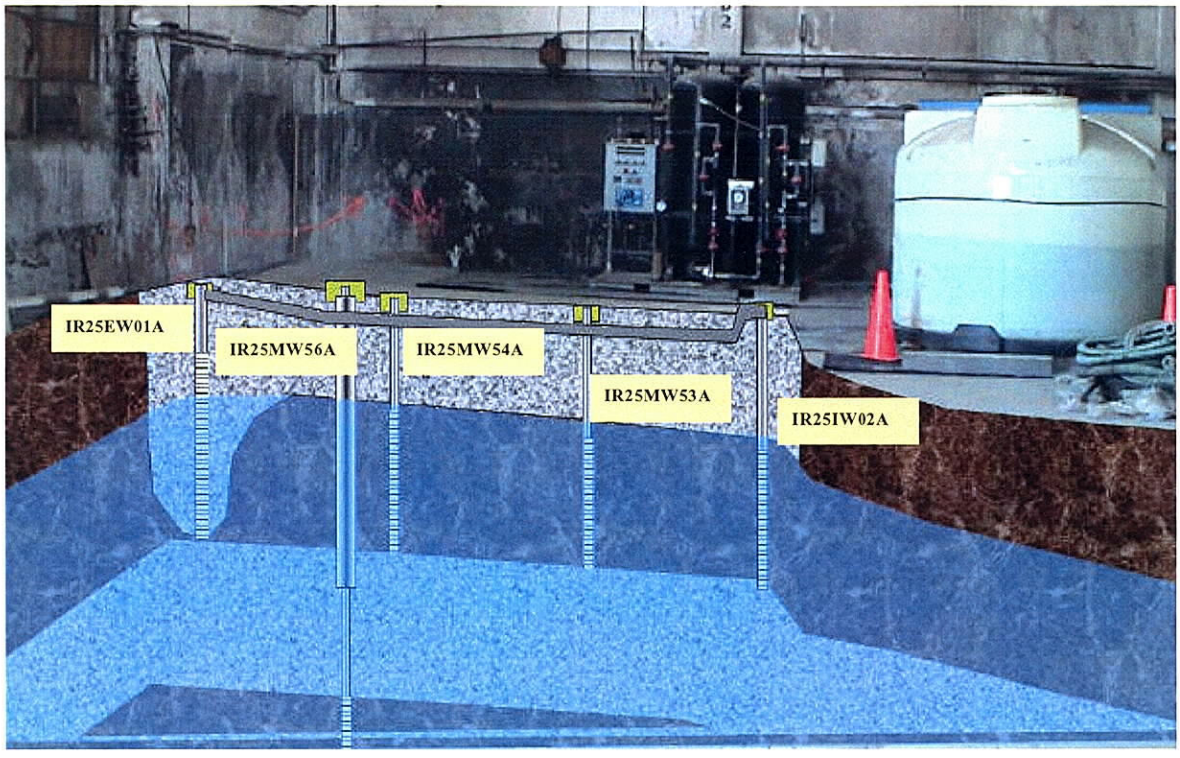


Photo No. 2: Treatability study area and bioremediation system layout.

AR_N00217_000936
HUNTERS POINT
SSIC NO. 5090.3.A

APPENDICES

List of Appendices

Appendix A	Boring Logs (Hardcopy)
Appendix B	Chains of Custody
Appendix C	Groundwater Analyses Data Summary Table for the Treatment Area
Appendix D	Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area
Appendix E	Soil Analyses Data Summary Table
Appendix F	Chemical Data Graphs
Appendix G	Laboratory Analytical Reports
Appendix H	Data Quality Assessment
Appendix I	Daily Report Logs
Appendix J	Response to Comments (Hardcopy)

Appendix A
Boring Logs

Attachment 1
Monitoring Well Completion Diagrams and Boring Logs
(Installed by Shaw under EMAC CTO 004)

IR25MW54-BH
IR25MW53A-BH
IR25IW02A-BH
IR25MW55A-BH
IR25MW54A-BH(MP)
IR25MW53A-BH(MP)
IR25IW02A-BH(MP)
IR25MW55A-BH(MP)

Errata Sheet For Boring Numbers
EMAC CTO 0004
Hunters Point Shipyard
San Francisco, CA

Boring Number Used in Sampling	Boring Number Presented in Work plan
IR25MW54A-BH	IR25SB932
IR25MW53A-BH	IR25SB933
IR25IW02A-BH	IR25SB934
IR25MW55A-BH	IR25SB935
IR25MW54A-BH2	IR25SB936
IR25MW53A-BH2	IR25SB937
IR25IW02A-BH2	IR25SB938
IR25MW55A-BH2	IR25SB939

BORING NO. IR25MW54-BH

COORDINATES: N _____ E _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 05/25/05
CHECKED BY W. Akiyama, R.G. DATE FINISHED 05/25/05
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. _____
TOTAL DEPTH 16'

DEPTH IN FEET	SAMPLE NUMBER IR25MW54-BH2	RECOVERY	PID (ppm)	DRILLING REMARKS	USCS	PROFILE	DESCRIPTION
0					fill		Concrete (Fill). 0.67'
1					fill		Class II Aggregate Base Rock (Fill). 1.5'
2					fill		Bort Soil (Fill).
3							
4							
5							
6							
7							Filter Fabric. 7.0'
8					fill		Crushed Rock (Fill). 8.0'
9							CLAYEY SAND; olive gray (5Y 5/2).
10		50%	0				0 ppm Vinyl Chloride DREAGER
11							11.5'
12					sc		SANDY CLAY TO CLAYEY SAND; yellowish brown (10YR 5/6) clayey sand, dark brown (10YR 3/3) sandy clay, slightly moist, fine to very fine sand, 40% clay, 60% sand.
13							
14		75%					
15			0				At 15.0': gray (2.5Y 5/0), dry. 0 ppm Vinyl Chloride DREAGER 15.5'
16							CLAYEY SAND; yellowish red (5YR 4/6), 10% clay, 90% sand, very fine to fine grained, tube was wet, shoe slightly moist. TOTAL DEPTH OF BORING IS 16.0 FEET
17							

DRILLER : Don Pearson & Chris Garvey
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Geoprobe
SAMPLING METHOD : 2" Modified California Sampler
PROJECT : Hunters Point EMAC CTO-004
LOCATION : Hunters Point Shipyard
PROJECT NO. : 102569/01091003

NOTE: BORING DECOMMISSIONED BY TRIME GROUT

DRAWN BY	MJV	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A17
DATE	06/22/05	APPROVED BY	DL 6/22/05	

Shaw

BORING NO. IR25MW53A-BH

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 05/25/05

CHECKED BY W. Akiyama, R.G. DATE FINISHED 05/25/05

APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. _____

TOTAL DEPTH 16.0'

DEPTH IN FEET	SAMPLE NUMBER IR25MW53A-BH	RECOVERY	PID (ppm)	DRILLING REMARKS	USCS	PROFILE	DESCRIPTION
0					fill		Concrete (Fill). 0.67'
1					fill		Class II Aggregate Base Rock (Fill). 1.5'
2					fill		Bort Soil (Fill).
3							
4							
5							
6							
7							Filter Fabric. 7.0'
8					fill		Base Rock (Fill). 8.0'
9							CLAYEY SAND; dark grayish brown (10YR 4/2), with patches of dark yellowish brown (10YR 4/6), slightly moist, 60% medium to very coarse sand.
10		33%	0				0 ppm Vinyl Chloride DREAGER
11							
12					sc		
13	1274	75%	0				
14							0 ppm Vinyl Chloride DREAGER
15	1272						15.0' CLAYEY SAND; very dark grayish brown (2.5Y 3/2), wet, medium dense, 20% clay, 80% fine to very fine sand, subrounded. (Cuttings appear to have angular pebbles which would explain more water in hole.
16							TOTAL DEPTH OF BORING IS 16.0 FEET
17							

DRILLER : Don Person & Chris Garvey

DRILLING CO. : Gregg Drilling & Testing

DRILLING METHOD : Geoprobe

SAMPLING METHOD : 2" Modified California Sampler

PROJECT : Hunters Point EMAC CTO-001 Task 4

LOCATION : Hunters Point Shipyard

PROJECT NO. : 102569/01091003

NOTE: BORING DECOMMISSIONED BY TRIME GROUT

DRAWN BY	MJV	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A15
DATE	06/22/05	APPROVED BY	DL 6/22/05	

Shaw

BORING NO. IR25IW02A-BH

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 5/25/05

CHECKED BY W. Akiyama, R.G. DATE FINISHED 5/25/05

APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. _____

TOTAL DEPTH 16.0'

DEPTH IN FEET	SAMPLE NUMBER IR25IW02A-BH2	RECOVERY	PID (ppm)	DRILLING REMARKS	USCS	PROFILE	DESCRIPTION
0					fill		Concrete (Fill). 0.67'
1					fill		Class II Aggregate Base Rock (Fill). 1.5'
2					fill		Bort Soil (Fill).
3							
4							
5							
6							
7							Filter Fabric. 7.0'
8					fill		Crushed Rock (Fill). 8.0'
9					sc		CLAYEY SAND; brown (7.5YR 5/2), medium sand in clay matrix, wet, dense.
10		33%					0 ppm Vinyl Chloride DREAGER
11			0.9				
12							
13							
14		100%					0 ppm Vinyl Chloride DREAGER
15	1270		0				15.0'
					gc		CLAYEY GRAVEL TO CLAYEY SAND; angular pieces, wet, very dense.
16							At 15.5': Hard Zone (est. by driller), gray with mafic pieces (7.5YR 6/0), possibly broken off rock pieces.
							TOTAL DEPTH OF BORING IS 16.0 FEET
17							

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" California Modified Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 102569

NOTE: BORING DECOMMISSIONED BY TRIME GROUT

Shaw

DRAWN BY	T.R.S.	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A18
DATE	6/22/05	APPROVED BY	DL 6/22/05	

BORING NO. IR25MW55A-BH

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 05/25/05

CHECKED BY W. Akiyama, R.G. DATE FINISHED 05/25/05

APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. _____

TOTAL DEPTH 16.0'

DEPTH IN FEET	SAMPLE NUMBER IR25MW55A-BH	RECOVERY	PID (ppm)	DRILLING REMARKS	USCS	PROFILE	DESCRIPTION
0					fill		Asphalt, 4". 0.33'
1							
2							
3							3.5'
4					sc		CLAYEY SAND; dark yellowish brown (10YR 3/4), stiff, slightly moist, 30% clay, 70% sand, medium to very fine grain, round to subround.
5							At 5.0': Color changes to dark yellowish brown (10YR 4/4).
6							6.0'
7					sp		SAND; brown (10YR 4/3), moist to wet, medium stiff, 10% silt, 90% medium to very fine sand, rounded.
8							
9							
10		100%					
11							11.0'
12			42		cl		SANDY CLAY; olive (5Y 5/4), stiff, slightly moist, streaks of weathered serpentine, 10% sand, fine grained, 90% clay. 0 ppm Vinyl Chloride DREAGER
13							
14	1273	100%					0 ppm Vinyl Chloride DREAGER
15							15.0'
			1.2		sc		CLAYEY SAND; light olive brown (2.5Y 5/4), very fine grained sand, rounded, 5% clay, wet, strong odor.
16							TOTAL DEPTH OF BORING IS 16.0 FEET
17							

DRILLER : Don Pearson & Chris Garver

DRILLING CO. : Gregg Drilling

DRILLING METHOD : Geoprobe

SAMPLING METHOD :

PROJECT : Hunters Point EMAC CTO-004

LOCATION : Hunters Point Shipyard

PROJECT NO. : 102569/01091003

NOTE: BORING DECOMMISSIONED BY TRIME GROUT

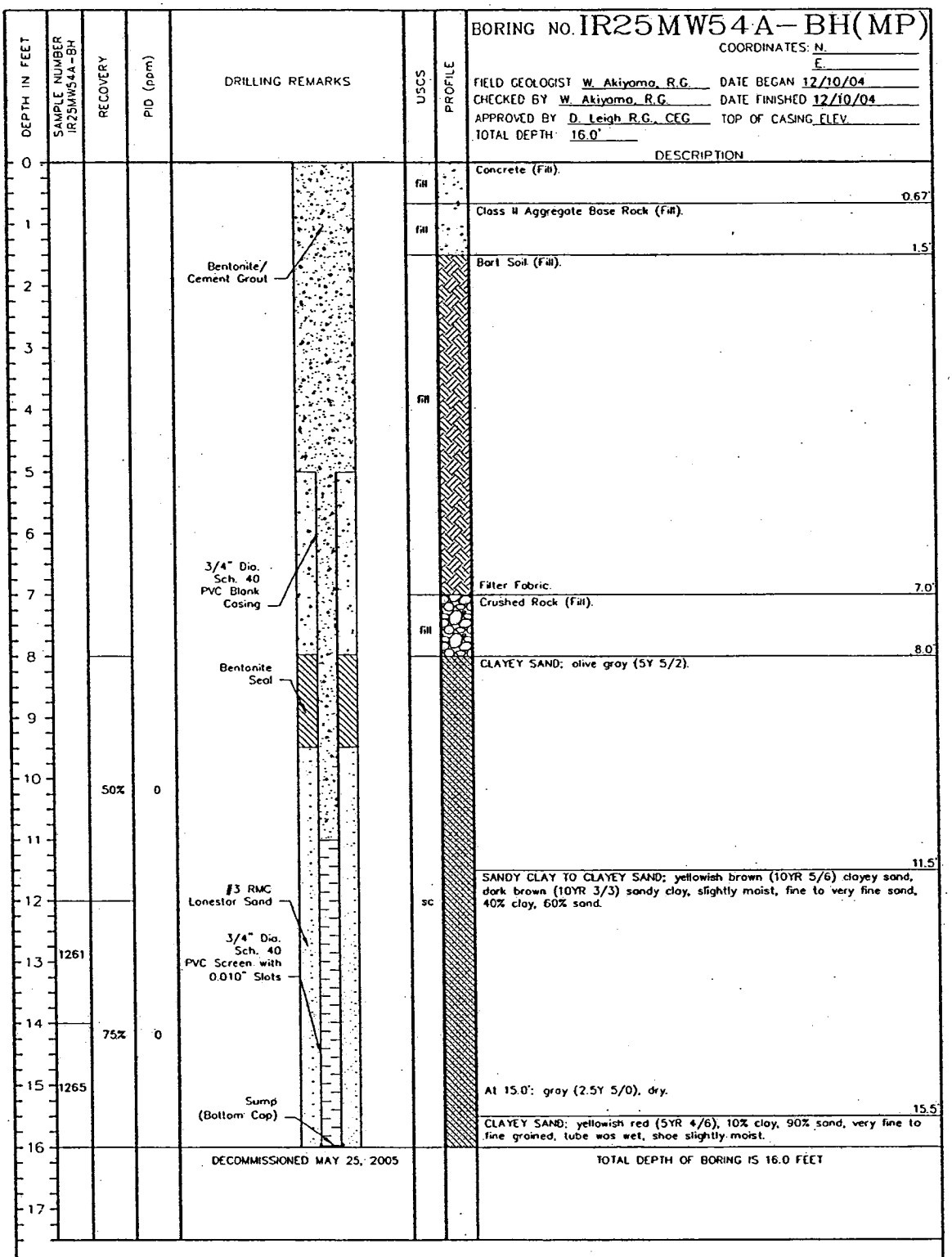
DRAWN BY	MJV	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A16
DATE	6/22/05	APPROVED BY	DL 6/22/05	

Shaw

BORING NO. IR25MW54A-BH(MP)

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 12/10/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 12/10/04
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV.
TOTAL DEPTH 16.0'



DRILLER : Bobby Deason
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Geoprobe
SAMPLING METHOD : 2" Modified California Sampler
PROJECT : Hunters Point EMAC CTO-004
LOCATION : Hunters Point Shipyard
PROJECT NO. : 102569/01091003

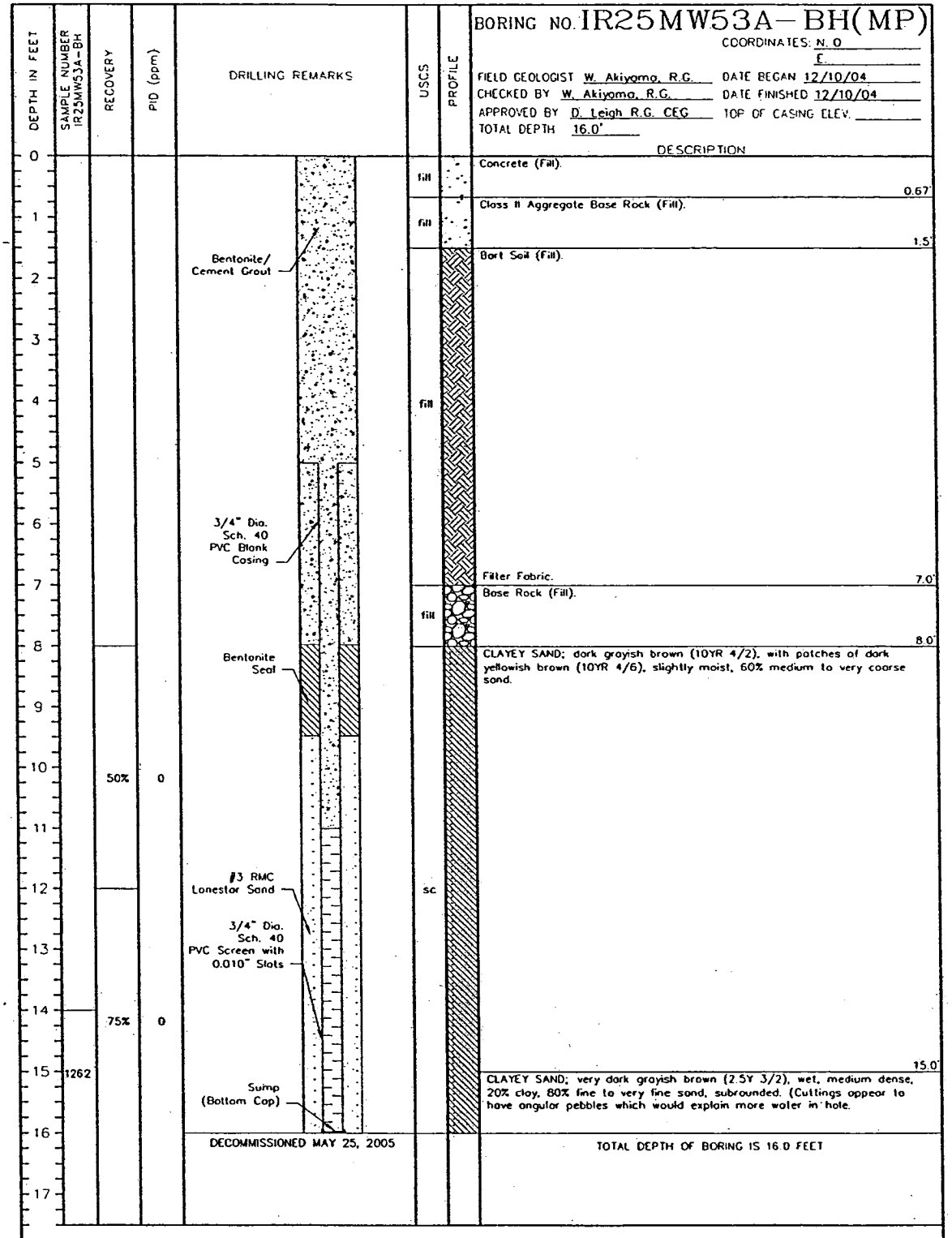
DRAWN BY	MJV	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A14
DATE	06/22/05	APPROVED BY	DL 6/22/05	

Shaw

BORING NO. IR25MW53A-BH(MP)

COORDINATES: N. 0
E.

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 12/10/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 12/10/04
APPROVED BY D. Leigh R.G. CEG TOP OF CASING ELEV.
TOTAL DEPTH 16.0'



DRILLER : Bobby Deason
DRILLING CO. : Gregg
DRILLING METHOD : Geoprobe
SAMPLING METHOD :
PROJECT : Hunters Point EMAC CTO-004
LOCATION : Hunters Point Shipyard
PROJECT NO. : 102569/01091003

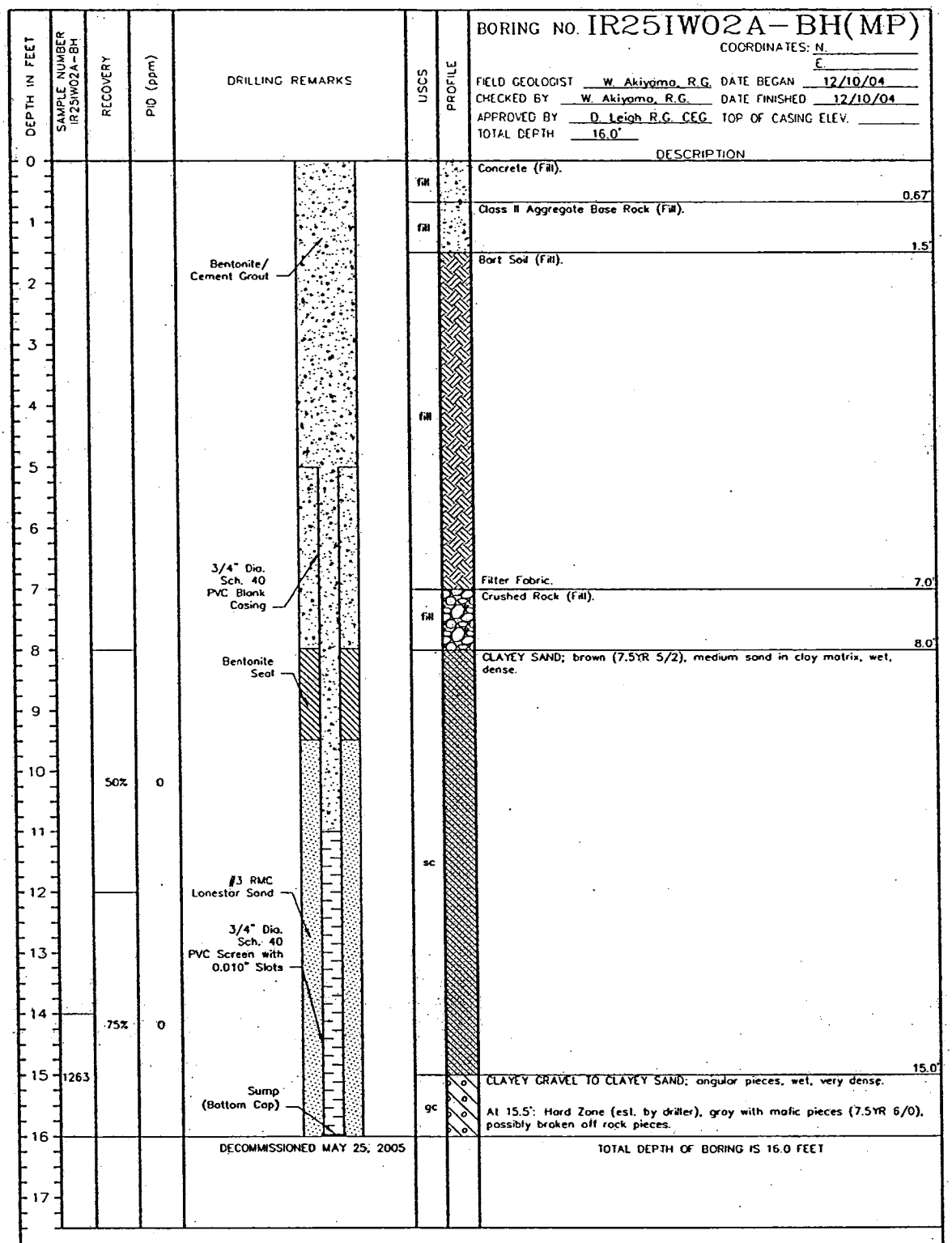
DRAWN BY	MJV	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A12
DATE	6/22/05	APPROVED BY	DL 6/22/05	

Shaw

BORING NO. IR25IW02A-BH(MP)

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 12/10/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 12/10/04
APPROVED BY D. Leigh R.G. CEG TOP OF CASING ELEV. _____
TOTAL DEPTH 16.0'



DRILLER : Bob
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Geoprobe
SAMPLING METHOD : 2" California Modified Sampler
PROJECT : Hunters Point EMAC CTO-004
LOCATION : Hunters Point Shipyard
PROJECT NO. : 102569/01091003

DRAWN BY	MJV	CHECKED BY	WSA 06/16/05	DRAWING NO. : 102569-A11
DATE	06/22/05	APPROVED BY	DL 06/16/05	

Shaw

BORING NO. IR25MW55A-BH(MP)

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 12/10/04

CHECKED BY W. Akiyama, R.G. DATE FINISHED 12/10/04

APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV.

TOTAL DEPTH 16.0'

DEPTH IN FEET	SAMPLE NUMBER IR25MW55A-BH	RECOVERY	PID (ppm)	USCS	PROFILE	DESCRIPTION
0				fill		Asphalt, 4". 0.33'
1				gp		Base Rock GRAVEL; dark brown (10YR 3/3), dry, firm, angular, .5"x1", grades to silty sand and gravel, reddish brown (10YR 2/2), 30% silt, 70% gravel.
2						
3						3.5'
4				sc		CLAYEY SAND; dark yellowish brown (10YR 3/4), stiff, slightly moist, 30% clay, 70% sand, medium to very fine grain, round to subround.
5						At 5.0': Color changes to dark yellowish brown (10YR 4/4).
6						6.0'
7				sp		SAND; brown (10YR 4/3), moist to wet, medium stiff, 10% silt, 90% medium to very fine sand, rounded.
8						
9						
10		50%	0			
11						11.0'
12				cl		SANDY CLAY; olive (5Y 5/4), stiff, slightly moist, streaks of weathered serpentine, 10% sand, fine grained, 90% clay.
13						
14		75%	0			
15	1264					15.0'
16				sc		CLAYEY SAND; light olive brown (2.5Y 5/4), very fine grained sand, rounded, 5% clay, wet, strong odor.
17						

Bentonite/ Cement Grout

3/4" Dia. Sch. 40 PVC Blank Casing

Bentonite Seal

#3 RMC Lonestar Sand

3/4" Dia. Sch. 40 PVC Screen with 0.010" Slots

Sump (Bottom Cap)

DECOMMISSIONED MAY 25, 2005

TOTAL DEPTH OF BORING IS 16.0 FEET

DRILLER : Bobby Deason
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Geoprobe
SAMPLING METHOD : 2" Modified California Sampler
PROJECT : Hunters Point EMAC CTO-004
LOCATION : Hunters Point Shipyard
PROJECT NO. : 102569/01091003

DRAWN BY	MJV	CHECKED BY	WSA 6/22/05	DRAWING NO. : 102569-A13
DATE	06/22/05	APPROVED BY	DL 6/22/05	

Shaw

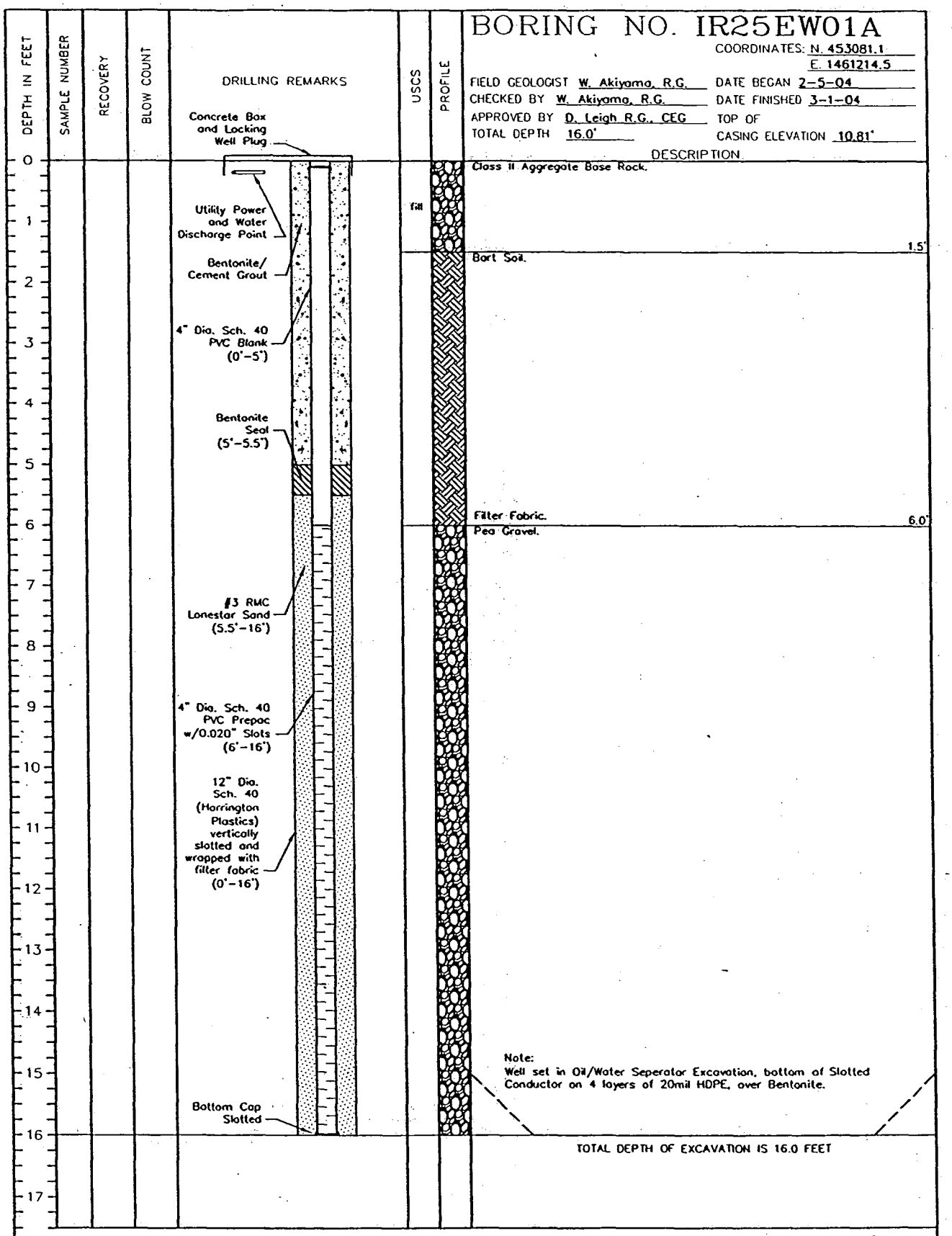
Attachment 2
Monitoring Well Completion Diagrams and Boring Logs
(Installed by Shaw under EMAC CTO 001, Task 5)

IR25EW01A
IR25IW02A
IR25MW53A
IR25MW54A
IR25MW55A
IR25MW56A
IR25MW57A

BORING NO. IR25EW01A

COORDINATES: N. 453081.1
E. 1461214.5

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2-5-04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 3-1-04
APPROVED BY D. Leigh R.G., CEG TOP OF
TOTAL DEPTH 16.0' CASING ELEVATION 10.81'



DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : None. Set in Excavation using Conductor Casing
SAMPLING METHOD : Sampling conducted on Excavation Sidewalls
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : In Seperator Excavation Bldg. 134
PROJECT NO. : 843812-04501010

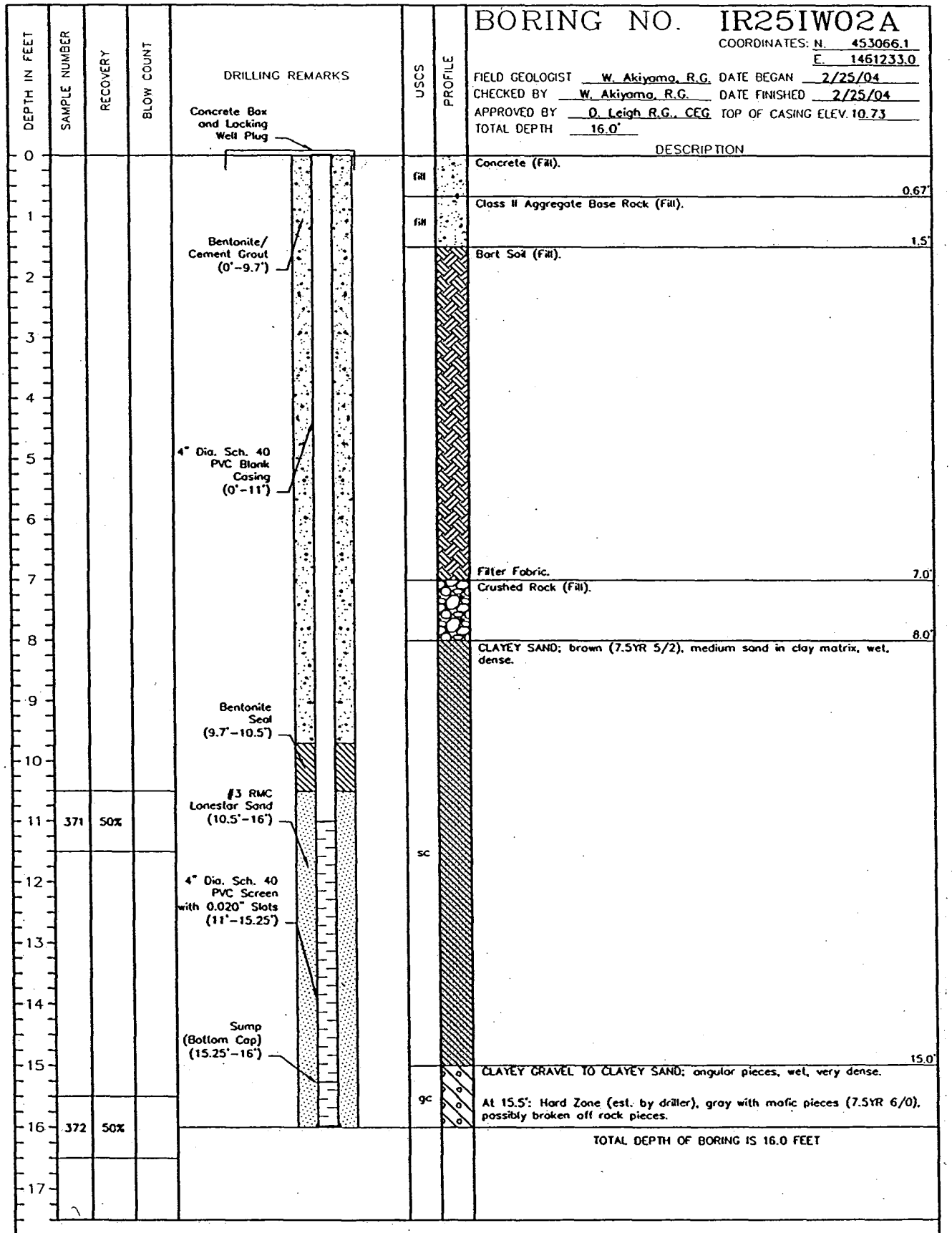
DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A2
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25IW02A

COORDINATES: N. 453066.1
E. 1461233.0

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/25/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 2/25/04
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. 10.73
TOTAL DEPTH 16.0'



DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" California Modified Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

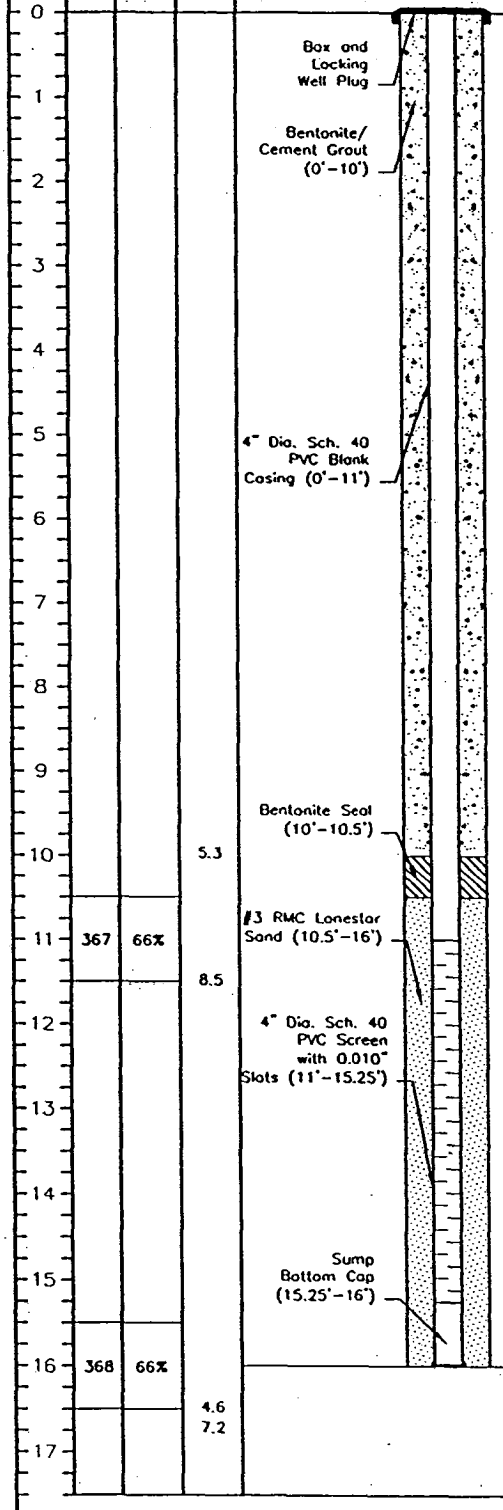
DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A3
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

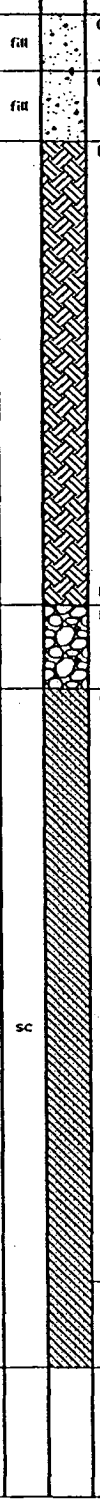
Shaw

BORING NO. IR25MW53A

COORDINATES: N. 453069.7
E. 1461230.0

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/24/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 2/24/04
APPROVED BY _____ TOP OF CASING ELEV. 11.07
TOTAL DEPTH 16.0'





DESCRIPTION

Concrete (Fill). 0.67'

Class II Aggregate Base Rock (Fill). 1.5'

Bark Soil (Fill).

Filter Fabric. 7.0'

Base Rock (Fill). 8.0'

CLAYEY SAND; dark grayish brown (10YR 4/2), with patches of dark yellowish brown (10YR 4/6), slightly moist, 60% medium to very coarse sand.

15.0'

CLAYEY SAND; very dark grayish brown (2.5Y 3/2), wet, medium dense, 20% clay, 80% fine to very fine sand, subrounded. (Cuttings appear to have angular pebbles which would explain more water in hole.

TOTAL DEPTH OF BORING IS 16.0 FEET

DRILLER :
DRILLING CO. :
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

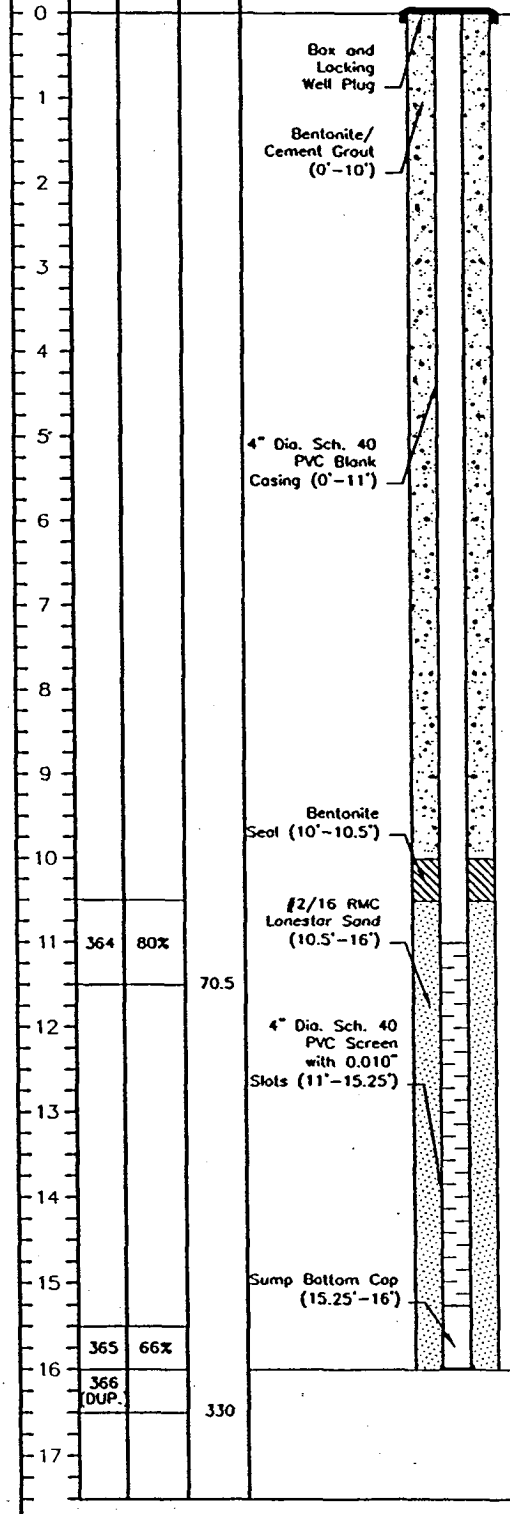
DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A4
DATE	3/17/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW54A

COORDINATES: N. 453074.2
E. 1461224.2

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/24/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 2/24/04
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. 11.12
TOTAL DEPTH 16.0'



USCS	PROFILE	DESCRIPTION	
fill		Concrete (Fill).	0.67'
fill		Class II Aggregate Base Rock (Fill).	1.5'
		Bort Soil (Fill).	
		Filter Fabric.	7.0'
		Crushed Rock (Fill).	8.0'
		CLAYEY SAND; olive gray (5Y 5/2).	11.5'
sc		SANDY CLAY TO CLAYEY SAND; yellowish brown (10YR 5/6) clayey sand, dark brown (10YR 3/3) sandy clay, slightly moist, fine to very fine sand, 40% clay, 60% sand.	
		At 15.0': gray (2.5Y 5/0), dry.	15.5'
		CLAYEY SAND; yellowish red (5YR 4/6), 10% clay, 90% sand, very fine to fine grained, tube was wet, shoe slightly moist.	
		TOTAL DEPTH OF BORING IS 16.0 FEET	

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" Modified California Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

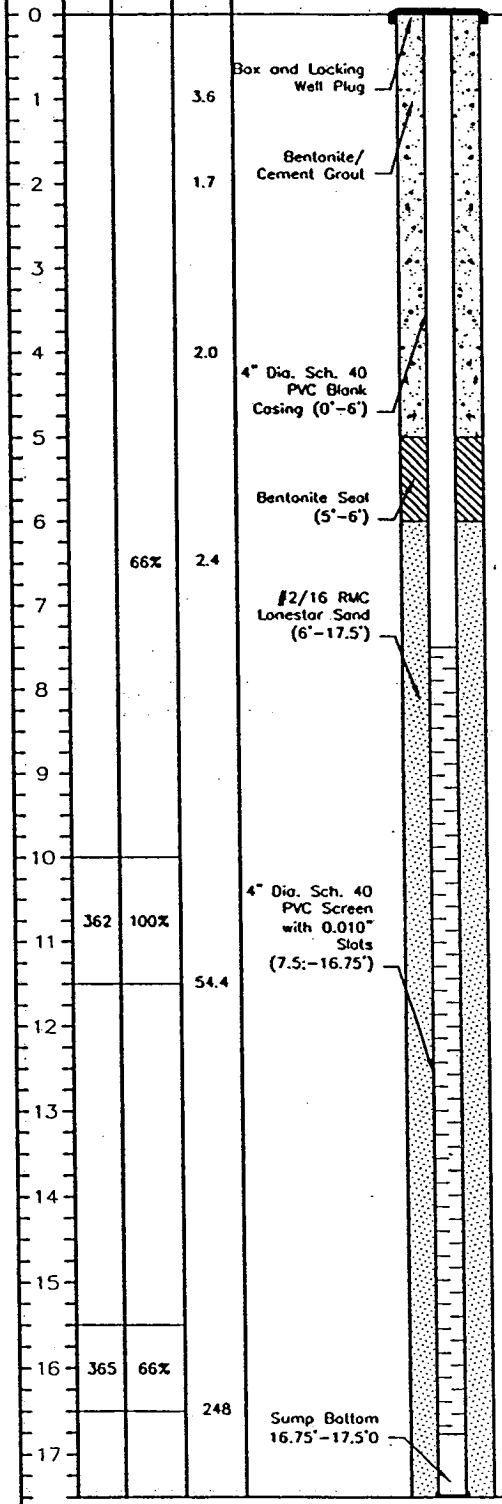
DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A5
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW55A

COORDINATES: N. 453092.9
E. 1461217.3

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/23/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 2/24/04
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. 10.39
TOTAL DEPTH 17.5'



USCS	PROFILE	DESCRIPTION	
fill		Asphalt, 4".	0.33'
gp		Base Rock GRAVEL; dark brown (10YR 3/3), dry, firm, angular, .5"x1", grades to silty sand and gravel, reddish brown (10YR 2/2), 30% silt, 70% gravel.	3.5'
sc		CLAYEY SAND; dark yellowish brown (10YR 3/4), stiff, slightly moist, 30% clay, 70% sand, medium to very fine grain, round to subround. At 5.0': Color changes to dark yellowish brown (10YR 4/4).	6.0'
sp		SAND; brown (10YR 4/3), moist to wet, medium stiff, 10% silt, 90% medium to very fine sand, rounded.	11.0'
cl		SANDY CLAY; olive (5Y 5/4), stiff, slightly moist, streaks of weathered serpentine, 10% sand, fine grained, 90% clay.	15.0'
sc		CLAYEY SAND; light olive brown (2.5Y 5/4), very fine grained sand, rounded, 5% clay, wet, strong odor.	

TOTAL DEPTH OF BORING IS 17.5 FEET

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" Modified California Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

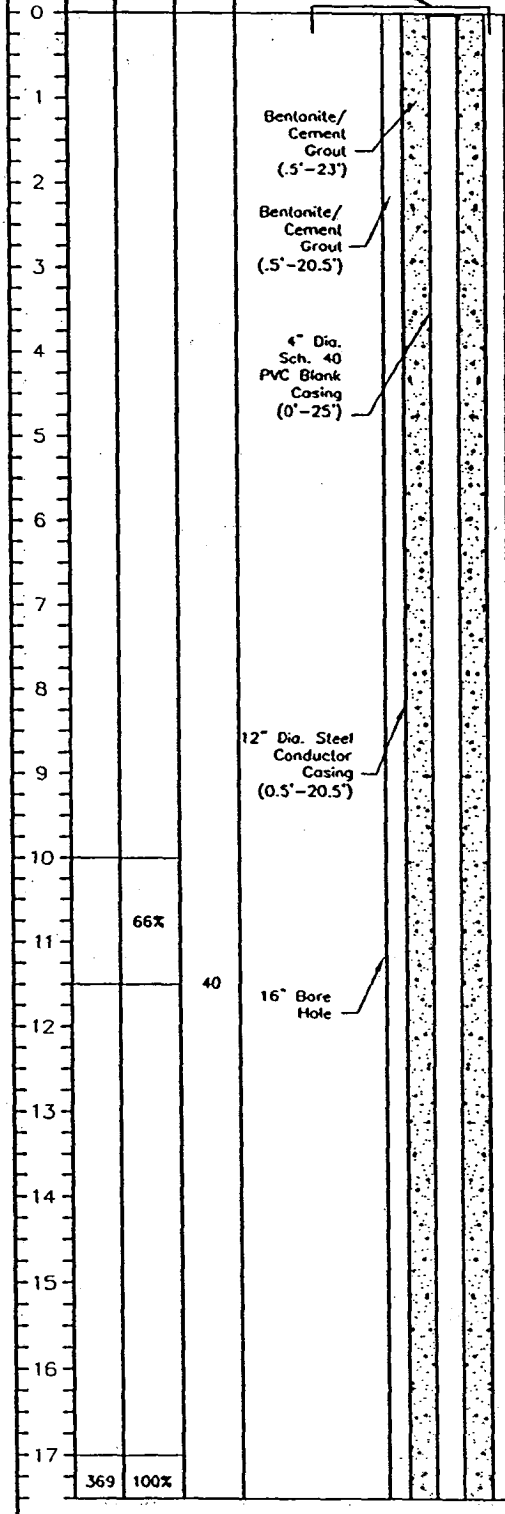
DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A6
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW56A

COORDINATES: N. 453075.8
E. 1461222.1

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/25/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 3/1/04
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. 11.10
TOTAL DEPTH 30.0'



USCS	PROFILE	DESCRIPTION	
fill		Concrete, (fill).	0.67'
fill		Class II Aggregate Base Rock, (fill).	2.167'
fill		Bort Soil (fill). Filter Fabric.	7.0'
fill		Crushed Rock (fill).	8.0'
sc		CLAYEY SAND TO SANDY CLAY; olive brown (2.5Y 4/4), 50% sand, 50% clay, sand coarse to medium grain, moist (possibly wet due to water in core barrel), angular grained.	

DRILLER : Jason Neff
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" California Modified Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A7
DATE	5/13/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW56A

COORDINATES: N. 453075.8
E. 1461222.1

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/25/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 3/1/04
APPROVED BY D. Leigh R.G., CEG TOP OF CASING ELEV. 11.10
TOTAL DEPTH 30.0'

DEPTH IN FEET	SAMPLE NUMBER	RECOVERY	PID	DRILLING REMARKS	USCS	PROFILE	DESCRIPTION
18	370 (DUP.)	100%	79				SANDY CLAY; olive (5Y 4/3), wet.
19							
20							
21		100%					
22			9.0				22.0' CLAYEY SAND; gray (5YS1), slightly moist, medium dense, clony in fine to very fine sand, round to angular, shell fragments, bay sediment.
23				Bentonite Seal (23'-24')			
24					SC		
25				#2/16 RMC Lonestar Sand (24'-30')			
26	377	100%		4" Dia. Sch. 40 PVC Screen with 0.010" Slots (25'-29.25')			
27			3.8				27.0' CLAYEY SAND; dark gray (N4), slightly moist, medium dense, 10% clay, 90 % very fine to fine rounded sand, no shells.
28							
29				Sump Bottom Cap (29.25'-30.0')			
30			163				Color change to 5B 4/1. Dark blue gray.
31							TOTAL DEPTH OF BORING IS 30.0 FEET
32							
33							
34							
35							

DRILLER : Jason Neff
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" California Modified Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

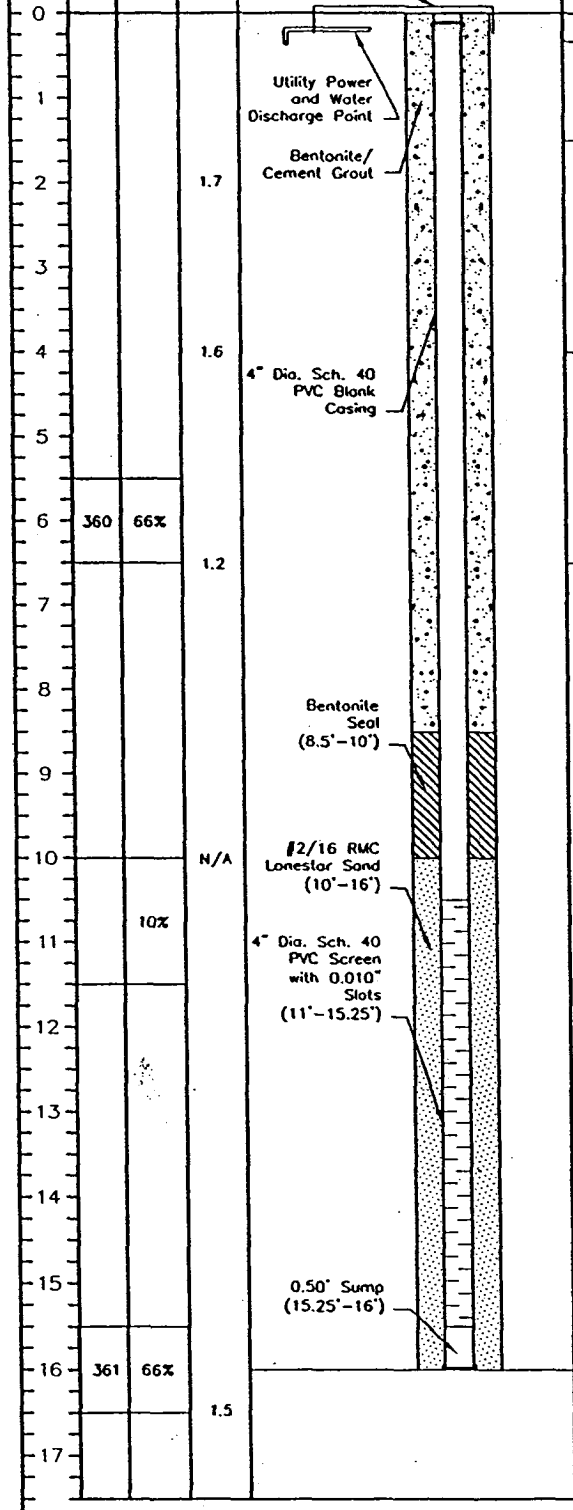
DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A7
DATE	5/13/04	APPROVED BY	WSA 5/24/04	

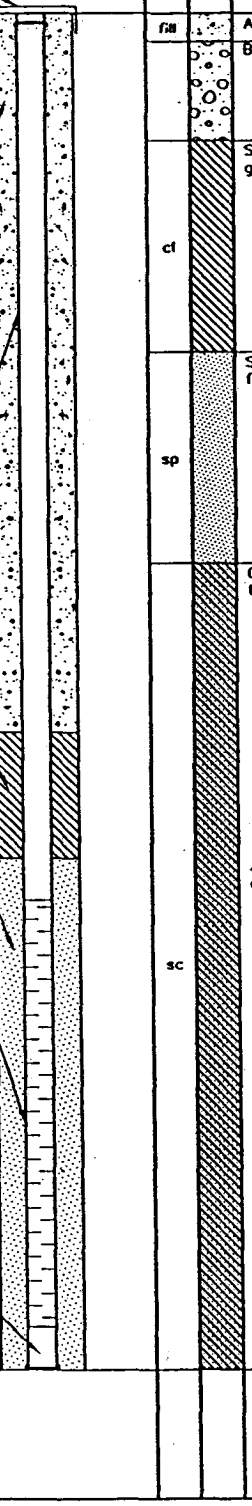
Shaw

BORING NO. IR25MW57A

COORDINATES: N. 453102.5
E. 1461221.0

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 2/23/04
CHECKED BY W. Akiyama, R.G. DATE FINISHED 2/23/04
APPROVED BY D. Leigh R.G., CEG SURFACE ELEV. 9.21
TOTAL DEPTH 17.5' CORE SIZE 10"





DESCRIPTION	
Asphalt, 4".	0.33'
Base Rock GRAVEL.	1.5'
SANDY CLAY; dark brown (10YR 3/3), stiff, slightly moist, 5% gravel, 10% fine to very fine sand, clay, base rock.	4.0'
SAND; yellowish brown (10YR 5/4), slightly moist, loose, 100% medium to fine sand, round to subround, qaurtz sand, trace mg.	6.5'
CLAYEY SAND; strong brown (7.5YR 5/6), stiff, moist, 15% clay, 85% fine to very fine rounded sand.	
At 10.0': CLAYEY SAND; dark yellowish brown (10YR 4/6), moist, firm, 20% clay, 80% fine sand, subrounded.	
At 16.0': CLAYEY SAND; olive (5Y 4/4), very moist to wet, stiff, 20% clay, 80% very fine sand, subrounded.	
TOTAL DEPTH OF BORING IS 16.0 FEET	

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Hollow Stem Auger
SAMPLING METHOD : 2" Modified California Sampler
PROJECT : Hunters Point EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A8
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

Attachment 3
Decommissioned Well Logs
(Decommissioned by Shaw under EMAC CTO 001, Task 5)

IR25MW18A
IR25MW19A
IR25MW20A
IR25MW22A
IR25MW15A1
IR25MW15A2
IR25MW903
IR25MW905
IR25VW6-06A
IR25VW6-07A
IR25VW6-19A
IR25SG044
BADCAT WELL

BORING NO. IR25MW18A

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 1/20/04

CHECKED BY W. Akiyama, R.G. DATE FINISHED 1/20/04

APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. –

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0					fill		ASPHALT 0.16'
1				DRILLED OUT TO 17', TRIMMED CEMENT GROUT TO SURFACE	gm		SILTY GRAVEL; dark yellowish brown (10YR 4/4), 40% silt, 60% gravel, slightly moist, loose, trace clays.
2							
3							
4							
5							
6							
7							1.75'
8					ml		CLAYEY SILT; dark reddish brown (2.5YR 3/4), moist, hard, medium plasticity, 40% clay. 7.5'
9					sc		CLAYEY SAND; dark yellowish brown, (10YR 4/6), moist, firm, 20% clay, 80% fine, subrounded to round, medium plasticity.
10							
11							10.5'
12					cl		GRAVELLY CLAY; olive (5Y 5/3), moist, firm 25% gravel, 75% clay (weathered serpentine)
13							
14							13.0'
15					sc		CLAYEY SAND; dark yellowish brown (10YR 4/6), moist, firm, 20% clay, 80% fine sand, subrounded to round.
16							
17							16.0'
							TOTAL DEPTH OF BORING IS 16 FEET

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Mari MST (Rhino) 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard, EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	RB	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A17
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW19A

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. | DATE BEGAN 1/20/04
CHECKED BY W. Akiyama, R.G. | DATE FINISHED 1/20/04
APPROVED BY D. Leigh, R.G., CEG | SURFACE ELEV. –
SAMPLE DIA. _____

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0				DRILLED OUT TO 17', TRIMMED CEMENT GROUT TO SURFACE	fill		ASPHALT 0.58'
1–5					gm		SILTY GRAVEL; dark olive gray (5Y 3/2), slightly moist, 25% silt, 75% serpentine rock, angular, trace clays. 5.0'
5–7.5					cl		SANDY CLAY; black (2.5Y N2/0), moist, firm (stiff), 20% very fine sand, 80% clay, decayed grass. 7.5'
7.5–10					sc		CLAYEY SAND; dark yellowish brown (10YR 3/6), moist, soft, 10% clay, 90% very fine sand, subrounded to round. 10.0'
10–14.5					gc		CLAYEY GRAVEL; dark greenish gray (5GY 4/1), moist, soft, 45% clay, 55% serpentinite rock <1cm, odor. CLAYEY GRAVEL; dark greenish gray (5GY 4/1), moist, soft, 20% clay, 80% serpentinite rock well graded up to 3 cm, slight odor. 14.5'
14.5–17					sc		CLAYEY SAND; dark olive gray (5Y 3/2), moist, 20% clay, 80% very fine sand, subround to round, slight odor. 17.0'
							TOTAL DEPTH OF BORING IS 17 FEET

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Marl MST (Rhino)
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	RB	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A18
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW20A

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. | DATE BEGAN 1/20/04

CHECKED BY W. Akiyama, R.G. | DATE FINISHED 1/20/04

APPROVED BY D. Leigh, R.G. | SURFACE ELEV. --

SAMPLE DIA. _____

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0				DRILLED OUT TO 15', TRIMMED CEMENT GROUT TO SURFACE	fill		ASPHALT 0.16'
0-7					gm		SILTY GRAVEL; reddish brown (5YR 4/4), slightly moist, loose, 30% silt, 70% gravel, serpentinie rock, slickenside. 7.0'
7-7.5					gm		SILTY GRAVEL; dark yellowish brown (10YR 4/6), slightly moist, loose, 30% silts, 70% serpentine rock. 7.5'
7.5-8					gc		CLAYEY GRAVEL; very dark brown (10YR 2/2), moist soft, 30% clay 70% gravel, 4" thick interval. 8.0'
8-9					sm		SILTY SAND; very dark grayish brown (10YR 3/2), soft, 8" thick. 9.0'
9-10					sw		SAND; dark grayish brown (10YR 4/2), wet, loose, 4" thick. 10.0'
10-11					cl		SANDY SILTY CLAY; dark greenish gray (5BG 4/1), moist, soft, 20% sand, 30% silt, 50% clay, low plasticity. 11.0'
11-13					cl		SANDY CLAY; dark brown (10YR 3/3), wet, soft, 45% sand, 55% clay. 13.0'
13-15							TOTAL DEPTH OF BORING IS 15 FEET

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Mari MST 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	RB	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A19
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW22A

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 12/18/97

CHECKED BY W. Akiyama, R.G. DATE FINISHED 12/18/97

APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. ~

SAMPLE DIA. _____

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0					fill		CEMENT 0.5'
1				3/4" Dia. PVC Sch. 40 Blank Casing	gm		SILTY GRAVEL; very dark gray (5YR 3/1), moist, 70% silt, 30% gravel, trace clay, serpentine gravel up to 3" loose.
2				Portland Neat Cement			
3							
4				Bentonite Chip Seal			
5							5.0'
6					gp		GRAVELLY SAND; greenish gray (5G 6/1), dry, serpentine, sand and gravel, 50% gravel, trace silt, loose.
7				5' Dia. PVC Sch. 40 Slot Screen 0.010"			
8							8.0'
9					sm		SILTY SAND; very dark gray (5Y 3/1), moist, 40% silt, 60% sand, trace clay.
10							
11							11.5'
12					ml		SANDY SILT; dark reddish brown (5YR 3/2), moist, 50% sand, 55% silt trace clay, soft.
13				10' Sand Pack 2/12 Sand	ml		12.75' SANDY SILT; dark reddish brown (5YR 3/2), moist, very soft.
14					cl		14.0' SILTY CLAY; strong brown (7.5YR 4/6), moist, very soft, 20% silt, 80% clay.
15							15.0' TOTAL DEPTH OF BORING IS 15 FEET
16							
17							

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

NOTE:
Well pressure grouted

DRAWN BY	RB	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A20
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW15A1

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. | DATE BEGAN 6/8/94

CHECKED BY W. Akiyama, R.G. | DATE FINISHED 6/8/94

APPROVED BY D. Leigh, R.G., CEG | SURFACE ELEV. 7.69

TOTAL DEPTH 21.5' | SAMPLE DIA. _____

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0				DRILLED OUT TO 15', TRIMMED CEMENT GROUT TO SURFACE	fill		Concrete; red staining. 0.5'
5		1					SANDY LEAN CLAY WITH GRAVEL; dark reddish gray (5YR 4/2), soft, moist, 50% clay, 30% very fine sand, 20% fine to coarse gravel, fill. 5.5'
6		3	91.6		cl		SANDY LEAN CLAY; black (5YR 2.5/1), soft, moist to wet, 60% clay, 35% very fine sand, 5% sticks, gravel, fill. ▼ Groundwater encountered at 6.4'. 11.0'
6		5					
15				Bentonite Chips Seal (15.0'-21.5')	sc		CLAYEY SAND; strong brown (7.5YR 4/6), loose, moist, 60% medium sand, 40% clay, fill.

DRILLER : E. Santellan

DRILLING CO. : Gregg Drilling & Testing

DRILLING METHOD : Mart MST and 8" Hollow Stem Auger

SAMPLING METHOD :

PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4

LOCATION : Hunters Point Shipyard, Bldg. 134

PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A9
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW15A1

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 6/8/94
CHECKED BY W. Akiyama, R.G. DATE FINISHED 6/8/94
APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. 7.69
TOTAL DEPTH 21.5' SAMPLE DIA. _____

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)		ASTM D2488-00	PROFILE	
18							CLAYEY SAND; dark greenish gray (5G 4/1), medium dense, wet, 70% medium sand, 25% fat clay, 5% shell fragments, Undifferentiated Upper Sand deposits.
19				Bentonite Chips Seal (15.0'-21.5')	SC		
20							
21							11.0'
22							Bottom of boring at 21.5 ft. Boring backfilled with bentonite chips to 15 feet.
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Mari MST and 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A9
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

BORING NO. IR25MW15A2

COORDINATES: N. _____ E. _____

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 5/23/94
CHECKED BY W. Akiyama, R.G. DATE FINISHED 6/8/94
APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. 7.17
SAMPLE DIA. _____

DEPTH IN FEET	SAMPLE TYPE	BLOWS ON SAMPLER (PER 6")	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0					fill		Concrete 0.5'
		2			sc		CLAYEY SAND WITH GRAVEL; dark brown (7.5YR 3/2), loose, moist, 45% medium sand, 40% lean clay, 15% fine to coarse gravel, fill. 5.0'
		3					
		3		DRILLED OUT TO 30.8', TRIMMED CEMENT GROUT TO SURFACE			
5		2			sc		CLAYEY SAND; very dark gray (5Y 3/1), loose, wet, 55% very fine sand, 45% fat clay, fill.
		3					
		4					Change to olive brown (2.5Y 4/4), 80% medium sand, 20% lean clay at 8ft.
10		3					
		4					
		5					Free product observed at 14 ft. 15.0'
15		3			cl		SANDY LEAN CLAY; very dark grayish brown (10YR 3/2), soft, wet, 60% clay, 40% fine sand, fill.
		5					SANDY LEAN CLAY WITH GRAVEL; yellowish brown (10YR 5/4), soft, wet, 45% clay, 40% medium sand, 15% fine gravel, fill.
		4					GRAVELLY LEAN CLAY WITH SAND; dark olive gray (5Y 3/2), soft, wet, 65% clay, 20% fine gravel, 15% fine sand, fill. 19.0'
20		8			sp		POORLY GRADED SAND; dark olive gray (5Y 3/2), medium dense, wet, 90% medium sand, 5% clay, 5% shell fragments, undifferentiated Upper Sand deposits.
		16					
		37					25.0'
25		12			sc		CLAYEY SAND; light olive brown (2.5y 5/4), loose, wet, 65% medium sand, 30% lean clay, 5% iron oxide nodules, Undifferentiated Sedimentary deposits.
		15					
		12					CLAYEY SAND; light olive brown (2.5y 5/4), loose, wet, 65% medium sand, 30% lean clay, 5% iron oxide nodules, Undifferentiated Sedimentary deposits. 31.5'
30		6		Bentonite Chip Seal (30.8'-33')			
		10					
		27					SERPENTINITE BEDROCK; olive (5Y 5/6), intensely fractured, low hardness, moderately weathered. 33.0'
		23					
		60		9421C243			TOTAL DEPTH OF BORING IS 33 FEET
35							

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Marl MST (Rhino) 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	RB	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A10
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW903

COORDINATES: N. 453090.8
E. 1461215.8

FIELD GEOLOGIST M. Brown/S. Aiosa
CHECKED BY M. Brown
APPROVED BY W. Akiyama
TOTAL DEPTH 31 ft.

DATE BEGAN 11/29/00
DATE FINISHED 11/29/00
SURFACE ELEV. 10.8
TOC ELEV. 10.5
CORE SIZE 1 1/2" Dia.

DEPTH IN FEET	SAMPLE TYPE	RECOVERY (%)	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-93	PROFILE	
0			0				Hard gravel/asphalt at surface macro core to 15"
			0				1.25'
	EC	25	0		gp		No recovery from 1.5' to 3.0' SANDY GRAVEL; dry.
			0				
			0				
			0				GRAVEL to 1" loose.
			0				No recovery from 4.0' to 6.0'
5	EC	30	0				
			0				
			0				6.0'
			7.8	DRILLED OUT TO 30', CEMENT GROUT TRIMMED TO SURFACE	gc		SAND CLAY GRAVEL *mixture; gravel to 1.0", loose, FILL.*
							7.0'
	EC	100	4.4		sc		CLAYEY SAND; (5Y 3/2), dry, gravel to 1.0", sand grain size fine.
			26.7				8.0'
10			99.3				SANDY CLAY; (5Y 3/2), slightly moist, slightly plastic, 70% clay, 30% sand.
	EC	60					GRAVEL up to 1".
			486				No recovery 10.0' to 11.0'
			447				
			166				At 12.0': *pieces of serpentinite up to 2.0", moist.*
			32.6				No recovery 13.0' to 14.0'
	EC	60	7.4				Gravel to 1/4"; (5Y 4/3) olive, moist, slightly plastic 70% clay 25% sand 5 % gravel.
15			2.8				
16			81.1				No recovery 16.0' to 17.5'
17			<2000				
	EC	50	1091		cl		
			31.9				40% SAND 60% CLAY; *moist.*
			0				
20			0				
	EC	60	0				SANDY GRAVELLY CLAY; (5Y 4/3), moist, 20% gravel 20% sand 60% clay, gravel to 1.0", serpentinite fragments up to 1.0".
			0				
			0				
			0				SANDY SILTY CLAY; (5Y 3/2), wet dark olive gray (5Y 3/2), wet, 5% shell fragments, 55% clay 20% sand 20% silt, sand grain size fine.
	EC	100	0				
			0				
			0				
			0				
			0				
25			0				25.0'
			0				CLAYEY SILTY SAND; dark olive gray, wet, lots of shell fragments, 10% shell fragments, 20% clay 10% silt 60%
	EC	60	0		sc		
			0				
			0				
			0				
	EC	100	0				
			0				
30			0	BENTONITE CHIPS	cl		SANDY CLAY; (5Y 4/2), wet, 30% sand 70% clay, low plasticity.
							31.0'
							TOTAL DEPTH OF BORING IS 31.0 FEET
35							

DRILLER : M. Flynn
DRILLING CO. : Precision Sampling
DRILLING METHOD : Direct Push (Boring); Hollow Stem Auger (Well)
SAMPLING METHOD : Envirocore Sampler
PROJECT : Hunters Point
LOCATION : Hunters Point Shipyard
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A11
DATE	3/18/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25MW905

COORDINATES: N. 453071.1
E. 1461226.1

FIELD GEOLOGIST M. Brown
CHECKED BY M. Brown
APPROVED BY W. Akiyama
TOTAL DEPTH 31 ft.

DATE BEGAN 11/30/00
DATE FINISHED 11/30/00
SURFACE ELEV. 8.0
TOC ELEV. 7.7

DEPTH IN FEET	SAMPLE TYPE	RECOVERY (%)	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-93	PROFILE	
0							CONCRETE 0.5'
	EC	15		DRILLED OUT TO 22.5', TRIMMED GROUT TO SURFACE	gp fill		6" recovery 1' to 4' CLAYEY SANDY GRAVEL; olive brown, slightly moist, compact, FILL. No recovery 4' to 5.5' 5.5'
5	EC	50	0 0 0 0				SILTY CLAY with 5% very fine SAND; olive (5Y 4/3), firm to stiff, slightly moist, non plastic. No recovery 7' to 8.5'
	EC	50	0 1.5				SILTY CLAY; very dark gray (10YR 3/1), stiff, slightly moist.
10	EC	90	0 3.6 18.3 12.5		cl		No recovery 10' to 10.5' SANDY CLAY; olive (5Y 4/3), 30% very fine to fine sand, non plastic, moist, dark gray mottling, firm.
	EC	50	8.2 17.7 0.3 17.0				No recovery 13' to 14.5' 14.5'
15					sc		CLAYEY SAND with 25% blue SERPENTINITE chunks up to 0.75" diameter; dark blue-gray (5B 4/1), moist, compact. 15.5'
	EC	100	24.1 14.6 22.4 13.3		cl		SANDY CLAY; olive brown (2.5Y 5/4), stiff, moist, non plastic. As above; gravelly 10% to 17.5' SANDY CLAY; olive brown, soft to firm, very moist, moderately plastic.
19			0 0				
20	EC	100	0 2.3 1.9 2.0 0.2 1.9				At 19.5': Begin SANDY CLAY; dark blue gray (5B 4/1), with 20% shell fragments, wet, soft, slightly plastic. 21.5'
	EC	60	0 0 0 0 0		sm		At 21.5': Begin SILTY CLAY SAND; dark blue gray (5B 4/1), 15% shell fragments, wet, compact. 24.5'
25	EC	100	0 0 0 0	Bentonite Chips	sc		At 24.5': Begin CLAYEY SAND; olive brown (2.5Y 5/4), dense, stiff, moist. 27.5'
	EC	100	0 0 0 0		cl		At 27.5': Begin SANDY CLAY; olive-brown (2.5Y 5/4), firm to stiff, slightly moist, slightly plastic. 31.0'
30							TOTAL DEPTH OF BORING IS 31.0' FEET
35							

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Marl MST (Rhino) Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A12
DATE	3/22/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25VW6-06A

COORDINATES: N. 453077.31
E. 1461219.56

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 10-12-00
CHECKED BY W. Akiyama, R.G. DATE FINISHED 10-12-00
APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. 7.46

DEPTH IN FEET	SAMPLE NUMBER	RECOVERY (%)	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0							Concrete 0.75'
1	SS	0			cl fill		no recovery 0.8' to 2'; rock blocking sample shoe at 2'.
2			0	DRILLED OUT TO 7', BACKFILLED WITH CEMENT GROUT			SANDY LEAN CLAY; dark brown, dry, 10% fine gravel, 30% fine sand, FILL. 2.5'
3	SS	100	0		sm		SILTY SAND; medium brown, moist, loose, FILL. 3.25'
4			3.8		cl fill		SANDY LEAN CLAY; dark gray, moist, soft.
5	SS	75	0				No recovery 4' to 4.5'.
6			9.6				20% gravel to 1.5" diameter at 5'.
7			22.5				5.75'
8			969		sm fill		SILTY SAND; moist, compact, 60% fine sand, FILL. 6.0'
9	NS	NA	NA	Bentonite Chips			TOTAL DEPTH OF DIRECT PUSH BORING IS 6 FEET
10							This interval was not logged during well installation.
11							11.0'
12							TOTAL DEPTH OF BORING IS 11 FEET
13							
14							
15							
16							Direct push soil boring (for soil sampling and lithologic logging) and hollow stem auger boring (for well installation) were both drilled at this location. The soil boring was drilled first, followed by overdrilling with auger to install the well. The soil boring and well were not necessarily completed to the same depth.
17							Soil description from original field logs was revised or corrected to conform to ASTM D2488-00 Standard Practice for Description and Identification of Soils.

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Marl MST (Rhino) 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A14
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25VW6-07A

COORDINATES: N. 453071.56
E. 1461239.27

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 10-12-00
CHECKED BY W. Akiyama, R.G. DATE FINISHED 10-12-00
APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. 8.43

DEPTH IN FEET	SAMPLE NUMBER	RECOVERY (%)	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0							Concrete 8"
1	SS	85	0 0 0		sc fill		CLAYEY SAND with GRAVEL; 25% clay, 25% gravel to 0.5" diameter, moist, loose, brown, FILL.
2							No recovery 2' to 3.5'.
3	SS	25		DRILLED OUT TO 10', BACKFILLED WITH CEMENT GROUT			3.5'
4					gp fill		POORLY GRADED GRAVEL with SAND; gravel to 2" diameter from 3.5'-4', dry, loose, FILL.
5	SS	40	0 0 0 17.5				No recovery 4'-5.2'. 5.0'
6					cl fill		SANDY LEAN CLAY; 40% fine sand, moist, soft, FILL. 5.5'
					sm fill		SILTY SAND; wet, compact, dark grey with sheen appearance, slight chemical odor, FILL. Refusal at 6'-cracked drill rod casing at top. 6.0'
							TOTAL DEPTH OF DIRECT PUSH BORING IS 6 FEET
7							
8	NS	NA	NA				This interval was not logged during well installation.
9							
10				Bentonite Chips			11.0'
11							TOTAL DEPTH OF BORING IS 11 FEET
12							
13							
14							
15							
16							Direct push soil boring (for soil sampling and lithologic logging) and hollow stem auger boring (for well installation) were both drilled at this location. The soil boring was drilled first, followed by overdrilling with auger to install the well. The soil boring and well were not necessarily completed to the same depth.
17							Soil description from original field logs was revised or corrected to conform to ASTM D2488-00 Standard Practice for Description and Identification of Soils.

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Marl MST (Rhino) 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard, EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A15
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25VW6-19A

COORDINATES: N. 453082.82
E. 1461223.84

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 10-12-00
CHECKED BY W. Akiyama, R.G. DATE FINISHED 10-12-00
APPROVED BY D. Leigh, R.G., CEG SURFACE ELEV. 7.55

DEPTH IN FEET	SAMPLE TYPE	RECOVERY (%)	P.I.D. READING (PPM)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0							Concrete 8"
1	SS	80	0		sc fill		No recovery 0.8'-1.0'. CLAYEY SAND with GRAVEL; light yellow-brown, slightly compact, dry, 20% clay, 20% gravel to 0.25" diameter, FILL.
2			0	DRILLED OUT TO 10', BACKFILLED WITH CEMENT GROUT			
			0				
			1.3				
3	SS	50	0.5				3.0'
			2.6		cl fill		GRAVELLY LEAN CLAY with SAND; firm, dark gray-brown, dry, FILL.
4			3.8				No recovery 4-5'.
5	SS	50	17.8				SANDY LEAN CLAY; firm, moist, slight chemical odor, FILL.
			15.9				
			310				Plywood fragments 5.5' to 6'. 6.0'
6							TOTAL DEPTH OF DIRECT PUSH BORING IS 6 FEET
7							
8							
9	NS	NA	NA				*This interval was not logged during well installation.*
10							
11				Bentonite Chips			11.5'
12							TOTAL DEPTH OF BORING IS 11.5 FEET
13							
14							
15							
16							Direct push soil boring (for soil sampling and lithologic logging) and hollow stem auger boring (for well installation) were both drilled at this location. The soil boring was drilled first, followed by overdrilling with auger to install the well. The soil boring and well were not necessarily completed to the same depth.
17							Soil description from original field logs was revised or corrected to conform to ASTM D2488-00 Standard Practice for Description and Identification of Soils.

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Mari MST 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A16
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. IR25SG044

COORDINATES: DEEP WELL N. 453070.46 E. 1461228.52 SHALLOW WELL N. 453071.61 E. 1461229.36

SURF. ELEV. 8.06 SURF. ELEV. 8.01

FIELD GEOLOGIST W. Akiyama, R.G. DATE BEGAN 10/12/00

CHECKED BY W. Akiyama, R.G. DATE FINISHED 10/12/00

APPROVED BY D. Leigh, R.G., CEG SAMPLE DIA.

DEPTH IN FEET	SAMPLE NUMBER	RECOVERY (%)	P.I.D. READING (ppm)	MONITORING WELL ABANDONMENT	ASTM D2488-00	PROFILE	
0							CONCRETE 0.75'
1	SS	10		DRILLED OUT TO 5', BACKFILLED WITH CEMENT GROUT	sm fill		No recovery 0.8" to 1.8' (rock in sample shoe) SILTY SAND with GRAVEL; dark gray brown, moist, compact, rock in shoe blocking at 2', FILL. 3.0'
2			0				
3	SS	100	0				
4			0	DRILLED OUT TO 11', BACKFILLED WITH CEMENT GROUT	cl fill		SANDY LEAN CLAY; 35% very fine to fine sand, moist, soft-firm, very dark gray, FILL. 6.0'
5	SS	100	0				
6			0				
	SS	50	0		cl serp. fill		SANDY LEAN CLAY; light greenish-blue color, hard, dry, spongy feel when squeezed, SERPENTINITE FILL. 6.5'
7	NS	NA	NA				TOTAL DEPTH OF DIRECT PUSH BORING IS 6.5 FEET. This interval was not logged during well installation. 10.0'
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							

Direct push soil boring (for soil sampling and lithologic logging) and hollow stem auger boring (for well installation) were both drilled at this location of this monitoring well pair. The soil boring was drilled first, followed by overdrilling with auger to install the well. The soil boring and well were not necessarily completed to the same depth.

No direct push soil boring was drilled at the shallow well location. The shallow and deep well locations are less than 4 feet apart.

Soil description from original field logs were revised or corrected to conform to ASTM D2488-00 Standard Practice for Description and Identification of Soils.

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Marl MST (Rhino) 8" Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point Shipyard EMAC CTO-001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812-04501010

DRAWN BY	RB	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812-A13
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw

BORING NO. BADCAT WELL

COORDINATES: N. N/A
E. N/A

FIELD GEOLOGIST W. Akiyama, R.G. | DATE BEGAN 1/20/04
CHECKED BY W. Akiyama, R.G. | DATE FINISHED 1/20/04
APPROVED BY D. Leigh, R.G., CEG | SURFACE ELEV. N/A
TOTAL DEPTH 35.0 ft. | TOP OF CASING –

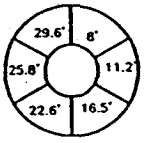
DEPTH IN FEET | SAMPLE DRIVE NUMBER | RECOVERY (PER 18" DRIVE) | P.I.D. READING (ppm) | GROUND SURFACE | ASTM D2488-93 | PROFILE | DESCRIPTION

0
5
10
15
20
25
30
35

No Geologic Log available.

DRILLED AT
0–30' CEMENT GROUT
TRIMMED TO DEPTH

NOTE: FIELD MEASUREMENTS OF CHAMBER TOTAL DEPTH



CENTER NOT MEASURED BECAUSE CENTER GENERALLY NOT USED FOR A WELL

DEPTHS FROM TCEMI IN E-MAIL: (2-18-04)

1. 7.5–8.5'
2. 10.5–11.5'
3. 16–17'
4. 22–23'
5. 25–26'
6. 29–30'
7. 34–35'

LOWER 5' ISOLATED, DUE TO UPPER 30' OF GROUT THERE FOR NO CONTAMINATION CONCERNS. DETAILS ARE UNAVAILABLE

ORIGINALLY INSTALLED AS A DEMONSTRATION WELL BY PRECISION SAMPLING ON 1/28/2000.

DRILLER : E. Santellan
DRILLING CO. : Gregg Drilling & Testing
DRILLING METHOD : Mari MST (Rhino) Hollow Stem Auger
SAMPLING METHOD :
PROJECT : Hunters Point EMAC CTO–001 Task 4
LOCATION : Hunters Point Shipyard, Bldg. 134
PROJECT NO. : 843812.04501010

Shaw™

DRAWN BY	T.R.S.	CHECKED BY	MR 5/24/04	DRAWING NO. : 843812–A21
DATE	3/30/04	APPROVED BY	WSA 5/24/04	

Shaw E & I, Inc.

Appendix B
Chains of Custody

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

2211

CHAIN OF CUSTODY

Ref. Document # 00103

Page 1 of 1

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 3/23/04
Waybill Number:
Lab Destination: APCL. 13760 Magnoliat Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3 SO_4, Br(300.0), Alkalinity(310	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
									3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	600 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
									HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
IR25MW42B-1010	GW	3/23/04	1400	PP	W				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
IR06MW44A-1005	GW	↓	1445	PP	W				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
IR25MW15F-1012	GW	↓	1545	PP	W				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
TB-1022	TB	3/23/04	1000	NA	W				✓											

Suman Sharma 3/23/04

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Put TOC, COD, Acetate & Propionate on hold

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 3-day ☐ 48-hr ☐ 5-day

Level Of QC Required: I - II (III) Project Specific:

Relinquished By: Suman Sharma Date: 3/23/04 Time: 1630

Received By: Date: 3/24/04 Time: 0850

Relinquished By: Date: Time:

Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

2224

Ref. Document # 00104

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: Bill Schaal (Name & phone #)

Shipment Date: 3/24/04
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Preservative (water)		HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
							Container Type		3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25MW37A-1007	GW	3/24/04	9:10	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
IR25MW37B-1008	GW		9:25	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
IR25MW37B-1023	GW		11:00	PP	GW				✓	MW 33	✓	✓	✓	✓						
IR25MW17A-1006	GW		1100	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
IR25MW38B-1009	GW		1130	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
IR25EW01A-1001	GW		1250	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
IR25MW55A-1004	GW		1420	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
IR25MW57A-1021	GW		1540	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
IR25MW904B-1018			1620	PP	GW				✓	✓	✓	✓	✓	✓	✓	✓				
TB2-1024	Trip Blank		0800	NA	W				✓											

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 3/24/04 Time: 1705
Received By: Date: 3/25/04 Time: 0840

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

2248

Ref. Document # 00105

Page 1 of 2

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date:
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice	
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE	
TB2-1026	Trip Blank	3/25/04	0800	PD	GW			✓												
IR25MW39B-1014	GW	3/24/04	1810	PP	GW			✓	✓	✓	✓	✓	✓	✓	✓					
IR25MW39A-1013	GW	3/25/04	0935	PP	GW			✓	✓	✓	✓	✓	✓	✓	✓					
IR25MW900B-1016			1015					✓	✓	✓	✓	✓	✓	✓	✓					
IR25MW900B-1025			1100					✓		✓	✓	✓	✓							
IR25MW902B-1019			1300					✓	✓	✓	✓	✓	✓	✓	✓					
IR25IW02A-1002			1200					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
IR25MW51A-1015			1320					✓	✓	✓	✓	✓	✓	✓	✓					
IR25MW54A-1002			1430					✓			✓	✓			✓	✓	✓			
IR25MW53A-1003								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) IR25MW54A-1002 only 1 liter provided for PCB+SVOCs

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II (III) Project Specific:

Relinquished By: Suman Sharma Date: 3/25/04 Time: 1820
Received By: Date: 3/26/04 Time: 0980
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

2248

Ref. Document # 00105

Page 2 of 2

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Shipment Date:

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B	NO_3, SO_4, Br(300.0), Alkalinit	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC	DHC (PCR)
								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice	
								3X 40 ml VOA	3X 40 ml VOA	1 Liter Amber	1-Liter Amber	1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE	
IR25MW11A-1011	GW	~~3/25/04~~ ~~1620~~	1620	PP	GW			✓	✓	✓	✓	✓	✓	✓	✓	✓				
IR25MW56A-1020	GW	✓	1730	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓				
				Sum																
				3/25/04																

CHAIN OF CUSTODY 2660

Ref. Document # 00107

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & Phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 04/22/04
Waybill Number:
Lab Destination: APCL, 13760 Magnolia, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s): BP

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Preservative (water)		HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
							Container Type		3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25 MW2A-1027	GW	4/21/04	1245	Grab	GW	1	500 mL HPDE								BR					
IR25 MW53A-1028			1315																	
IR25 MW54A-1029			1330																	
IR25 MW54A-1030			1300																	
IR25 MW15F-1031			1500																	
IR25 MW15F-1032			1600																	
IR25 MW90B-1033			1430																	
IR25 MW56A-1034			1300																	
IR25-INTWATER-1035	Injection water		1400																	
Temp Blank																				

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Analyze Samples for Bromide only.

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 3-day ☐ 48-hr ☐ 5-day

Level Of QC Required: I II III Project Specific

Relinquished By: Suman Sharma Date: 4/22/04 Time: 1530

Received By: Date: 4/23/04 Time: 1030

Relinquished By: Date: Time:

Received By: Date: Time:

Method Codes
C = Composite
G = Grab

Matrix Codes
DW = Drinking Water
GW = Ground Water
WW = Waste Water
SO = Soil
SL = Sludge
CP = Chip Samples

2086

CHAIN OF CUSTODY

2660

Ref. Document # 00107

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 04/22/04
Waybill Number:
Lab Destination: APCL, 13760 Magnolial.Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s): BP

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3 SO_4 Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Preservative (water)		HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
								Container Type	3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25IW2A-1027	GW	4/21/04	1245	Grab	GW	1	500 mL HPDE								BR					
IR25MW53A-1028			1315																	
IR25MW54A-1029			1330																	
IR25MW54A-1030			1300																	
IR25MW15F-1031			1500																	
IR25MW15F-1032			1600																	
IR25MW901B-1033			1430																	
IR25MW56A-1034			1300																	
IR25-INTWATER-1035	Injection water		1400																	
Temp Blank	—	—	—	—	—	—														

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Analyze Sample for Bromide only.

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Suman Sharma Date: 4/22/04 Time: 1530

Received By: Date: 4/23/04 Time: 1020

Relinquished By: Date: Time:

Received By: Date: Time:

Method Codes
C = Composite
G = Grab

Matrix Codes
DW = Drinking Water
GW = Ground Water
WW = Waste Water
SO = Soil
SL = Sludge
CP = Chip Samples

CHAIN OF CUSTODY

2867

Ref. Document # 0010

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: Bill Schaal (Name & phone #)

Shipment Date:
Waybill Number:
Lab Destination: APCL, 13760 Magnolial, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s):

Analyses Requested

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water) / Container Type	VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A)	NO_3, SO_4, ~~Cr(300.0)~~, Alkalinity(310.1) 0x 320.1	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Preservative (water)	HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
							Container Type	3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25MW53A-1039	GW	5/10/04	115	PP	GW			✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW54A-1038	↓		1325	↓	↓			✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW56A-1040	↓		1350	↓	↓			✓											
~~ER~~			~~1415~~																
IR25EW01A-1037	GW		1415	PP	GW			✓	✓	✓		✓		✓	✓		✓		
IR25IW02A-1036	GW		1520	PP	GW														
TB-1041	Trip Blank		0900	NA	TB			✓	✓	✓		✓		✓	✓		✓	✓	

Suman Sharma
5/10/04

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☐ 24-hr ☐ 48-hr ☐ Normal ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Suman Sharma Date: 5/10/04 Time: 1600
Received By: [signature] Date: 5/11/04 Time: 0940
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

T-358 P.002/002 F-938

May-12-2004 02:09pm From-SHAW ENVIRONMENTAL & INFRASTRUCTURE

CHAIN OF CUSTODY

Ref. Document # 0010

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt GTO 004
Purchase Order #:
Shipment Date:
Waybill Number:
Lab Destination: APCL, 13760 Magnolia, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, ~~(4500-Cl)~~, Alkalinity(310. 02 32.1	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							HCL		3X 40 ml VOA	3X 40 ml VOA	1 L-Liter Amber	1 L-Liter Amber	1 L-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE ZnAc	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25MW53A-1039	GW	5/10/04	1115	PP	GW				✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW54A-1038			1325						✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW56A-1040			1350						✓											
~~EB-1~~			~~1415~~																	
IR25EW01A-1037	GW		1415	PP	GW				✓	✓	✓		✓		✓	✓		✓		
IR25EW02A-1036	GW		1520	PP	GW				✓	✓	✓		✓		✓	✓		✓	✓	
TB-1041	Trip Blank		0900	~~PP~~ NA	TB				✓	~~✓~~	~~✓~~		~~✓~~	21	~~✓~~	~~✓~~		~~✓~~	~~✓~~	SS
								Suman Sharma 5/10/04												

Special Instructions: List of metals (As, Cd, Cr, Ni, Pb)

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By	Date	Time	Received By	Date	Time
Suman Sharma	5/10/04	1600		5/11/04	0940

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

3068

Ref. Document # 00108

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:
Shipment Date: 5/25/04
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
Preservative (water)								HCL	~~HCL~~	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25IW02A-1043	GROUND WATER	5/25/04	09:20	PP	GW			✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW53A-1044			11:03	PP				✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW53A-1045			11:15	PD				✓		✓		✓							
IR25MW54A-1046			12:10	PP				✓	✓	✓		✓		✓	✓		✓	✓	
IR25MW56A-1047	✓		13:35	PP	✓			✓						✓					
TB-1048	WATER	✓	08:00	N/A	TB			✓											

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)
IR25MW56A-1047 ANALYZE FOR VOC's & BROMIDE ONLY

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☒ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 5/25/04 Time: 14:45
Received By: Date: 5/26/04 Time: 0930

Relinquished By: Date: Time:
Received By Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00109

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 6/8/04
Waybill Number: 377024 11006
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3 SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
Preservative (water)								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
Container Type								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25IWO2A-1050	GROUNDWATER IWO2A	6/8/04	13:50	PP	W			✓	✓	✓				✓	✓		✓	✓	
IR25MW53A-1051	MW53A		09:30	PP				✓	✓	✓				✓	✓		✓	✓	
IR25MW54A-1052	MW54A		11:00	PP				✓	✓	✓				✓	✓		✓	✓	
IR25MW54A-1053	MW54A		11:15	PP				✓		✓									
IR25MW56A-1054	MW56A		12:30	PP				✓						✓					
TB-1055	WATER		08:00	N/A															

3242

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)
IR25MW56A-1054 ANALYZE FOR VOCs + BROMIDE ONLY

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 6/8/04 Time: 15:00
Received By: Date: 6/9/04 Time: 1080
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

the group

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD*

Reference Document No. 065675
Page 1 of 1

Project Name/No. 1 102569
Sample Team Members 2 B. Porter
Profit Center No. 3
Project Manager 4 Bill Schaal
Purchase Order No. 6
Required Report Date 11 10-days

Samples Shipment Date 7 06/25/04
Lab Destination 8 APCL
Lab Contact 9 Hsin-Yi Lee
Project Contact/Phone 12 (909) 590-1828
Carrier/Waybill No. 13

Bill to: 5 Suman Sharma
4005 Port Chicago Hwy
Concord, CA 94520

Report to: 10
Same as above

White: To accompany samples
Yellow: Field copy

ONE CONTAINER PER LINE

Sample Number 14	Sample Description/Type 15	Date/Time Collected 16	Container Type 17	Sample Volume 18	Pre-servative 19	Requested Testing Program 20	Condition on Receipt 21	Disposal Record No. 22
134-BT1	Batch Tank Pre-chem Injection	06/24/04 10:00	40-ml VOA	120-ml	HCl	VOC 8260B		
134-BT1 TB	Trip Blank	↓	↓	↓	↓	↓		

FOR LAB USE ONLY

FOR LAB USE ONLY

3483

Special Instructions: 23

Possible Hazard Identification: 24
Non-hazard ☒ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐

Sample Disposal: 25
Return to Client ☐ Disposal by Lab ☒ Archive _____ (mos.)

Turnaround Time Required: 26
Normal ☒ Rush ☐

QC Level: 27
I. ☐ II. ☐ III. ☐ Project Specific (specify):

1. Relinquished by 28 (Signature/Affiliation) [signature]	Date: ~~PO~~ 06/25/04 Time: 10:30	1. Received by 28 (Signature/Affiliation) [signature]	Date: 6/28/04 Time: 1020
2. Relinquished by (Signature/Affiliation)	Date: Time:	2. Received by (Signature/Affiliation)	Date: Time:
3. Relinquished by (Signature/Affiliation)	Date: Time:	3. Received by (Signature/Affiliation)	Date: Time:

Comments: 29

*See back of form for special instructions.

MCA 3/15/91

CHAIN OF CUSTODY

Ref. Document # 00110

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:
Shipment Date: 6/29/04
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_2SO_4,Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
									Analyses Requested											
									HCL	HCL / ICE	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
									3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25EW01A-1057	GROUNDWATER	6/29/04	15:20	PP	GW				X	X					X	X		X	X	
IR25IW02A-1058			09:10						X	X					X	X		X	X	
IR25MW53A-1059			10:40						X	X					X	X		X	X	
IR25MW54A-1060			12:30						X	X					X	X		X	X	
IR25MW56A-1061	↓		13:55		↓				X											
TB-1062	WATER	↓	0800	↓	W				X						3507					

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Bromide by 320.1.

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By:	Date:	Received By:	Date:
RUST	Time: 6/29/04 14:25		Time: 6/30/04 0900
Relinquished By:	Date:	Received By:	Date:
	Time:		Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00111

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: Bill Schaal (Name & phone #:)

Shipment Date: 7/12/04
Waybill Number: GOLDEN STATE
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
									HCL	~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice
									3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25RW01A-1063	GROUND WATER	7/12/04	15:30	PP	W	11			X	X					X	X		X	X	
IR25IW02A-1064			09:30			11			X	X					X	X		X	X	
IR25MW53A-1065			11:10			11			X	X					X	X		X	X	
IR25MW53A-1066			11:25			3			X											
IR25MW54A-1067			12:45			11			X	X					X	X		X	X	
IR25MW56A-1068	↓		14:15	↓		3			X											
TB-1069	WATER	↓	08:00	N/A	↓	3			X											

3657

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Bromide by 320.1.

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II III Project Specific

Relinquished By: [signature] Date: 7/12/04 Time: 16:15
Received By: [signature] Date: 7/13/04 Time: 0950

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00112

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 7/26/04
Waybill Number: 877020010 25
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s): Robert Rust

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water) / Container Type	VOCs (8260B) 3X 40 ml VOA	Methane, ethane,ethene RSK 175 3X 40 ml VOA	TPH-Extractables (8015B) 1 1-Liter Amber	SVOC (EPA 8270C) 1 1-Liter Amber	PCBs (EPA 8082) 1 1-Liter Amber	Dissolved Metals (5) (6010B/7470A) 500 ml HDPE	NO_3,SO_4, Br(300.0), Alkalinity(310. 500 ml HDPE	Sulfide (EPA 376.2) 125 ml HDPE	COD (EPA 410.4) 500 ml HDPE	TOC (EPA 415.1/9060) 2X 250 mL Amber	Acetate & Propionate (HPLC-UV) 500 ml HDPE	DHC (PCR) 500 ml HDPE
							Preservative (water)	HCL	~~HCL~~ ICE	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice
IR25EW01A-1070	GROUND WATER	7/26/04	15:45	PP	GW			X	X					X	X		X	X	
IR25IW02A-1071			09:45		GW			X	X					X	X		X	X	
IR25MW53A-1072			11:30		GW			X	X					X	X		X	X	
IR25MW54A-~~0173~~ 1073 (a)			13:20		GW			X	X					X	X		X	X	
IR25MW56A-1074			14:35		GW			X						X				X	
TB-1075	WATER		08:00	N/A	W			X											

3839

Special Instructions: IR25MW56A VOC, Bm ACETATE+PROPIONATE) BROMIDE BY 320.1
List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II III Project Specific.

Relinquished By: Date 7/26/04 Time 16:30
Received By: Date 7/27/04 Time 0950

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00113

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 8/9/04
Waybill Number: 377025610 24
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice	
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE	
IR25EW01A-1076	GROUNDWATER	8/9/04	15:55	PP	W			X	X					X	X		X	X		
IR25EW02A-1077			10:15					X	X					X	X		X	X		
IR25MW53A-1078			11:25					X	X					X	X		X	X		
IR25MW53A-1079			11:40					X												
IR25MW54A-1080			13:30					X	X					X	X		X	X		
IR25MW56A-1081			14:25					X												
TB-1082	WATER		08:00		W			X												

4005

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 3-day ☒ 5-day ☐ 48-hr

Level Of QC Required: I II III Project Specific

Relinquished By: Date: 8/9/04 Time: 16:40
Received By: Date: 8/10/04 Time: 0815

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00114

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:
Shipment Date:
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.) 320.1	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Preservative (water)		HCL	icc	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	HCl	Ice	Ice
							Container Type		3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25IW02A-1084	Ground Water	8/23/04	10:15	PP	GW				✓	✓					✓	✓		✓		
IR25mw53A-1085			11:40	PP	GW				✓	✓					✓	✓		✓		
IR25MW54A-1086			13:20	PP	GW				✓	✓					✓	✓		✓		
IR25MW56A-1087			1445	PP	GW				✓	✓					✓	✓		✓	SS	8/23
IR25EW01A-1083			1525	PP	GW				✓	✓					✓	✓		✓		
TB-1088	Trip Blank		1020	NA	TB				✓											

Suman Sharma 8/23/04

4177

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) By by 320.1

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Suman Sharma Date: 8/23/04 Time: 1545
Received By: Date: 8/24/04 Time: 0915
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00115

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 9/8/04
Waybill Number: 377023810211
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice		
							3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE		
IR25IW02A-1090	GROUNDWATER	9/8/04	09:20	PP	W	11			X	X					X	X		X	X	
IR25MW53A-1091			10:40	PP		11			X	X					X	X		X	X	
IR25MW54A-1092			12:30			11			X	X					X	X		X	Y	
IR25MW56A-1093			13:35			3			X											
IR25MW56A-1094			13:40			3			X											
IR25EW01A-1089			15:00			11			X	X					X	X		X	X	
TB-1095	WATER		08:00	N/A		3			X											

4408

NJT VSRD

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific

Relinquished By	Date	Time	Received By	Date	Time
	9/8/04	15:40		9/9/04	1030
Relinquished By	Date	Time	Received By	Date	Time

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00116

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date:
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.1	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Container Type		3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
									HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
TB-1101	Trip Blanks	9/21/04	800	NA	water				✓											
ER25MW54A-1099	Groundwater		1020	PP	GW				✓	✓					✓	✓		✓	✓	
ER25EW02A-1097			1125						✓	✓					✓	✓		✓	✓	
ER25MW53A-1098			1220						✓	✓					✓	✓		✓	✓	
ER25MW56A-1100			1315						✓											
ER25EW01A-1096			1355						✓	✓					✓	✓		✓	✓	

Suman Sharma 9/21/04

4608

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Bromide by 320.1

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III

Project Specific:

Relinquished By	Date	Time	Received By	Date	Time
Suman Sharma	9/21/04	1450		9/22/04	1015

Method Codes
C = Composite
G = Grab

Matrix Codes
DW = Drinking Water
GW = Ground Water
WW = Waste Water
SO = Soil
SL = Sludge
CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00117

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: Bill Schaal (Name & phone #)

Shipment Date: 10/5/04
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DIIC (PCR)
Preservative (water)								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
TB-1108	Trip Blank	10/5/04	900	NAGW				✓											
IR25EW02A-1103	GW		1000	PPGW				✓	✓					✓	✓		✓	✓	
IR25MW58A-1104	GW		1045					✓	✓					✓	✓		✓	✓	
IR25MW54A-1105	GW		1140					✓	✓					✓	✓		✓	✓	
IR25MW56A-1106	GW		1225					✓											
IR25MW56A-1107	GW		1325					✓											
IR25EW01A-1102	GW	✓	1310	✓	✓			✓	✓					✓	✓		✓	✓	

Suman Sharma 10/5/04

4797

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Bromide by 320.1

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific

Relinquished By: Suman Sharma Date: 10/5/04 Time: 1400
Received By: Date: 10/6/04 Time: 1000
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00118

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 10/19/04
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee Eric. W

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
									HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice
									3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
TB-1114	Trip Blank	10/19/04	1100	NA	TB				✓											
IR25EW01A-1109	GW		1145	G	GW				✓	✓					✓	✓		✓	✓	
IR25EW02A-1110	GW		1225	G					✓	✓					✓	✓		✓	✓	
IR25MW58A-1111	GW		1320	G					✓	✓					✓	✓		✓	✓	
IR25MW54A-1112	GW		1425	G					✓	✓					✓	✓		✓	✓	
IR25MW56A-1113	GW		1515	G	✓				✓											

5000

Suman Sharma 10/19/04

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Bromide by 320.1

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☑ 5-day

Level Of QC Required: I II (III) Project Specific

Relinquished By: Suman Sharma Date: 10/19/04 Time: 1600

Received By: Alex Date: 10/20/04 Time: 10:30

Relinquished By: Date: Time:

Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00119

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:
Shipment Date: 11/3/04
Waybill Number:
Lab Destination: APCL, 13760 Magnolia, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice	
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE	
IR25IW02A-1116	GROUNDWATER	11/3/04	0950	PP	W			X	X					X	X		X	X		
IR25MW53A-1118			12:25					X	X					X	X		X	X		
IR25MW54A-1119			13:50					X	X					X	X		X	X		
IR25MW56A-1120			15:05					X												
IR25IW02A-1117			10:00					X												
IR25EW01A-1115	↓		16:05	↓									5286							
TB-1121	WATER	↓	08:00	NA	↓			X												
	not used																			

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific

Relinquished By: [signature] RUST Date: 11/3/04 Time: 16:30

Received By: [signature] Date: 11/4/04 Time: 1000

Relinquished By: Date: Time:

Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00120

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 11/16/04
Waybill Number:
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
								HCL	HCL	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	H_2SO_4	Ice	Ice	
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE	
TB-1127	WATER	11/16/04	09:00	N/A	W	3		X												
IR25IW02A-1123	GROUNDWATER		10:40	PP	W			X	X						X	X		X	X	
IR25MW53A-1124			11:55	PP	W			X	X						X	X		X	X	
IR25MW54A-1125			13:10	PP	W			X	X						X	X		X	X	
IR25EW01A-1122			15:15	PP	W			X	X						X	X		X	X	
IR25MW56A-1126			14:20	PP	W			X												
	(NOT USED)																			

5450

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 11/16/04 Time: 16:00
Received By: Date: 11/17/04 Time: 0815

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00121

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: Bill Schaal/MICHAEL REED (Name & phone #)

Shipment Date: 12/06/04
Waybill Number: 4905261936 & 4905281938
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): ROBERT RUST, KIRK JOHNSTON

Analyses Requested

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water) / Container Type	VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A)	NO_3,SO_4, Br(300.0), Alkalinity(310.2)	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							Container Type	HCL	~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice
								3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25MW57A-1151	GROUNDWATER	12/6/04	1005	G	GW	12	VARIOUS	X	X	X	X	X	X	X	X				
IR25MW904B-1148			1125			12		X	X	X	X	X	X	X	X				
IR25MW55A-1134			1330			12		X	X	X	X	X	X	X	X				
IR25MW37A-1137			1525			12		X	X	X	X	X	X	X	X				
IR25MW37B-1138			1650			12		X	X	X	X	X	X	X	X				
TB1-1155	TRIP BLANK		0700		DW	3		X											
TEMP BLANK					DW	2	1 PER COOLER												

5664

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Br by 320.1

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific: AS PER SCOPE OF WORK

Relinquished By: [signature] Date: 12/6/04 Time: 17:15 Received By: [signature] Date: 12/7/04 Time: 1000

Relinquished By: Date: Time: Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 0012Z

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: ~~Bill Schaal~~ MICHAEL REED (Name & phone #)

Shipment Date: 12/07/04
Waybill Number: ~~490532992, 490533943~~ 490534944
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): ROBERT RUST, KIRK JOHNSON

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							HCL		~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice	
							3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE		
TB2-1156	TRIP BLANK	12/7/04	0745		DW	3			X											
TEMP BLANKS	COOLER TEMP BLANK	12/7/04	0745		~~DW~~	3	1 PER COOLER		(KR) X	(KR) X										
IR25MW39B-1144	GROUNDWATER		0885	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW39A-1143			1000	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW38B-1139			1120	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW17A-1136			1250	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW42B-1140			1400	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW44A-1135			1540	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW44A-1153			1540	G	GW	7			X		X	X	X	X						

5683

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Br by 320.1

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II (III) Project Specific: AS PER SCOPE OF WORK

Relinquished By	Date	Time	Received By	Date	Time
	12/7/04	17:00		12/8/04	0905
Relinquished By	Date	Time	Received By	Date	Time

Method Codes
C = Composite
G = Grab

Matrix Codes
DW = Drinking Water
GW = Ground Water
WW = Waste Water
SO = Soil
SL = Sludge
CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00123

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: ~~Bill Schaal~~ MICHAEL REED (Name & phone #)

Shipment Date: 12/8/04
Waybill Number: ~~490536194~~5,490537194~~6~~
Lab Destination: APCL, 13760 Magnoliat, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee 4905381947

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): ROBERT RUST KIRK JOHNSTON

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0). Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	Do Not Run
									HCL	~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice 2X
									3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
TEMP BLANKS	COOLER TEMP BLANK	12/8/04			DW	3	1 PER COOLER													N/A
TB3-1157	TRIP BLANK		0750		DW	3			X											
IR25MW11A-1141	GROUNDWATER		0910	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW900B-1146			1015	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW902B-1149			1125	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW902B-1152			1145	G	GW	7			X		X	X	X	X						
IR25MW15F-1142			1540	G	GW	12			X	X	X	X	X	X	X	X				
IR25IW02A-1130			1255	G	GW	~~12~~ 16			X	X	X	X	X	X	X	X	X	X	X	
IR25MW53A-1133			1415	G	GW	~~12~~ 16			X	X	X	X	X	X	X	X	X	X	X	

5738

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Br by 320.1

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By	Date	Time	Received By	Date	Time
	12/8/04	16:15		12/9/04	0835
Relinquished By	Date	Time	Received By	Date	Time

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 00124

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Project Manager: ~~Bill Schaal~~ MICHAEL FEED (Name & phone #)

Shipment Date: 12/09/04
Waybill Number: 490538194849053919 49
Lab Destination: APCL, 13760 Magnoliat,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): ROBERT RUST = RR ~~KIRK A. JOHNSTON = KAJ~~

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A	NO_3, SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							HCL	~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice
							3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
TEMP BLANK	COOLER TEMP BLANK	12/09/04			DW	2	1 PER COOLER													
TB4-1158	TRIP BLANK		0805		DW	3			X											
IR25MW51A-1145	GROUND WATER		0905	G	GW	12			X	X	X	X	X	X	X	X	X	X	X	
IR25MW51A-1154			0925	G	GW	7			X		X	X	X	X						
IR25EW01A-1131			1030	G	GW	16			X	X	X	X	X	X	X	X	X	X	X	
IR25MW56A-1150			1155	G	GW	12			X	X	X	X	X	X	X	X				
IR25MW54A-1132			1340	G	GW	16			X	X	X	X	X	X	X	X	X	X	X	

5762

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg) Br by 320.1

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II (III) Project Specific: PER SCOPE OF WORK

Relinquished By: Date: 12/9/04 Time: 15:00
Received By: Date: 12/10/04 Time: 1000
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # _____

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number:	102569
Project Name / Location:	Hunters Point CTO 004
Shipment Date:	12/10/04

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	TPH- Diesel(EPA 8015B)	Metals(As,Cr,Cd,Mn,Hg 6010B/7000)	PCB (EPA 8082)
							Preservative (water)	NA	NA	NA	NA	NA
							Preservative (soil)	Ice	Ice	Ice	Ice	Ice
							Container Type	3 Encore	8-oz Glass Jar		8-oz Glass Jar	8-oz Glass Jar
IR25MW54A-BH-1261	Soil	12/10/04	1045				3 Encore 3 Tubes	X	X	X	X	X
IR25MW53A-BH-1262	Soil	12/10/04	9:40				3 Encores 3 Tubes	X	X	X	X	X
IR25IW02A-BH-1263	Soil	12/10/04	9:10				3 Encores + 3 Tubes	X	X	X	X	X
IR25MW55A-BH-1264	Soil	12/10/04	1140				3 Encores 3 Tubes	X	X	X	X	X
IR25MW54BH-1265	Soil	12/10/04	1100				3 Encore 3 Tubes	X	X	X	X	X
			NOT	used	WSA							

5772

Special Instructions:

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II (III) Project Specific: _____

Relinquished By: Wayne Ang Date: 12-10-04 Time: 1230

Received By: _____ Date: 12/11/04 Time: 1000

Relinquished By: _____ Date: _____ Time: _____

Received By: _____ Date: _____ Time: _____

Method Codes
C = Composite
G = Grab

Matrix Codes
DW = Drinking Water
GW = Ground Water
WW = Waste Water
SO = Soil
SL = Sludge
CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 125

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 1/11/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Preservative (soil)	VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and eth
								HCL	Ice	Ice	Ice	Ice	Ice
								Ice	Ice	Ice	Ice	Ice	Ice
								3 VOA	1 1- Liter	1 1- Liter	3 VOA		
TB-1166	WATER	1/11/05	0800	N/A	W	3		X					
IR25WOZA-1162	GROUNDWATER		09:35	PP	W	8		X	X	X	X		
IR25MW53A-1163			11:20		W	8		X	X	X	X		
IR25MW54A-1164			12:45		W	8		X	X	X	X		
IR25MW56A-1165			13:40		W	3		X					
IR25EW01A-1161			14:35		W	8		X	X	X	X		

1122

NOT USED

Special Instructions:

Turnaround Time: ☐ 24-hr ☐ 48-hr ☑ Normal ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 1/11/05 Time: 16:00
Received By: Date: 1/12/05 Time: 1210

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 126

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 1/18/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): Rust

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Preservative (soil)	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and ett
								HCL	Ice	Ice	Ice	Ice	Ice
								Ice	Ice	Ice	Ice	Ice	Ice
								3 VOA	1 1- Liter	1 1- Liter	3 VOA		
IR25EW01A-1167		1/18/05	15:40	PP	W			X	X		X		
IR25IW02A-1168			09:40	PP	W			X	X		X		
IR25MW53A-1169			11:20	PP	W			X	X		X		
IR25MW53A-1170			11:30	PP	W			X	X				
IR25MW54A-1171			12:55	PP	W			X	X		X		
IR25MW56A-1172			14:30	PP	W			X					
TB-1173			08:00	N/A	W			X					

1222

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Rust Date: 1/18/05 Time: 16:30
Received By: Date: 1/19/05 Time: 0845

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 127

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 1/25/05
Waybill Number: 490540 1950
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): Robert Rust

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and eth
							Preservative (water)	HCL	Ice	Ice	Ice
							Preservative (soil)	Ice	Ice	Ice	Ice
								3 VOA	1 1- Liter	1 1- Liter	3 VOA
IR25EW01A-1174	GROUND WATER	1/25/05	14:45	PP	W	7		X	X		X
IR25IW02A-1175			09:35			7		X	X		X
IR25MW53A-1176			11:20			7		X	X		X
IR25MW54A-1177			13:25			7		X	X		X
IR25MW56A-1178			16:05			3		X			
TB-1179	WATER		08:00	N/A		3		X			
	NOT USED										

1308

Special Instructions:

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 1/25/05 Time: 17:00
Received By: Date: 1/26/05 Time: 0830

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 128

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 02/01/05
Waybill Number: 490500 1966
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and eth
							Preservative (water)	HCL	Ice	Ice	Ice
							Preservative (soil)	Ice	Ice	Ice	Ice
							Container Type	3 VOA	1 1- Liter	1 1- Liter	3 VOA
IR25EW01A-1180	GROUND WATER	2/1/05	14:50	PP	W	7		X	X		X
IR25IW02A-1181			09:40	PP	W	7		X	X		X
IR25MW53A-1182			11:00	PP	W	7		X	X		X
IR25MW54A-1183			12:20	PP	W	7		X	X		X
IR25MW56A-1184			13:30	PP	W	3		X			
IR25MW56A-1185			13:35	PP	W	3		X			
TB-1186	WATER	2/1/05	0800	NA	W	3		X			

1398

NOT USED

Special Instructions:

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By	Date	Time	Received By	Date	Time
	2/1/05	16:15		2/2/05	0830
Relinquished By	Date	Time	Received By	Date	Time

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 129

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #: 49054

Shipment Date: 2/15/05 ~~2/15/05~~
Waybill Number: ~~2/15/05~~
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828
WAYBILL 490542 1951

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and eth
							Preservative (water)	HCL	Ice	Ice	Ice
							Preservative (soil)	Ice	Ice	Ice	Ice
								3 VOA	1 1- Liter	1 1- Liter	3 VOA
IR25EW01A-1187	GROUND WATER	2/15/05	15:15	PD	W	7		X	X		X
IR25IW02A-1188		2/15/05	09:50	PP	W	7		X	X		X
IR25MW53A-1189		2/15/05	11:15	PP	W	7		X	X		X
IR25MW54A-1190		2/15/05	12:35	PP	W	7		X	X		X
IR25MW56A-1191		2/15/05	13:55	PP	W	3		X			
TB-1192	WATER	2/15/05	0800	N/A	W	3		X			

1592

NOT USED

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 2/15/05 Time: 1600
Received By: Date: 2/16/05 Time: 0825

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 130

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 3/2/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Preservative (soil)	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and et
								HCL	Ice	Ice	Ice	Ice	Ice
								Ice	Ice	Ice	Ice	Ice	Ice
								3 VOA	1 1- Liter	1 1- Liter	3 VOA		
IR25EW01A-1193	GROUND WATER	3/2/05	09:25	PP	W	7		X	X		X		
IR25IW02A-1194			10:45	PP	W	7		X	X		X		
IR25MW53A-1195			12:05	PP	W	7		X	X		X		
IR25MW53A-1196			12:15	PP	W	4		X	X				
IR25MW54A-1197			13:35	PP	W	7		X	X		X		
IR25MW56A-1198			14:55	PP	W	3		X					
TB-1199	WATER		08:00	N/A	W	3		X					

1782

NOT USED

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By:	Date: 3/2/05	Time:	Received By:	Date: 3/3/05	Time: 1130
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

Method Codes

C = Composite G = Grab

Matrix Codes

DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

COC# 0131

~~Ref Document #~~ ~~00~~

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Bill Schaal (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:

Shipment Date: 3/15/05
Waybill Number:
Lab Destination: APCL, 13760 Magnolial,Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Container Type	VOCs (8260B)	Methane, ethane,ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals [5] (6010B/7470A	NO_3,SO_4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acetate & Propionate (HPLC-UV)	DHC (PCR)
							HCL	~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCL	Ice	Ice
							3X 40 ml VOA	3X 40 ml VOA	1-Liter Amber	1-Liter Amber	1-Liter Amber	500 ml HDPE	500 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL Amber	500 ml HDPE	500 ml HDPE
IR25EW01A-1200	GROUNDWATER	3/15/04	10:10	PP	W	7			X	X		X								
IR25IW02A-1201			11:30	PP	W	7			X	X		X								
IR25MW53A-1202			12:50	PP	W	7			X	X		X								
IR25MW54A-1203			14:10	PP	W	7														
IR25MW56A-1204			15:30	PP	W	3			X											
TB-1205			08:00	N/A	W	3			X											

1894

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific.

Relinquished By: Date: 3/15/05 Time: 16:00
Received By: Date: 3/16/05 Time: 0840
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

T-037 P.001/001 F-008
Mar-24-2005 03:31pm From-SHAW ENVIRONMENTAL & INFRASTRUCTURE

CHAIN OF CUSTODY

COC# 0131-00

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102559
Project Name / Location: Hunters Pt CTO 004
Purchase Order #:
Shipment Date: 3/15/05
Waybill Number:
Lab Destination: APCL, 13760 Magnolia, Chino, CA, 91710
Lab Contact Name / ph. #: 909-590-1828 Hsin Yi Lee

Project Manager: ~~Bill Schaal~~ Mike Rezeal

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Analyses Requested: VOCs (8260B)	Methane, ethane, ethene RSK 175	TPH-Extractables (8015B)	SVOC (EPA 8270C)	PCBs (EPA 8082)	Dissolved Metals (5) (6010B/7470A)	NO3,SO4, Br(300.0), Alkalinity(310.	Sulfide (EPA 376.2)	COD (EPA 410.4)	TOC (EPA 415.1/9060)	Acrolein & Propionaldehyde (HPLC UV)
									HCL	~~HCL~~ ice	Ice	Ice	Ice	HNO_3	Ice	NaOH ZnAc	H_2SO_4	~~H_2SO_4~~ HCl	Ice
									3X 40 ml VOA	3X 40 ml VOA	1 1-Liter Amber	1 1-Liter Amber	1 1-Liter Amber	500 ml HDPE	60 ml HDPE	125 ml HDPE	500 ml HDPE	2X 250 mL amber	500 ml HDPE
R25EW01A-1200	GROUNDWATER	3/15/05	10:10	PP	W	7			X	X		X							
R25EW02A-1201			11:20	PP	W	7			X	X		X							
R25MW53A-1202			12:50	PP	W	7			X	X		X							
R25MW54A-1203			14:10	PP	W	7			X	X		X							
R25MW56A-1204			15:20	PP	W	3			X										
TB-1205			08:00	N/A	W	3			X										

Special Instructions: List of metals (As, Cd, Cr, Mn, Hg)

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific.

Relinquished By: Date: 3/15/05 Time: 16:00
Received By: Date: Time:
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 132

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 3/29/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Preservative (soil)	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and et
							HCL	Ice	Ice	Ice			
							Ice	Ice	Ice	Ice			
							3 VOA	1 1- Liter	1 1- Liter	3 VOA			
IR25EW01A-1206	GROUND WATER	3/29/05	15:15	PP	GW	7				X	X		X
IR25IW02A-1207		3/29/05	09:50	PP	GW	7				X	X		X
IR25MW53A-1208		3/29/05	11:10	PP	GW	7				X	X		X
IR25MW53A-1209		3/29/05	11:20	PP	GW	4				X	X		
IR25MW54A-1210		3/29/05	12:40	PP	GW	7				X	X		X
IR25MW56A-1211		3/29/05	13:55	PP	GW	3				X			
TB-1212	WATER	3/29/05	08:00	N/A	W	3				X			

2096

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 3/29/05 Time: 15:45
Received By: Date: 3/30/05 Time: 1030

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 133

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Shipment Date: 4/12/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Preservative (soil)	Container Type	VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and et						
								HCL	Ice	Ice	Ice									
								Ice	Ice	Ice	Ice									
								3 VOA	1 1- Liter	1 1- Liter	3 VOA									
IR25EW01A-1213	GROUNDWATER	4/12/05	15:35	PP	GW	7					X	X		X						
IR25IW02A-1214			10:15	PP	GW	7					X	X		X						
IR25MW53A-1215			11:35	PP	GW	7					X	X		X						
IR25MW54A-1216			12:55	PP	GW	7					X	X		X						
IR25MW56A-1217			14:15	PP	GW	3					X									
TB-1218	WATER		08:00	N/A	W	3					X									
													2280							

Special Instructions:

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 4/12/05 Time: 16:00
Received By: Date: 4/13/05 Time: 0900
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Samples

CHAIN OF CUSTODY

Ref. Document # 134

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:
Shipment Date: 4/26/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Sampler's Name(s): RUST

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and et
						Preservative (water)	HCL	Ice	Ice	Ice
						Preservative (soil)	Ice	Ice	Ice	Ice
						Container Type	3 VOA	1 1-Liter	1 1-Liter	3 VOA
IR25EW01A-1219	GROUNDWATER	4/26/05	10:15	PP	GW	7	X	X		X
IR25IW02A-1220			11:35	PP	GW	7	X	X		X
IR25MW53A-1221			12:55	PP	GW	7	X	X		X
IR25MW54A-1222			14:15	PP	GW	7	X	X		X
IR25MW54A-1223			14:25	PP	GW	4	X	X		
IR25MW56A-1224			15:45	PP	GW	3	X			
TB-1225	WATER	4/26/05	08:00	N/A	W	3	X			

2480

Special Instructions:

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 4/26/05 Time: 16:00
Received By: Date: 4/27/05 Time: 0920

Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 135

Page 1 of 1

Shaw

Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Shipment Date: 5/10/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB EPA 8082	RSK 175 9Methane, ethane and et
							Preservative (water)	HCL	Ice	Ice	Ice
							Preservative (soil)	Ice	Ice	Ice	Ice
								3 VOA	1 1-Liter	1 1-Liter	3 VOA
IR25EW01A-1226	GROUNDWATER	5/10/05	10:05	PP	GW	7		X	X		X
IR25IW02A-1227	↓	↓	11:30	↓	↓	7		X	X		X
IR25MW53A-1228			12:55			7		X	X		X
IR25MW54A-1229			14:20			7		X	X		X
IR25MW56A-1230	↓		15:45	↓	↓	3		X			
TB-1231	WATER	↓	08:00	N/A	W	3		X			

2677

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 5/10/05 Time: 16:00 Received By: Date: 5/11/05 Time: 1030

Relinquished By: Date: Time: Received By: Date: Time:

Method Codes

C = Composite G = Grab

Matrix Codes

DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 136

Page 1 of

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date:
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA. 94520

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB (EPA 8082)	RSK 175 9Methane, ethane and ethene)	TPH(EPA 8015B)	Dissolved metals (EPA 6010B)	Nitrate/sulfate/bromide/alkalinity (300.0/310.1/320.1)	Sulfide (EPA 376.2)	COD (EPA 410.1)	TOC (EPA 415.1)	Acetate & Propionate (HPLC)	Dihalococcodes
Preservative (water)								HCL	Ice	Ice	Ice	Ice	HNO3	Ice	NaOH/ZnAC	H2S04	HCL	Ice	Ice
Preservative (soil)								Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
								3 VOA	1 1- Liter	1 1- Liter	3 VOA	1 1- Liter	1 0.5L HPDE	1 0.5L HPDE	1 0.125mL HPDE	1 0.5L HPDE	2 0.250mL Amber	1 0.5L HPDE	2 0.5L HPDE
TB1-1257	WATER	5/11/05	0800	N/A	W	3		X											
IR25MW42B-1242	GROUNDWATER		10:30	PP	GW	12		X	X	X	X	X	X	X	X				
IR25MW42B-1255			10:45			7		X	X	X	≠	X	X	≠	≠				
IR06MW44A-1237			12:25			12		X	X	X	X	X	X	X	X				
IR25MW51A-1247			13:55			12		X	X	X	X	X	X	X	X				
IR25MW39A-1245			15:20			12		X	X	X	X	X	X	X	X				

2688

Special Instructions:

Turnaround Time: ☐ 24-hr ☐ 48-hr ☑ Normal ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 5/11/05 Time: 16:30
Received By: Date: 5/12/05 Time: 0900
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 137

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.

4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:

Project Manager: Mike Reed (Name & phone #)

Shipment Date: 5/12/05
Waybill Number:
Lab Destination: APCL. 13760 Moagnolia Ave, Chino CA
Lab Contact Name / ph. #: 909-590-1828

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s):

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	Preservative (water)	Preservative (soil)	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB (EPA 8082)	RSK 175 9Methane, ethane and ethene)	TPH(EPA 8015B)	Dissolved metals (EPA 6010B)	Nitrate/sulfate/bromide/alkalinity (300.0/310.1/320.1)	Sulfide (EPA 376.2)	COD (EPA 410.1)	TOC (EPA 415.1)	Acetate & Propionate (HPLC)	Dihalococcodes
								HCL	Ice	Ice	Ice	Ice	Ice	Ice	HNO3	Ice	NaOH/ZnAC	H2S04	HCL	Ice	Ice
								Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
								3 VOA	1 L Liter	1 L Liter	3 VOA	1 L Liter	1 L Liter	0.5L HPDE	0.5L HPDE	0.125mL HPDE		0.5L HPDE	0.250mL Amber	0.5L HPDE	
TB-1258	WATER	5/12/05	08:00	N/A	W	3		X													
IR25MW39B-1246	GROUND-WATER		09:05	PP	GW	12		X	X	X	X	X	X	X	X	X					
IR25MW37B-1240	GROUNDWATER		11:10			12		X	X	X	X	X	X	X	X	X					
IR25MW37B-1256			11:20			7		X	X	X		X	X								
IR25MW37A-1239			12:45			12		X	X	X	X	X	X	X	X	X					
IR25MW17A-1238			14:10			12		X	X	X	X	X	X	X	X	X					
IR25MW11A-1243			15:20					X	X	X	X	X	X	X	X	X					

8714

Special Instructions:

Turnaround Time: ☒ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By: Date: 5/12/05 Time: 16:30
Received By: Date: 5/13/05 Time: 1000
Relinquished By: Date: Time:
Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 138

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:
Shipment Date: 5/16/05
Waybill Number:
Lab Destination: APCL. 13760 Moagnolia Ave. Chino. CA
Lab Contact Name / ph. #: 909-590-1828

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST / LRINZRU

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Preservative (soil)	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB (EPA 8082)	RSK 175 9Methane, ethane and ethene)	TPH(EPA 8015B)	Dissolved metals (EPA 6010B)	Nitrate/sulfate/bromide/alkalinity (300.0/310.1/320.1)	Sulfide (EPA 376.2)	COD (EPA 410.1)	TOC (EPA 415.1)	Acetate & Propionate (HPLC)	Dihalococcodes
							Preservative (water)			HCL	Ice	Ice	Ice	Ice	HNO3	Ice	NaOH/ZnAC	H2S04	HCL	Ice	Ice
							Preservative (soil)			Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice	Ice
									Container Type	3 VOA	1 1-Liter	1 1-Liter	3 VOA	1 1-Liter	0.5L HPDE	0.5L HPDE	0.125mL HPDE	0.5L HPDE	2 0.250mL Amber	0.5L HPDE	0.5L HPDE
TB3-1259	WATER	5/16/05	09:00	N/A	W	3				X											
IR25MW900B-1248	GROUND WATER		11:30	PP	GW	12				X	X	X	X	X	X	X	X				
IR25MW900B-1254			11:40			7				X	X	X		X	X						
IR25MW902B-1251			13:00			12				X	X	X	X	X	X	X	X				
IR25MW15F-1244			14:15			12				X	X	X	X	X	X	X	X				

2742

NOV USED

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific

Relinquished By:	Date: 5/16/05 Time: 16:00	Received By	Date: 5/17/05 Time: 0932
Relinquished By:	Date: Time:	Received By:	Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 139

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:
Shipment Date: 5/17/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST / LANZAS

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Preservative (soil)	Container Type	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	PCB (EPA 8082)	RSK 175 9Methane, ethane and ethene)	TPH(EPA 8015B)	Dissolved metals (EPA 6010B)	Nitrate/sulfate/bromide/alkalinity (300.0/310.1/320.1)	Sulfide (EPA 376.2)	COD (EPA 410.1)	TOC (EPA 415.1)	Acetate & Propionate (HPLC)	Dihalococcodes
TB4-1260	WATER	5/17/05	0800	N/A	W	3	HCL	Ice	3 VOA	X											
IR25EW01A-1233	GROUNDWATER		08:10		GW	16	Ice	Ice	1-L Liter	X	X	X	X	X	X	X	X	X	X	X	
IR25MW02A-1232			09:30			16	Ice	Ice	1-L Liter	X	X	X	X	X	X	X	X	X	X	X	
IR25MW53A-1235			11:00			16	Ice	Ice	1-L Liter	X	X	X	X	X	X	X	X	X	X	X	
IR25MW54A-1234			12:25			16	Ice	Ice	1-L Liter	X	X	X	X	X	X	X	X	X	X	X	
IR25MW56A-1252			13:30			12	Ice	Ice	0.5L HPDE	X	X	X	X	X	X	X	X				
							Ice	Ice	0.5L HPDE												
							Ice	Ice	0.125mL HPDE												
							H2SO4	Ice	0.5L HPDE												
							HCL	Ice	0.250mL amber												
							Ice	Ice	0.5L HPDE												
							Ice	Ice	0.5L HPDE												

2765

NOT USED

Special Instructions: TAT 72 hrs

Turnaround Time: ☐ Normal ☒ 3-day ☐ 24-hr ☐ 48-hr ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By	Date	Time	Received By	Date	Time
	5/17/05	1500		5/18/05	0900

Method Codes
C = Composite
G = Grab

Matrix Codes
DW = Drinking Water
GW = Ground Water
WW = Waste Water
SO = Soil
SL = Sludge
CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 181

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 102569
Project Name / Location: Hunters Point CTO 004
Purchase Order #:
Shipment Date: 5/18/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA
Lab Contact Name / ph. #: 909-590-1828

Project Manager: Mike Reed (Name & phone #)

Send Report To: Suman Sharma
Phone/Fax Number: 925-288-2332
Address: 4005 Port Chicago Hwy
City: Concord, CA, 94520

Sampler's Name(s): RUST / LENZEN

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Preservative (water)	Preservative (soil)	Container Type	VOCs (8260B)	SVOC (EPA 8270C)	PCB (EPA 8082)	RSK 175 9Methane, ethane and ethene)	TPH(EPA 8015B)	Dissolved metals (EPA 6010B)	Nitrate/sulfate/bromide/alkalinity (300.0/310.1/320.1)	Sulfide (EPA 376.2)	COD (EPA 410.1)	TOC (EPA 415.1)	Acetate & Propionate (HPLC)	Dihalococcodes
							Analyses Requested														
~~TB4-1260~~	~~WATER~~	~~5/18/05~~	~~0800~~	~~N/A~~	~~W~~	~~3~~	HCL	Ice	3 VOA	X											
IR25MW38B-1241	GROUNDWATER	5/18/05	08:15	PP	GW	12	Ice	Ice	1 L Liter	X	X	X	X	X	X	X	X				
IR25MW57A-1253	↓		09:30	PP	GW	12	Ice	Ice	1 L Liter	X	X	X	X	X	X	X	X				
TB5-1261	WATER		08:00	N/A	W	3	Ice	Ice	3 VOA	X											
IR25MW904B-1250	GROUNDWATER		10:40	PP		12	Ice	Ice	1 L Liter	X	X	X	X	X	X	X	X				
IR25MW55A-1236	↓	↓		PP		12	Ice	Ice	1 L Liter	X	X	X	X	X	X	X	X				

0.5L HPDE; 0.5L HPDE; 1 0.125mL HPDE; 0.5L HPDE; 2 250mL Amber; 0.5L HPDE; 2 0.5L HPDE

2778

NOT USED

Special Instructions:

Turnaround Time: ☑ Normal ☐ 24-hr ☐ 48-hr ☐ 3-day ☐ 5-day

Level Of QC Required: I II III Project Specific:

Relinquished By:	Date: 5/18/05	Received By:	Date: 5/19/05
	Time: 14:15		Time: 1040
Relinquished By:	Date:	Received By:	Date
	Time:		Time

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # 145

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number:	102569
Project Name / Location:	Hunters Point CTO 004
Shipment Date:	5/26/05

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type	VOCs (8260B)	SVOC (EPA 8270C)	TPH- Diesel(EPA 8015B)	Metals(As,Cr,Cd,Mn,Hg 6010B/7000)	PCB (EPA 8082)
							Preservative (water)	NA	NA	NA	NA	NA
							Preservative (soil)	Ice	Ice	Ice	Ice	Ice
							Container Type	3 Encore	8-oz Glass Jar		8-oz Glass Jar	8-oz Glass Jar
IR25IW02A-BH-1270	Soil Boring	5/25/05	940AM	G	SO	6		X	X	X	X	X
IR25MW54A-BH-1271			840AM	G	SO	6		X	X	X	X	X
IR25MW53A-BH-1272			905AM	G	SO	6		X	X	X	X	X
IR25MW55A-BH-1273			805AM	G	SO	6		X	X	X	X	X
IR25MW53A-BH-1274			920AM	G	SO	6		X	X	X	X	X

2856

J D [signature] 5/25/05

Special Instructions:

Turnaround Time: 72 ☐ Normal ☐ 24-hr ☒ 3-day ☐ 48-hr ☐ 5-day

Level Of QC Required: I II III Project Specific: w/ EDD

Relinquished By: J D [signature] Date: 5/25/05 Time: 1400

Received By: [signature] Date: 5/26/05 Time: 1010

Relinquished By: Date: Time:

Received By: Date: Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples

CHAIN OF CUSTODY

Ref. Document # _____

Page 1 of 1

Shaw
Shaw Environmental and Infrastructure Inc.
4005 Port Chicago Hwy
Concord, CA 94520

Project Number:	102569
Project Name / Location:	Hunters Point CTO 004
Shipment Date: 5/31/05	

Project Manager: Dave Cacciatore (Name & phone #)

Shipment Date: 5/31/05
Waybill Number:
Lab Destination: APCL, 13760 Moagnolia Ave, Chino, CA

Send Report To:	Suman Sharma
Phone/Fax Number:	925-288-2332
Address:	4005 Port Chicago Hwy
City:	Concord, CA, 94520

Sample ID Number	Sample Description	Collection Information: Date	Time	Method	Matrix	# of containers	Container Type, soil	Preservative (water)	Preservative (soil)	Container Type, water	Analyses Requested: VOCs (8260B)	SVOC (EPA 8270C)	TPH- Diesel(EPA 8015B)	Metals (Title 22) 6010B/7000	PCB (EPA 8082)
								HCL	Ice	3- 40-ml VOA Vial	3 Encores	Ice	Ice	HNO3	Ice
								Ice	Ice	1 LA		8-oz Glass Jar		500ml HPDE	1 LA
														8-oz Glass Jar	
IR25-IDW-WW-1280	GROUND WATER	5/31/05	~~09:30~~ 10:11	C	GW	7					X	X	X	X	X
IR25-IDW-Soil-1281	SOIL	5/31/05	~~10:17~~ 09:37	C	SO	7					X	X	X	X	X
Trip Blank TB-053105	WATER	5/31/05	08:00		W	3					X				

2887

Special Instructions:

Turnaround Time: ☐ Normal ☐ 24-hr ☐ 3-day ☒ 48-hr ☐ 5-day

Level Of QC Required: I II III Project Specific: _____

Relinquished By:	Date: 5/31/05	Received By:	Date: 6/1/05
	Time: 11:15		Time: 0900
Relinquished By:	Date:	Received By:	Date:
	Time:		Time:

Method Codes
C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO = Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Sa

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25EW01A

Days from Day Zero (4/15/04)	-22	25	40	54	75	88	102	116	130	146	159	173	187	202	215	238
Sample ID	IR25EW01A-1001	IR25EW01A-1037	IR25EW01A-1042	IR25EW01A-1049	IR25EW01A-1057	IR25EW01A-1063	IR25EW01A-1070	IR25EW01A-1076	IR25EW01A-1083	IR25EW01A-1089	IR25EW01A-1096	IR25EW01A-1102	IR25EW01A-1109	IR25EW01A-1115	IR25EW01A-1122	IR25EW01A-1131
Sample Collection Date	3/24/2004	5/10/2004	5/25/2004	6/8/2004	6/29/2004	7/12/2004	7/26/2004	8/9/2004	8/23/2004	9/8/2004	9/21/2004	10/5/2004	10/19/2004	11/3/2004	11/16/2004	12/9/2004
Parameter																
Volatile Organic Compounds (EPA 8260B), µg/L																
Tetrachloroethene	3,600	1,320			1,150	67	*12.5*	*6.5*	*6.5*	*1.6*	*3*	*1.3*	*1.3*	*1.5*	*1.3*	*25*
Trichloroethene	515	492			250	45	*12.5*	*6.5*	*6.5*	*1.4*	*3*	*1.2*	*1.2*	*1.4*	*1.2*	*2.5*
cis-1,2-DCE	3,580	13,600			1,400	4,600	3,620	279	*6.5*	*2.1*	*1.4*	*1.5*	*1.5*	*2.1*	*1.5*	*3*
trans-1,2-DCE	75	190			34	43	50	60	54	31	29	34	43	31	27	38
1,2-Dichloroethene (total)	3,655	13,790			1,434	4,643	3,670	339	59.5	31	30	35	44	33	29	41
Vinyl Chloride	908	2,940			200	285	956	6,240	3,650	105	*3*	*1.7*	*1.7*	*2.5*	*1.7*	*2.5*
1,1-Dichloroethene	*6.5*	*6.5*			*6.5*	*6.5*	*12.5*	*6.5*	*6.5*	*1.3*	*2.3*	*1.6*	*1.6*	*1.3*	*1.6*	*3.3*
1,2-Dichloroethane	313	1,050			414	507	480	317	120	113	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*12.5*
Benzene	20	42			*6.5*	8	*12.5*	13	10	10	20	34	46	41	44	71
Chlorobenzene	200	261			120	140	100	230	3,550	4,250	6,180	8,440	10,700	9,480	8,880	13,200
1,2-Dichlorobenzene	8,390	14,000			2,710	3,200	2,420	3,010	665	820	82	89	110	100	110	79
1,3-Dichlorobenzene	66	130			28	39	30	50	35	30	20	20	20	20	*6.5*	*12.5*
1,4-Dichlorobenzene	1,890	3,220			532	672	519	906	892	983	1,220	1,350	1,910	1,580	1,020	935
Methylene Chloride	793	180			58	*12.5*	*25*	30	*12.5*	*12.5*	*12.5*	*8*	*10*	*12.5*	*12.5*	*25*
1,2,4-Trichlorobenzene	42	48			10	10	*12.5*	12	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*12.5*
Naphthalene	47	98			20	*6.5*	*12.5*	26	37	36	32	20	20	20	20	*12.5*
Semivolatile Organic Compounds (EPA 8270C), µg/L																
Phenol	92															73
2,4-Dimethylphenol	110															96
3,4-Methylphenol (m,p-Cresol)	314															247
2-Methylphenol(o-Cresol)	477															160
PCBs (EPA 8082), µg/L																
Aroclor 1260	0.3	0.5														*0.48*
TPH-diesel (EPA 8015B), µg/L																
Diesel	10,100	38,000														7,970
General Chemistry Parameters, mg/L																
Alkalinity (EPA 310.1)	231	347			1,040	1,420	1,040	1,260	935	1,290	1,070	992	1,060	1,110	1,210	1,180
Bromide	1.3	1.6			193	170	147	188	145	150	137	105	134	161	152	125
Nitrate as N (EPA 300)	1.1	0.5			*5*	*4*	*5*	*4*	*5*	*8.4*	*4*	*4*	*4*	*4.9*	*6.1*	*5*
Sulfide (EPA 376.2)	0.5	0.1			0.13	4.1	2.4	0.27	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
Sulfate (EPA 300)	147	97.6			165	87.4	*65*	*50*	*417*	*50*	*50*	*50*	*50*	*50*	*50*	*65*
COD, mg-O_2/L																1,040
TOC, mg/L		61.9			776	648	556	537	475	496	433	395	302	354	323	376
Metals (EPA 6010B), µg/L																
Arsenic	3.4															28.6
Cadmium	0.52															1.3
Chromium	1.5															27.7
Manganese	262															29,300
Mercury	0.095															*0.1*
Metabolic Acids (HPLC), mg/L																
Acetic Acid					20	560	500	510	95	50	410	340	*50*	330	280	260
Propionic Acid					500	810	720	750	690	730	660	600	520	530	480	370
Ferrous Iron (Hach 8146), mg/L																
Ferrous Iron	0.01	0.02			0.41	1.65	3.55	7.9	6.35	11.65	10.65	11.8	13.75	10.75	11.05	8
Dissolved Gases (RSK 175), µg/L																
Methane	280	600			57	27	36	83	210	200	240	290	140	500	600	1,200
Ethane	4	*15*			*1.5*	1.5	*1.5*	*1.5*	*15*	*7.5*	*15*	*15*	*15*	*150*	*150*	*150*
Ethene	200	390			39	23	32	162	1,400	2,600	2,200	2,100	909	2,600	2,700	4,100
Field Measurements																
pH, SU	8.0	7.69			6.83	6.68	6.67	6.79	6.66	6.76	6.64	6.79	6.8	6.87	6.76	6.72
Temperature, °C	14.2	15.96			17.41	17.45	17.37	17.6	17.92	18.32	17.74	17.72	17.66	17.1	17.29	16.71
Specific Conductance, mS/cm	1.33	2.1			13.96	13.05	12.77	13.54	12.76	13.16	14.46	12.84	11.35	11.35	12.51	11.91
Dissolved Oxygen (DO), mg/L	10.42	1.99			2.3	0.05	4.28	1.91	0.18	3.36	3.47	0.3	0.36	0.53	0.31	0.29
ORP, mV	75	-220			-236.6	-326	-305	-191.2	-156.8	-145.6	-148.8	-157	-136.2	-197.7	-150	-104.8
Bromide (ISP), mV		-102.5			-174.2	-178.3		-177.8	-171.5	-170.7	-175.2	-170.5	-173.1	-168.9	-167.4	-171.7
Field Measurements EW01MP																
pH, SU																
Temperature, °C																
Specific Conductance, mS/cm																
Dissolved Oxygen (DO), mg/L																
ORP, mV																
Bromide (ISP), mV																
Molar Concentration, µmol/L																
PCE	21.71	7.96			6.93	0.40	0.08	0.04	0.04	0.01	0.02	0.01	0.01	0.01	0.01	0.15
TCE	3.91	3.73			1.90	0.34	0.09	0.05	0.05	0.01	0.02	0.01	0.01	0.01	0.01	0.02
DCE (total)	37.70	142.25			14.79	47.89	37.86	3.50	0.61	0.32	0.31	0.36	0.45	0.34	0.30	0.42
VC	14.53	47.04			3.20	4.56	15.30	99.84	58.40	1.58	0.05	0.03	0.03	0.04	0.03	0.06
Ethene	6.98	13.61			1.36	0.80	1.12	5.65	48.86	90.74	76.76	73.29	31.72	90.74	94.23	143.09
Ethane	0.13	0.49			0.05	0.05	0.05	0.05	0.49	0.24	0.49	0.49	0.49	4.89	4.89	4.89
Total µmol/L	84.96	215.08			26.23	54.05	54.49	109.13	106.45	93.00	77.67	74.18	32.71	96.03	99.47	148.63
TCB	0.23	0.26			0.06	0.06	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07
1,2-DCB	57.07	95.23			18.43	21.77	16.46	20.47	4.52	5.58	0.56	0.61	0.75	0.68	0.75	0.54
1,4-DCB	12.86	21.90			3.62	4.57	3.53	6.16	6.07	6.89	8.30	9.18	12.99	10.75	6.94	6.38
Chlorobenzene	1.78	2.32			1.07	1.24	0.89	2.04	31.56	37.78	54.93	75.02	95.11	84.27	78.93	117.33
Benzene	0.26	0.54			0.06	0.10	0.16	0.17	0.13	0.13	0.26	0.44	0.59	0.53	0.56	0.91
Total µmol/L	71.94	119.72			23.17	27.64	20.95	28.75	42.18	50.08	63.83	84.65	106.89	95.73	86.66	124.30

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25EW01A

Days from Day Zero (4/15/04)	271	278	285	292	306	321	334	348	362	376	390	397
Sample ID	IR25EW01A-1161	IR25EW01A-1167	IR25EW01A-1174	IR25EW01A-1180	IR25EW01A-1187	IR25EW01A-1193	IR25EW01A-1200	IR25EW01A-1206	IR25EW01A-1213	IR25EW01A-1219	IR25EW01A-1226	IR25EW01A-1233
Sample Collection Date	1/11/2005	1/18/2005	1/25/2005	2/1/2005	2/15/2005	3/2/2005	3/15/2005	3/29/2005	4/12/2005	4/26/2005	5/10/2005	5/17/2005
Parameter												
Volatile Organic Compounds (EPA 826												
Tetrachloroethene	*1.5*	*1.5*	*1.3*	*1.3*	*1.3*	*1.3*	*1.3*	*1.3*	*1.7*	*1.7*	*1.7*	3.7
Trichloroethene	*1.4*	*1.4*	*1.2*	*1.2*	*1.2*	*1.2*	*1.2*	*0.9*	*2*	*2*	*2*	*0.4*
cis-1,2-DCE	375	204	*1.5*	12	*1.5*	*1.5*	*1.5*	*1.5*	*1.4*	*1.4*	*1.4*	1.9
trans-1,2-DCE	26	34	17	16	8	12	16	14	11	*1.7*	*1.7*	13.2
1,2-Dichloroethene (total)	401	238	18.5	28	9.5	9.5	17.5	15.5	12.4	3.1	3.1	15.1
Vinyl Chloride	*372*	272	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*4.5*	*1.4*	*1.4*	*1.4*	*0.29*
1,1-Dichloroethene	*1.3*	*1.3*	*1.6*	*1.6*	*1.6*	*1.6*	*1.6*	*1.1*	*0.9*	*0.9*	*0.9*	*0.18*
1,2-Dichloroethane	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	4
Benzene	55	77	58	61	36	59	82	82	74	54	40	77
Chlorobenzene	7,470	10,200	8,920	9,090	4,860	8,330	10,900	10,800	9,380	6,940	5,410	11,500
1,2-Dichlorobenzene	190	160	75	54	26	40	46	45	47	31	20	54
1,3-Dichlorobenzene	*6.5*	*9*	10	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	6.1
1,4-Dichlorobenzene	267	398	352	327	150	250	260	250	250	170	130	223
Methylene Chloride	*12.5*	*12.5*	*12.5*	*12.5*	*12.5*	*12.5*	*12.5*	*12.5*	*14*	*12.5*	*12.5*	*4*
1,2,4-Trichlorobenzene	*6.5*	*6.5*	*9*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*1.3*
Naphthalene	28	41	27	20	*12*	20	20	20	20	*10*	10	30
Semivolatile Organic Compounds (EPA												
Phenol	100	88	257	170	53	58	75	37	46	33	24	36
2,4-Dimethylphenol	87	170	226	190	94	120	150	130	150	88	130	130
3,4-Methylphenol (m,p-Cresol)	160	110	432	331	170	198	211	160	170	110	140	150
2-Methylphenol(o-Cresol)	110	100	281	239	140	150	170	130	130	84	80	88
PCBs (EPA 8082), µg/L												
Aroclor 1260	*0.05*											*48*
TPH-diesel (EPA 8015B), µg/L												
Diesel												5,360
General Chemistry Parameters, mg/L												
Alkalinity (EPA 310.1)												857
Bromide												59.2
Nitrate as N (EPA 300)												*8*
Sulfide (EPA 376.2)												*0.16*
Sulfate (EPA 300)												*155*
COD, mg-O_2/L												346
TOC, mg/L												100
Metals (EPA 6010B), µg/L												
Arsenic												*11.3*
Cadmium												*1.3*
Chromium												*9.9*
Manganese												17,200
Mercury												*0.12*
Metabolic Acids (HPLC), mg/L												
Acetic Acid												31
Propionic Acid												*7.5*
Ferrous Iron (Hach 8146), mg/L												
Ferrous Iron												15.35
Dissolved Gases (RSK 175), µg/L												
Methane	820	1,100	1,800	2,200	1,400	3,100	5,500	2,900	6,100	5,600	3,800	7,200
Ethane	*150*	*150*	*150*	*150*	*15*	8	*150*	*150*	*150*	*150*	*150*	*150*
Ethene	1,200	1,600	1,900	1,900	891	1,500	2,100	1,100	1,800	1,500	950	1,800
Field Measurements												
pH, SU	6.76	6.5	6.7	6.85	6.97	6.94	6.75	6.93	7.05	7.09	7.12	7.52
Temperature, °C	14.64	15	14.74	15.34	14.3	14.45	14.82	15.14	15.5	14.99	15.1	15.21
Specific Conductance, mS/cm	7.82	7.96	8.69	9.57	7.175	7.505	8.932	7.682	8.089	7.81	7.228	7.82
Dissolved Oxygen (DO), mg/L	19.36	13.1	16.71	18.45	28.62	11.32	21.06	22.32	18.48	18.14	14.9	
ORP, mV	-28.2	-35.1	-42.9	44.8	-21.56	-19.9	-40	-41.1	-46.2	-40	-32.5	
Bromide (ISP), mV												
Field Measurements EW01MP												
pH, SU	6.95	6.68	6.8	6.92	6.84	6.82	6.67	6.71	6.91	6.87	6.99	
Temperature, °C	15.72	15.12	15.03	17.15	14.77	14.41	15.09	14.7	14.64	15.11	15.13	
Specific Conductance, mS/cm	5.55	4.12	4.82	4.68	5.707	3.882	4.26	3.761	4.931	5.406	5.497	
Dissolved Oxygen (DO), mg/L	1.85	0.71	1.41	0.82	5.96	0.26	0.56	2.97	0.73	0.73	0.7	
ORP, mV	-34.5	-13.6	-35	-22.7	-34	-0.49	-43.2	-54.5	-74.7	-62.3	-62.6	
Bromide (ISP), mV												
Molar Concentration, µmol/L												
PCE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
TCE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.00
DCE (total)	4.14	2.46	0.19	0.29	0.10	0.10	0.18	0.16	0.13	0.03	0.03	0.16
VC	5.95	4.35	0.03	0.03	0.03	0.03	0.03	0.07	0.02	0.02	0.02	0.00
Ethene	41.88	55.84	66.31	66.31	31.10	52.35	73.29	38.39	62.82	52.35	33.15	62.82
Ethane	4.89	4.89	4.89	4.89	0.49	0.26	4.89	4.89	4.89	4.89	4.89	4.89
Total µmol/L	56.88	67.56	71.44	71.54	31.73	52.75	78.41	43.53	67.89	57.32	38.13	67.90
TCB	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.01
1,2-DCB	1.29	1.09	0.51	0.37	0.18	0.27	0.31	0.31	0.32	0.21	0.14	0.37
1,4-DCB	1.82	2.71	2.39	2.22	1.02	1.70	1.77	1.70	1.70	1.16	0.88	1.52
Chlorobenzene	66.40	90.67	79.29	80.80	43.20	74.04	96.89	96.00	83.38	61.69	48.09	102.22
Benzene	0.71	0.99	0.74	0.76	0.46	0.76	1.05	1.05	0.95	0.69	0.51	0.99
Total µmol/L	69.54	94.50	82.24	83.43	44.43	76.05	99.01	98.04	85.43	63.09	49.15	104.11

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25MW54A

Days from Day Zero (4/15/04)	-22	25	40	54	75	88	102	116	130	146	159	173	187	202	215	238
Sample ID	IR25MW54A-1002	IR25MW54A-1038	IR25MW54A-1046	IR25MW54A-1052	IR25MW54A-1060	IR25MW54A-1067	IR25MW54A-1073	IR25MW54A-1080	IR25MW54A-1086	IR25MW54A-1092	IR25MW54A-1099	IR25MW54A-1105	IR25MW54A-1112	IR25MW54A-1119	IR25MW54A-1125	IR25MW54A-1132
Sample Collection Date	3/25/04	5/10/04	5/25/04	6/8/04	6/29/04	7/12/04	7/26/04	8/9/04	8/23/04	9/8/04	9/21/04	10/5/04	10/19/04	11/3/04	11/16/04	12/9/04
Parameter																
Volatile Organic Compounds (EPA 8260B), µg/L																
Tetrachloroethene	32,600	11,300	10,000	16,000	7,800	800	753	1,620	1,510	1,390	1,330	1,240	1,610	1,070	634	108
Trichloroethene	2,500	4,300	2,400	2,700	780	170	163	240	277	190	279	275	358	225	168	56
cis-1,2-DCE	59,300	49,900	47,100	50,500	5,880	3,440	1,040	3,970	2,870	2,450	3,730	5,370	7,630	5,230	3,230	1,790
trans-1,2-DCE	*250*	*250*	*500*	*500*	67	80	51	60	68	37	110	50	69	41	30	25
1,2-Dichloroethene (total)	59,550	50,150	47,600	51,000	5,947	3,520	1,091	4,030	2,938	2,487	3,840	5,420	7,699	5,271	3,260	1,815
Vinyl Chloride	3,700	10,500	7,900	4,600	900	8,970	3,050	3,570	6,100	2,850	3,330	5,060	6,560	1,510	1,100	1,260
1,1-Dichloroethene	*250*	*250*	*500*	*500*	*50*	*25*	5	*25*	*6.5*	*1.3*	*2.3*	*1.6*	10	7.7	*1.6*	*3.3*
1,2-Dichloroethane	51,200	22,200	15,000	23,600	27,300	8,870	4,060	9,630	9,270	4,720	9,380	7,000	9,950	5,150	2,520	1,340
Benzene	320	*250*	*500*	*500*	78	80	39	80	97	75	100	85	96	62	55	59
Chlorobenzene	500	800	*500*	*500*	200	470	1,190	2,790	3,260	3,700	4,580	3,630	4,700	2,780	1,680	2,880
1,2-Dichlorobenzene	32,800	24,000	16,000	19,000	7,330	4,240	2,660	4,020	4,740	3,550	4,490	4,200	5,920	4,730	1,920	842
1,3-Dichlorobenzene	*250*	*250*	*500*	*500*	*50*	60	39	37	47	34	37	37	44	41	20	*12.5*
1,4-Dichlorobenzene	8,000	6,200	4,600	5,600	1,600	1,500	766	1,530	1,500	1,330	1,450	1,430	2,310	1,480	974	823
Methylene Chloride	2,900	*500*	*1,000*	*1,000*	*200*	*50*	22	49	12	*12.5*	*12.5*	40	30	*12.5*	*12.5*	*28*
1,2,4-Trichlorobenzene	*250*	*250*	*500*	*500*	*50*	*25*	5.2	*25*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*6.5*	*12.5*
Naphthalene	*250*	*250*	*500*	*500*	*50*	*25*	26	*25*	*47*	*37*	*32*	*20*	*10*	*28*	*20*	*12.5*
Semivolatile Organic Compounds (EPA 8270C), µg/L																
Phenol	340															*16*
2,4-Dimethylphenol	4,610															200
3,4-Methylphenol (m,p-Cresol)	1,500															120
2-Methylphenol(o-Cresol)	880															*34*
PCBs (EPA 8082), µg/L																
Aroclor 1260	*0.8*	*0.48*	0.2													*0.8*
TPH-diesel (EPA 8015B), µg/L																
Diesel		59,500	43,400	80,000												1,960
General Chemistry Parameters, mg/L																
Alkalinity (EPA 310.1)		441	436	472	1,350	1,420	1,170	1,140	143	984	845	675	665	600	452	537
Bromide		0.75	21.1	4.9	190	209	144	158	123	117	109	117	106	102	75.3	42.7
Nitrate as N (EPA 300)		*2*	*2*	*2.5*	*8*	*4*	*5*	*4*	*4*	*8.9*	*2.5*	*2*	*4*	*2.5*	*2*	*2*
Sulfide (EPA 376.2)	*0.5*	*0.5*	*0.5*	*0.5*	7.5	1.7	0.12	0.12	0.08	*0.5*	0.073	0.068	0.17	*0.34*	2.1	2.2
Sulfate (EPA 300)		141	121	142	206	*50*	*65*	*50*	*50*	*50*	*32.5*	*50*	*50*	*50.4*	51	*47.3*
COD, mg-O_2/L	745															206
TOC, mg/L	109	69.5	78.3		873	724	523	398	327	280	219	301	317	160	125	68.7
Metals (EPA 6010B), µg/L																
Arsenic																*13.2*
Cadmium																*5*
Chromium																*2.2*
Manganese																980
Mercury																*0.1*
Metabolic Acids (HPLC), mg/L																
Acetic Acid		*2.5*	*2.5*	*2.5*	680	200	560	440	24	310	340	490	610	190	300	100
Propionic Acid		*5*	*5*	*5*	960	1,600	650	460	369	310	320	260	140	*5*	*50*	*5*
Ferrous Iron (Hach 8146), mg/L																
Ferrous Iron	0.03	0.02	0.02	0.02	0.18	7.2	11.95	10.95	16.5	16.5	16.5	9.8	10.5	4	2.34	0
Dissolved Gases (RSK 175), µg/L																
Methane	680	500	410	370	500	500	770	1,400	2,100	1,400	1,200	1,600	1,600	1,400	1,900	2,400
Ethane	*150*	30	*15*	*15*	*15*	30	*150*	*150*	*150*	*150*	*150*	34	34	28	37	51
Ethene	1,300	686	803	936	470	687	1,200	1,300	3,000	1,700	2,100	1,200	1,400	794	940	1,000
Field Measurements																
pH, SU	7.31	7.11	7.01	6.94	6.68	6.77	6.8	6.9	6.6	6.75	6.6	6.85	6.85	6.98	6.98	7.28
Temperature, °C	15.67	15.78	15.86	15.89	18.49	16.6	16.75	16.77	16.9	17.1	16.96	17.03	17.19	17.03	17.06	16.67
Specific Conductance, mS/cm	5.85	5.44	4.88	5.143	15.7	13.99	12.92	11.92	11.5	11.38	13.05	11.18	8.14	8.34	7.03	4.47
Dissolved Oxygen (DO), mg/L	9.29	2.38	0.21	0.44	0.27	0.03	3.9	2.96	0.18	0.18	2.32	0.33	0.14	0.44	0.13	0.08
ORP, mV	56	-105	-149.6	-125.8	-262.5	-267.3	-203	-135.8	-194.7	-207.2	-171.2	-206.3	-209.2	-284.1	-244.5	-304.7
Bromide (ISP), mV		-104.5	-113.2	-113.8	-183.7	-177.4		-176.1	-173	-179	-171.7	-171.7	-168.4	-167.7	-143.1	-162.3
Field Measurements 54MP																
pH, SU																
Temperature, °C																
Specific Conductance, mS/cm																
Dissolved Oxygen (DO), mg/L																
ORP, mV																
Molar Concentration, µmol/L																
PCE	196.58	68.14	60.30	96.48	47.04	4.82	4.54	9.77	9.11	8.38	8.02	7.48	9.71	6.45	3.82	0.65
TCE	18.96	32.62	18.20	20.48	5.92	1.29	1.24	1.82	2.10	1.44	2.12	2.09	2.72	1.71	1.27	0.42
DCE (total)	614.28	517.31	491.01	526.06	61.35	36.31	11.25	41.57	30.31	25.65	39.61	55.91	79.42	54.37	33.63	18.72
VC	59.20	168.00	126.40	73.60	14.40	143.52	48.80	57.12	97.60	45.60	53.28	80.96	104.96	24.16	17.60	20.16
Ethene	45.37	23.94	28.02	32.67	16.40	23.98	41.88	45.37	104.70	59.33	73.29	41.88	48.86	27.71	32.81	34.90
Ethane	4.89	0.98	0.49	0.49	0.49	0.98	4.89	4.89	4.89	4.89	4.89	1.11	1.11	0.91	1.21	1.66
Total µmol/L	939.29	810.99	724.43	749.80	145.59	210.90	112.60	160.54	248.71	145.30	181.21	189.42	246.77	115.32	90.34	76.52
TCB	1.38	1.38	2.76	2.76	0.28	0.14	0.03	0.14	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07
1,2-DCB	223.11	163.25	108.84	129.24	49.86	28.84	18.09	27.35	32.24	24.15	30.54	28.57	40.27	32.17	13.06	5.73
1,4-DCB	54.42	42.17	31.29	38.09	10.88	10.20	5.21	10.41	10.20	9.05	9.86	9.73	15.71	10.07	6.63	5.60
Chlorobenzene	4.44	7.11	4.44	4.44	1.78	4.18	10.58	24.80	29.16	32.89	40.71	32.27	41.76	24.71	14.93	25.60
Benzene	4.10	3.21	6.41	6.41	1.00	1.03	0.50	1.03	1.24	0.96	1.28	1.09	1.23	0.79	0.71	0.76
Total µmol/L	287.46	217.12	153.74	180.95	63.80	44.39	34.41	63.72	72.88	67.08	82.43	71.69	99.03	67.76	35.36	37.75

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25MW54A

Days from Day Zero (4/15/04)	271	278	285	292	306	321	334	348	362	376	390	397
Sample ID	IR25MW54A-1164	IR25MW54A-1171	IR25MW54A-1177	IR25MW54A-1183	IR25MW54A-1190	IR25MW54A-1197	IR25MW54A-1203	IR25MW54A-1210	IR25MW54A-1216	IR25MW54A-1222	IR25MW54A-1229	IR25MW54A-1234
Sample Collection Date	1/11/05	1/18/05	1/25/05	2/1/05	2/15/05	3/2/05	3/15/05	3/29/05	4/12/05	4/26/05	5/10/05	5/17/05
Parameter												
Volatile Organic Compounds (EPA 826												
Tetrachloroethene	1,000	1,410	1,150	1,960	2,410	9,750	2,450	1,770	1,250	1,290	863	5,220
Trichloroethene	373	645	493	757	880	2,840	596	557	346	358	323	807
cis-1,2-DCE	12,200	17,700	13,700	18,200	19,600	26,700	23,100	18,900	14,400	13,800	14,100	19,700
trans-1,2-DCE	71	136	264	98	203	355	180	106	98	218	74	97
1,2-Dichloroethene (total)	12,271	17,836	13,964	18,298	19,803	27,055	23,280	19,006	14,498	14,018	14,174	19,797
Vinyl Chloride	3,230	5,700	4,320	2,870	3,990	7,350	3,690	2,650	1,990	2,030	2,430	5,130
1,1-Dichloroethene	*2.6*	16	*3.3*	*3.3*	*3.3*	58	15	13	*0.9*	*1.8*	*1.8*	11
1,2-Dichloroethane	9,300	15,300	13,900	21,000	19,700	57,600	25,200	26,300	20,200	18,500	12,300	22,300
Benzene	100	140	140	140	160	523	160	130	69	59	60	110
Chlorobenzene	4,460	6,120	5,970	4,610	4,950	5,060	5,330	3,820	2,230	1,310	1,800	3,970
1,2-Dichlorobenzene	3,570	4,800	5,380	5,130	5,290	12,200	9,600	6,430	5,710	8,420	8,280	9,040
1,3-Dichlorobenzene	30	41	40	50	40	110	55	60	53	50	50	67
1,4-Dichlorobenzene	1,200	1,680	2,110	2,080	2,190	3,850	2,070	1,930	1,170	849	968	2,120
Methylene Chloride	*25*	*21*	*25*	*25*	*25*	*25*	*25*	*12.5*	*30*	*26*	*34*	51
1,2,4-Trichlorobenzene	*12.5*	*6.5*	*12.5*	*12.5*	*12.5*	*12.5*	*12.5*	*6.5*	*6.5*	*12.5*	*12.5*	*11*
Naphthalene	40	41	40	40	30	74	30	*6.5*	*37*	*30*	*40*	59
Semivolatile Organic Compounds (EPA												
Phenol	110	98	290	*240*	92	170	*14*	14	*48*	*31*	*41*	160
2,4-Dimethylphenol	1,370	1,490	2,350	2,500	1,860	3,600	1,200	1,750	110	770	1,000	4,040
3,4-Methylphenol (m,p-Cresol)	511	499	1,100	*890*	540	1,300	140	92	*48*	240	340	1,300
2-Methylphenol(o-Cresol)	259	257	600	*770*	470	730	430	334	240	230	340	730
PCBs (EPA 8082), µg/L												
Aroclor 1260	*0.05*											*0.48*
TPH-diesel (EPA 8015B), µg/L												
Diesel												39,200
General Chemistry Parameters, mg/L												
Alkalinity (EPA 310.1)												771
Bromide												24.6
Nitrate as N (EPA 300)												*10*
Sulfide (EPA 376.2)												*0.076*
Sulfate (EPA 300)												*192*
COD, mg-O_2/L												
TOC, mg/L												
Metals (EPA 6010B), µg/L												
Arsenic												*9.9*
Cadmium												5
Chromium												*4.5*
Manganese												3,910
Mercury												*0.16*
Metabolic Acids (HPLC), mg/L												
Acetic Acid												*7.5*
Propionic Acid												*7.5*
Ferrous Iron (Hach 8146), mg/L												
Ferrous Iron												2.21
Dissolved Gases (RSK 175), µg/L												
Methane	1,300	1,500	1,900	710	1,200	790	1,100	420	660	790	1,000	1,700
Ethane	50	52	54	22	42	22	32	15	23	32	43	62
Ethene	855	1,200	2,200	1,100	1,400	1,200	1,200	671	940	1,000	1,500	2,600
Field Measurements												
pH, SU	7.18	6.87	6.9	7.18	7.1	7.31	7.13	7.33	7.46	7.42	7.37	7.31
Temperature, °C	15.83	15.62	15.67	15.58	15.43	15.3	15.35	15.2	15.2	15.45	15.48	15.58
Specific Conductance, mS/cm	6.29	6.92	0.782	8.028	7.933	7.694	7.609	7.702	7.782	7.918	8.211	8.7
Dissolved Oxygen (DO), mg/L	29.63	21.87	6.9	20.75	26.56	14.8	28.66	43.13	39.08	26.69	17.65	
ORP, mV	-35.3	-31.8	-77	52.5	125.2	-10.2	20.8	101.6	117.9	128.4	-7.8	
Bromide (ISP), mV												
Field Measurements S4MP												
pH, SU	7.12	6.9	7.12	7.26	7.12	6.97	7.03	7.11	7.16	7.12	7.19	
Temperature, °C	15.7	15.23	15.28	15.56	15.29	14.99	15.32	15	14.94	15.27	15.14	
Specific Conductance, mS/cm	3.558	3.08	3.256	3.153	3.544	3.279	3.491	3.436	3.007	3.102	3.621	
Dissolved Oxygen (DO), mg/L	0.69	1.39	2.46	0.77	0.65	0.27	1.23	0.64	0.13	0.36	0.93	
ORP, mV	-88.4	-74	-82.7	-86.9	-82.8	-116.4	-90.9	-143.5	-129.7	-87.4	-96.5	
Molar Concentration, µmol/L												
PCE	6.03	8.50	6.93	11.82	14.53	58.79	14.77	10.67	7.54	7.78	5.20	31.48
TCE	2.83	4.89	3.74	5.74	6.68	21.54	4.52	4.23	2.62	2.72	2.45	6.12
DCE (total)	126.58	183.98	144.04	188.75	204.27	279.08	240.14	196.05	149.55	144.60	146.21	204.21
VC	51.68	91.20	69.12	45.92	63.84	117.60	59.04	42.40	31.84	32.48	38.88	62.08
Ethene	29.84	41.88	76.78	38.39	48.86	41.88	41.88	23.42	32.81	34.90	52.35	90.74
Ethane	1.63	1.70	1.76	0.72	1.37	0.72	1.04	0.49	0.75	1.04	1.40	2.02
Total µmol/L	218.59	332.16	302.38	291.34	339.55	519.62	361.40	277.26	225.11	223.52	246.50	416.65
TCB	0.07	0.04	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.07	0.07	0.06
1,2-DCB	24.28	32.65	36.60	34.90	35.98	82.99	65.30	43.74	38.84	57.28	56.32	61.49
1,4-DCB	8.16	11.43	14.35	14.15	14.90	26.19	14.08	13.13	7.96	5.78	6.58	14.42
Chlorobenzene	39.64	54.40	53.07	40.98	44.00	44.98	47.38	33.96	19.82	11.64	16.00	35.29
Benzene	1.28	1.79	1.79	1.79	2.05	6.71	2.05	1.67	0.88	0.76	0.77	1.41
Total µmol/L	73.44	100.31	105.88	91.89	97.00	160.93	128.68	92.52	67.54	75.52	79.75	112.67

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25MW56A

Days from Day Zero (4/15/04)	-22	25	40	54	75	88	102	116	130	146	159	173	187	202	215	238
Sample ID	IR25MW56A-1020	IR25MW56A-1040	IR25MW56A-1047	IR25MW56A-1054	IR25MW56A-1061	IR25MW56A-1068	IR25MW56A-1074	IR25MW56A-1081	IR25MW56A-1087	IR25MW56A-1093	IR25MW56A-1100	IR25MW56A-1106	IR25MW56A-1113	IR25MW56A-1120	IR25MW56A-1126	IR25MW56A-1150
Sample Collection Date	3/25/04	5/10/04	5/25/04	6/8/04	6/29/04	7/12/04	7/26/04	8/9/04	8/23/04	9/8/04	9/3/04	10/5/04	10/19/04	11/3/04	11/16/04	12/9/04
Parameter																
Volatile Organic Compounds (EPA 8260B), µg/L																
Tetrachloroethene	1,650	250	120	60	50	30	18.8	30	44	42	26	18.5	29.5	21	35	22
Trichloroethene	620	140	100	35	25	20	28.3	33	35	22	26	27.4	33.5	23.4	26.4	30
cis-1,2-DCE	2,790	5,110	3,670	3,300	530	779	826	1,400	1,490	1,390	1,410	1,620	1,870	921	844	1,160
trans-1,2-DCE	25	48	25	35	25	24	24.8	28	24	20	35	29	41.7	31.6	34.9	43
1,2-Dichloroethene (total)	2,815	5,158	3,695	3,335	555	803	850.8	1,428	1,514	1,410	1,445	1,649	1,912	953	879	1,203
Vinyl Chloride	820	1,900	1,830	1,370	620	1,240	701	925	1,220	853	808	1,560	1,360	707	499	1,260
1,1-Dichloroethene	25	25	25	25	25	2.5	3.1	2.5	2.5	0.51	0.92	0.65	5.4	0.51	0.65	3.3
1,2-Dichloroethane	2,380	2,830	1,850	1,880	600	1,020	773	966	1,040	784	1,170	1,120	1,370	889	990	1,220
Benzene	25	25	25	25	25	8	6.2	9	10	8	9	13	16	18	21	20
Chlorobenzene	34	37	25	31	25	19	17.2	25	24	18	24	26	32	91	175	89
1,2-Dichlorobenzene	4,910	4,530	4,040	4,050	1,220	2,680	2,050	2,410	2,490	2,430	2,480	2,810	3,140	3,700	2,420	3,190
1,3-Dichlorobenzene	30	35	30	31	25	21	23.7	21	20	18	18	24	27	234	22	30
1,4-Dichlorobenzene	1,170	1,060	940	900	280	569	464	538	506	478	523	684	741	820	596	731
Methylene Chloride	330	50	50	50	200	5	0.5	5	5	5	5	10	6	6	5	25
1,2,4-Trichlorobenzene	25	25	25	25	25	2.5	7.5	6	7	7	5	8	2.5	2.5	4	12.5
Naphthalene	25	25	25	25	25	2.5	9.5	4	8	5	3	2.5	2.5	2.5	4	12.5
Semivolatile Organic Compounds (EPA 8270C), µg/L																
Phenol	5															48
2,4-Dimethylphenol	48															48
3,4-Methylphenol (m,p-Cresol)	7															48
2-Methylphenol(o-Cresol)	26															48
PCBs (EPA 8082), µg/L																
Aroclor 1260	0.5															0.04
TPH-diesel (EPA 8015B), µg/L																
Diesel	2,950															1,690
General Chemistry Parameters, mg/L																
Alkalinity (EPA 310.1)	852															645
Bromide	125		22.1	23.8			25.4									11.2
Nitrate as N (EPA 300)	21.6															8
Sulfide (EPA 376.2)	0.5															0.5
Sulfate (EPA 300)	362															240
COD, mg-O2/L																
TOC, mg/L																
Metals (EPA 6010B), µg/L																
Arsenic	25															7.7
Cadmium	0.2															5
Chromium	35.8															7.1
Manganese	1,890															6,390
Mercury	0.1															0.1
Metabolic Acids (HPLC), mg/L																
Acetic Acid							2.5									
Propionic Acid							5									
Ferrous Iron (Hach 8146), mg/L																
Ferrous Iron	0.03	0.03	0	0.06	6.43	4.1	2.25	1.69	1.76	1.46	1.48	1.47	1.58	2.25	1.84	1.81
Dissolved Gases (RSK 175), µg/L																
Methane	210															500
Ethane	15															15
Ethene	721															450
Field Measurements																
pH, SU	7.5	7.47	7.29	7.3	7	6.95	6.87	6.99	6.84	6.99	6.86	7	7.05	7.11	7	6.99
Temperature, °C	15.82	16.25	16.2	16.18	16.54	16.39	16.54	16.51	16.62	16.82	16.75	16.6	16.75	16.75	16.81	16.62
Specific Conductance, mS/cm	17.9	20.2	16.23	16.79	18.26	17.67	17.7	18.05	18.23	18.45	21.9	19.43	14.21	16.02	18.9	17.64
Dissolved Oxygen (DO), mg/L	3.1	1.96	0.39	1.12	4.51	0.98	5.39	1.13	1.98	0.3	2.1	0.3	0.18	0.41	0.24	0.24
ORP, mV	11	-176.0	-185.9	-178.3	-121.2	-194.2	-141	-121.5	-71.2	-130.4	-141.2	-138.5	-135.1	-229.4	-166.9	-105.2
Bromide (ISP), mV		-132.1	-135.6	-137.7	-143.0	-143		-143.6	-145.6	-146.3	-154.5	-171.7	-150.7	-161.4	-154.9	-154.3
Molar Concentration, µmol/L																
PCE	9.95	1.51	0.72	0.46	0.30	0.18	0.11	0.18	0.27	0.25	0.16	0.11	0.18	0.13	0.21	0.13
TCE	4.70	1.06	0.76	0.27	0.19	0.15	0.21	0.25	0.27	0.17	0.20	0.21	0.25	0.18	0.20	0.23
DCE (total)	29.04	53.19	38.12	34.40	5.72	8.28	8.76	14.73	15.62	14.54	14.91	17.01	19.72	9.83	9.07	12.41
VC	13.12	30.40	29.28	21.92	9.92	19.84	11.22	14.80	19.52	13.65	12.93	24.96	21.76	11.31	7.98	20.16
Ethene	25.16															
Ethane	0.49															
Total µmol/L	82.46	86.16	68.88	57.07	16.14	28.46	20.32	29.96	35.67	28.81	28.19	42.29	41.92	21.45	17.46	32.93
TCB	0.14	0.14	0.14	0.14	0.14	0.01	0.04	0.03	0.04	0.04	0.03	0.04	0.01	0.01	0.02	0.07
1,2-DCB	33.40	30.81	27.48	27.55	8.30	18.23	13.94	16.39	16.94	16.53	16.87	19.11	21.36	25.17	16.46	21.70
1,4-DCB	7.96	7.21	6.39	6.12	1.90	3.87	3.16	3.66	3.44	3.25	3.56	4.65	5.04	5.58	4.05	4.97
Chlorobenzene	0.30	0.33	0.22	0.26	0.22	0.17	0.15	0.22	0.21	0.16	0.21	0.23	0.28	0.81	1.56	0.79
Benzene	0.32	0.32	0.32	0.32	0.32	0.10	0.06	0.12	0.13	0.10	0.12	0.17	0.21	0.23	0.27	0.26
Total µmol/L	42.12	38.81	34.56	34.41	10.88	22.39	17.37	20.42	20.76	20.08	20.78	24.21	26.90	31.80	22.36	27.79

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25MW56A

Days from Day Zero (4/15/04)	271	278	285	292	306	321	334	348	362	376	390	397
Sample ID	IR25MW56A-1165	IR25MW56A-1172	IR25MW56A-1178	IR25MW56A-1184	IR25MW56A-1191	IR25MW56A-1198	IR25MW56A-1204	IR25MW56A-1211	IR25MW56A-1217	IR25MW56A-1224	IR25MW56A-1230	IR25MW56A-1252
Sample Collection Date	1/11/05	1/18/05	1/25/05	2/1/05	2/15/05	3/2/05	3/15/05	3/29/05	4/12/05	4/26/05	5/10/05	5/17/05
Parameter												
Volatile Organic Compounds (EPA 826												
Tetrachloroethene	18	19.5	18.6	16	14	24	24	24.5	15.9	9.8	14	22.9
Trichloroethene	18	34.8	48.7	46	46	36	36	41.7	30.3	20	21	27.1
cis-1,2-DCE	636	862	1,020	1,120	973	831	803	893	615	463	431	586
trans-1,2-DCE	46	54.6	32.7	30	32	35	36	48.4	37.8	24	23	25.9
1,2-Dichloroethene (total)	682	916.6	1,053	1,150	1,005	866	839	941.4	652.8	487	454	611.9
Vinyl Chloride	901	526	520	612	497	442	355	450	267	189	169	212
1,1-Dichloroethene	*1.3*	*0.51*	*0.65*	*1.6*	*1.6*	*1.6*	*1.6*	*0.44*	*0.36*	*0.9*	*0.9*	*0.18*
1,2-Dichloroethane	856	907	920	906	1,020	1,020	807	924	711	575	441	530
Benzene	20	30	18	20	20	20	20	24	19	10	*13*	12
Chlorobenzene	85	145	64	50	51	67	51	46	62	45	44	36
1,2-Dichlorobenzene	2,520	3,120	2,860	2,850	3,030	1,470	1,020	1,590	1,600	1,490	1,210	749
1,3-Dichlorobenzene	20	27	22	20	20	26	10	16	2.5	10	10	10
1,4-Dichlorobenzene	458	718	634	634	626	289	210	321	342	323	277	134
Methylene Chloride	*12.5*	*5*	*5*	*12.5*	*12.5*	*12.5*	*12.5*	*5*	*6*	*12.5*	*18*	*4*
1,2,4-Trichlorobenzene	*6.5*	7	*5*	*6.5*	*6.5*	*6.5*	*6.5*	*2.5*	*2.5*	*6.5*	*6.5*	*2*
Naphthalene	*6.5*	*2.5*	*2.5*	*6.5*	*6.5*	*6.5*	*6.5*	*2.5*	*2.5*	*6.5*	*6.5*	*2.5*
Semivolatile Organic Compounds (EP/												
Phenol												*4.8*
2,4-Dimethylphenol												*4.8*
3,4-Methylphenol (m,p-Cresol)												*4.8*
2-Methylphenol(o-Cresol)												*4.8*
PCBs (EPA 8082), µg/L												
Aroclor 1260												*0.48*
TPH-diesel (EPA 8015B), µg/L												
Diesel												360
General Chemistry Parameters, mg/L												
Alkalinity (EPA 310.1)												691
Bromide												20.5
Nitrate as N (EPA 300)												*16*
Sulfide (EPA 376.2)												*0.053*
Sulfate (EPA 300)												*370*
COD, mg-O_2/L												
TOC, mg/L												
Metals (EPA 6010B), µg/L												
Arsenic												*6.5*
Cadmium												*5*
Chromium												*3.9*
Manganese												4,620
Mercury												*0.14*
Metabolic Acids (HPLC), mg/L												
Acetic Acid												
Propionic Acid												
Ferrous Iron (Hach 8146), mg/L												
Ferrous Iron												0.05
Dissolved Gases (RSK 175), µg/L												
Methane												73
Ethane												7.5
Ethene												290
Field Measurements												
pH, SU	7.07	6.76	6.94	7.1	6.98	7.18	7.08	7.19	7.3	7.34	7.34	7.45
Temperature, °C	16.3	16.21	16.21	16.23	16.17	15.98	16.16	15.82	15.89	16.07	16	15.93
Specific Conductance, mS/cm	17.66	16.75	16.94	17.12	17.47	16.9	16.48	16.67	17.12	17.51	18.57	19.07
Dissolved Oxygen (DO), mg/L	0.19	0.15	0.15	0.19	0.16	0.08	0.02	0.78	0.28	0.09	0.01	
ORP, mV	-95.7	-101.2	-95.2	-89	-93.5	-73.5	-82.6	-60.9	-92.4	-81.6	-72.7	
Bromide (ISP), mV												
Molar Concentration, µmol/L												
PCE	0.11	0.12	0.11	0.10	0.08	0.14	0.14	0.15	0.10	0.06	0.08	0.14
TCE	0.14	0.26	0.37	0.35	0.35	0.27	0.27	0.32	0.23	0.15	0.16	0.21
DCE (total)	7.04	9.46	10.86	11.86	10.37	8.93	8.65	9.71	6.73	5.02	4.68	6.31
VC	14.42	8.42	8.32	9.79	7.95	7.07	5.68	7.20	4.59	3.02	2.70	3.39
Ethene												10.12
Ethane												0.24
Total µmol/L	21.70	18.25	19.66	22.10	18.75	16.42	14.75	17.38	11.65	8.26	7.63	20.41
TCB	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.01	0.01	0.04	0.04	0.01
1,2-DCB	17.14	21.22	19.45	19.39	20.61	10.00	6.94	10.82	10.88	10.14	8.23	5.09
1,4-DCB	3.12	4.88	4.31	4.31	4.26	1.97	1.43	2.18	2.33	2.20	1.88	0.91
Chlorobenzene	0.76	1.29	0.57	0.44	0.45	0.60	0.45	0.41	0.55	0.40	0.39	0.32
Benzene	0.26	0.38	0.23	0.26	0.26	0.26	0.26	0.31	0.24	0.13	0.17	0.15
Total µmol/L	21.30	27.82	24.59	24.44	25.61	12.85	9.11	13.73	14.02	12.90	10.71	6.49

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25MW53A

Days from Day Zero (4/15/04)	-22	25	40	54	75	88	102	116	130	146	159	173	187	202	215	238
Sample ID	IR25MW53A-1003	IR25MW53A-1039	IR25MW53A-1044	IR25MW53A-1051	IR25MW53A-1059	IR25MW53A-1065	IR25MW53A-1072	IR25MW53A-1078	IR25MW53A-1085	IR25MW53A-1091	IR25MW53A-1098	IR25MW53A-1104	IR25MW53A-1111	IR25MW53A-1118	IR25MW53A-1124	IR25MW53A-1133
Sample Collection Date	3/25/04	5/10/04	5/25/04	6/8/04	6/29/04	7/12/04	7/26/04	8/9/04	8/23/04	9/8/04	9/21/04	10/5/04	10/19/04	11/3/04	11/16/04	12/8/04
Parameter																
Volatile Organic Compounds (EPA 8260B), µg/L																
Tetrachloroethene	2.5	55	25	25	6.5	2.5	2.5	2.5	2.5	0.6	1.2	0.5	0.5	0.6	0.5	1.3
Trichloroethene	2.5	52	25	25	6.5	2.5	2.5	2.5	2.5	0.55	1.2	0.5	0.5	0.6	0.5	1.2
cis-1,2-DCE	152	3,500	1,780	80	20	37	20	15	14	4.8	0.54	5.4	5.8	6	20.5	39
trans-1,2-DCE	37	186	150	70	29	26	13	11	13	6	5.6	14.9	15.2	7	9.5	15
1,2-Dichloroethene (total)	189	3,686	1,930	150	49	63	33	26	27	11	5.6	20	21	13	30	54
Vinyl Chloride	140	2,300	3,930	340	28	15	7	7	11	4.3	5	6	11	4.2	9.2	17
1,1-Dichloroethene	2.5	2.5	25	25	6.5	2.5	2.5	2.5	2.5	0.51	0.92	0.65	0.65	0.51	0.65	1.6
1,2-Dichloroethane	250	192	380	200	100	68	28	22	23	11	6	12	17	9	10	42
Benzene	5	17	25	25	20	24	25	28	32	30	33	48	54	40	38	32
Chlorobenzene	218	270	1,310	3,330	2,570	4,120	3,240	3,620	3,510	3,610	3,750	4,140	4,640	4,240	3,010	3,040
1,2-Dichlorobenzene	446	4,620	3,110	1,530	507	288	131	59	47	32	25	29	46	35	43	74
1,3-Dichlorobenzene	5	46	35	25	20	11	68	2.5	2.5	4	2.5	2.5	3	3	2.5	6.5
1,4-Dichlorobenzene	147	1,140	960	960	742	818	671	430	200	124	86	87	77	65	72	79
Methylene Chloride	25	5	50	50	30	5	5	5	5	5	5	5	4	5	5	16
1,2,4-Trichlorobenzene	2.5	6	25	25	6.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	6.5
Naphthalene	2.5	24	25	25	20	12	17	11	14	13	8	8	2.5	8	6	6.5
Semivolatile Organic Compounds (EPA 8270C), µg/L																
Phenol	4.8															4.8
2,4-Dimethylphenol	4.8															22
3,4-Methylphenol (m,p-Cresol)	4.8															4
2-Methylphenol(o-Cresol)	4.8															8
PCBs (EPA 8082), µg/L																
Aroclor 1260	0.5	0.03	0.06													0.03
TPH-diesel (EPA 8015B), µg/L																
Diesel	480	11,800	12,700	15,000												1,920
General Chemistry Parameters, mg/L																
Alkalinity (EPA 310.1)	633	896	1,130	1,080	877	850	767	872	703	895	886	963	996	945	891	842
Bromide	4.5	43.7	130	101	106	67.9	64.9	72.8	49.1	55.6	56.7	59.4	65.3	64.8	59.4	42.1
Nitrate as N (EPA 300)	2.1	0.8	0.8	1	1	1	1	1	1	2.3	0.8	1	1	1	1	1
Sulfide (EPA 376.2)	0.5	0.87	1.5	1.1	0.53	0.55	0.56	0.65	0.63	0.89	0.82	0.5	0.62	0.42	0.22	0.19
Sulfate (EPA 300)	106	43.4	25.9	26	35.9	50.2	38.6	33.9	36	12.5	10	12.5	12.5	35.2	49.4	60.6
COD, mg-O2/L	21															83.6
TOC, mg/L	8.5	433	457	342	278	156	134	125	88.5	114	85.1	88.7	88.7	34.1	14.4	9.6
Metals (EPA 6010B), µg/L																
Arsenic	19.6															10.5
Cadmium	0.23															5
Chromium	3.3															2.3
Manganese	769															1,680
Mercury	0.13															0.072
Metabolic Acids (HPLC), mg/L																
Acetic Acid	2.5	520	440	400	330	9	2.5	2.5	2.5	2.5	8	2.5	120	2.5	2.5	2.5
Propionic Acid	5	420	470	388	330	5	5	5	5	71	68	5	110	5	5	5
Ferrous Iron (Hach 8146), mg/L																
Ferrous Iron	0.01	0.36	0.47	0.33	0.45	0.62	0.68	0.41	0.55	0.63	1.02	2.28	0.81	1.5	0.42	1.2
Dissolved Gases (RSK 175), µg/L																
Methane	380	390	500	430	820	440	610	860	2,400	1,800	3,300	4,100	6,800	11,000	16,000	10,000
Ethane	18	15	7.5	15	15	15	7.5	25	89	190	210	133	126	120	130	71
Ethene	14	310	458	662	770	220	190	177	180	31	12	3	8	3	7.5	
Field Measurements																
pH, SU	7.72	7.32	7.04	7.1	7.11	7.25	7.07	7.2	7.08	7.17	7.06	7.24	7.3	7.26	7.15	7.23
Temperature, °C	15.33	15.79	15.84	15.81	16.12	16.14	16.39	16.4	16.58	16.88	16.79	16.74	16.99	16.95	16.95	16.77
Specific Conductance, mS/cm	3.34	3.63	4.14	4.129	4.076	3.764	4.037	4.052	3.97	4.256	5.09	4.49	3.3	3.82	4.53	3.94
Dissolved Oxygen (DO), mg/L	9.38	2.45	0.3	0.33	0.9	1.39	3.05	1.51	0.13	0.48	5.08	0.28	0.16	0.36	0.14	0.14
ORP, mV	-7	-219.0	-269.0	-272.8	-222	-206	-206	-261	-227.1	-225.3	-266.5	-220.4	-226.3	-291.9	-204.1	-158.7
Bromide (ISP), mV		-174.9	-161.4	-161.2	-158.3	-150.7		-151.6	-156.5	-162.3	-158.6	-157.4	-164.9	-154.3	-146.3	-148.8
Field Measurements 53MP																
pH, SU																
Temperature, °C																
Specific Conductance, mS/cm																
Dissolved Oxygen (DO), mg/L																
ORP, mV																
Molar Concentration, µmol/L																
PCE	0.02	0.33	0.15	0.15	0.04	0.02	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.01
TCE	0.02	0.39	0.19	0.19	0.05	0.02	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.01
DCE (total)	1.95	38.02	19.91	1.55	0.51	0.65	0.34	0.27	0.28	0.11	0.06	0.21	0.22	0.13	0.31	0.56
VC	2.24	36.80	62.88	5.44	0.45	0.24	0.11	0.11	0.18	0.07	0.08	0.08	0.18	0.07	0.15	0.27
Ethene	0.49	10.82	15.96	23.10	26.87	7.68	6.63	6.18	6.28	1.06	0.42	0.10	0.28	0.10	0.26	0.00
Ethane	0.59	0.49	0.24	0.49	0.49	0.49	0.24	0.82	2.90	6.20	6.85	4.34	4.11	3.91	4.24	2.32
Total µmol/L	5.30	86.86	99.36	30.92	28.40	9.09	7.36	7.41	9.67	7.47	7.42	4.74	4.79	4.23	4.97	3.16
TCB	0.01	0.03	0.14	0.14	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04
1,2-DCB	3.03	31.43	21.16	10.41	3.45	1.96	0.89	0.40	0.32	0.22	0.17	0.20	0.31	0.24	0.29	0.50
1,4-DCB	1.90	7.75	6.53	6.53	5.05	5.56	4.56	2.92	1.36	0.84	0.58	0.59	0.52	0.44	0.49	0.54
Chlorobenzene	1.94	2.40	11.64	29.60	22.84	36.62	28.80	32.16	31.20	32.09	33.33	36.80	41.24	37.69	26.76	27.02
Benzene	0.06	0.22	0.32	0.32	0.26	0.31	0.32	0.36	0.41	0.38	0.42	0.62	0.69	0.51	0.49	0.41
Total µmol/L	6.05	41.83	39.79	47.00	31.63	44.47	34.59	35.66	33.30	33.55	34.53	38.22	42.79	38.90	28.04	28.51

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25MW53A

Days from Day Zero (4/15/04)	271	278	285	292	306	321	334	348	362	376	390	397
Sample ID	IR25MW53A-1163	IR25MW53A-1169	IR25MW53A-1176	IR25MW53A-1182	IR25MW53A-1189	IR25MW53A-1195	IR25MW53A-1202	IR25MW53A-1208	IR25MW53A-1215	IR25MW53A-1221	IR25MW53A-1228	IR25MW53A-1235
Sample Collection Date	1/11/05	1/18/05	1/25/05	2/1/05	2/15/05	3/2/05	3/15/05	3/29/05	4/12/05	4/26/05	5/10/05	5/17/05
Parameter												
Volatile Organic Compounds (EPA 826												
Tetrachloroethene	*0.6*	*0.6*	*0.25*	*0.5*	*0.5*	*0.5*	*0.5*	*0.61*	*1.7*	*0.66*	*0.66*	0.25
Trichloroethene	*0.56*	*0.6*	*0.25*	*0.49*	*0.49*	*0.49*	*0.49*	*0.36*	*2*	*0.8*	*0.8*	0.33
cis-1,2-DCE	35.7	43	26.8	28.1	27.8	40.8	35.9	36.6	48	34.2	15.1	38.5
trans-1,2-DCE	12	11.9	5.9	4.8	4.7	6.7	8.4	7.7	1.7	4.6	3.1	8.89
1,2-Dichloroethene (total)	47	16.2	32.7	32.9	32.5	47.5	44.3	44.3	49.7	38.6	18.2	47.39
Vinyl Chloride	8	13	8.6	5.1	3.2	5.1	12	7.5	*1.4*	5.8	3.7	10.2
1,1-Dichloroethene	*0.51*	*0.51*	*0.33*	*0.65*	*0.65*	*0.65*	*0.65*	*0.44*	*0.9*	*0.36*	*0.36*	*0.036*
1,2-Dichloroethane	36	58	47	49	53	66	52	53	60	52	24	42.6
Benzene	13	11	8	6	7	7	8	8	6.5	*4*	*4*	6.9
Chlorobenzene	1,180	976	828	598	569	586	560	588	422	263	264	386
1,2-Dichlorobenzene	64	81	86	65	62	72	86	84	77	53	51	86
1,3-Dichlorobenzene	*2.5*	*2.5*	3	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*6.5*	*2.5*	*2.5*	1.9
1,4-Dichlorobenzene	48	55	62	45	44	50	53	57	46	30	29	40.2
Methylene Chloride	*5*	*5*	*2.5*	*5*	*5*	*5*	*5*	*5*	*16*	*5*	*5*	*0.2*
1,2,4-Trichlorobenzene	*2.5*	*2.5*	*1.3*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*6.5*	*2.5*	*2.5*	*0.5*
Naphthalene	*4*	*2.5*	*1.3*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*6.5*	*2.5*	*2.5*	*0.5*
Semivolatile Organic Compounds (EPA												
Phenol	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*5*	*4.8*	*4.8*
2,4-Dimethylphenol	*7*	*6*	*5*	*2*	*2*	*1*	*4.8*	*4.8*	*4.8*	*5*	*4.8*	*4.8*
3,4-Methylphenol (m,p-Cresol)	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*5*	*4.8*	*4.8*
2-Methylphenol(o-Cresol)	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*5*	*4.8*	*4.8*
PCBs (EPA 8082), µg/L												
Aroclor 1260	*0.1*											*0.48*
TPH-diesel (EPA 8015B), µg/L												
Diesel												130
General Chemistry Parameters, mg/L												
Alkalinity (EPA 310.1)												728
Bromide												8.2
Nitrate as N (EPA 300)												*2.5*
Sulfide (EPA 376.2)												*0.066*
Sulfate (EPA 300)												128
COD, mg-O2/L												53.7
TOC, mg/L												7.6
Metals (EPA 6010B), µg/L												
Arsenic												*3.5*
Cadmium												*5*
Chromium												*2.3*
Manganese												1,210
Mercury												0.42
Metabolic Acids (HPLC), mg/L												
Acetic Acid												*7.5*
Propionic Acid												*7.5*
Ferrous Iron (Hach 8146), mg/L												
Ferrous Iron												0.19
Dissolved Gases (RSK 175), µg/L												
Methane	6,000	7,500	5,300	5,300	4,400	2,600	4,400	2,800	3,300	3,100	3,800	2,800
Ethane	34	23	25	24	25	21	25	14	20	16	19	22
Ethene	24	*300*	*300*	*300*	*150*	*1.5*	17	5	5	*150*	*150*	6
Field Measurements												
pH, SU	7.25	7	7.14	7.38	7.26	7.42	7.28	7.38	7.4	7.46	7.38	7.61
Temperature, °C	16.02	16.01	15.98	15.82	15.71	15.52	15.53	15.36	15.34	15.5	15.51	15.58
Specific Conductance, mS/cm	3.62	3.43	3.49	3.488	3.632	3.484	3.448	3.515	3.54	3.663	3.965	4.512
Dissolved Oxygen (DO), mg/L	11.57	12.49	10.38	15.44	12.44	7.76	17.09	15.89	14.61	19.17	12.91	
ORP, mV	-23	12.3	8.1	72.3	102.4	45.5	33.8	42.2	6.1	67.4	10.1	
Bromide (ISP), mV												
Field Measurements 53MP												
pH, SU	7.22	6.99	7.05	7.24	7.17	7.37	7.07	7.09	7.33	7.3	7.23	
Temperature, °C	15.76	15.3	15.66	15.87	15.39	14.67	15.41	15.09	14.83	15.22	15.22	
Specific Conductance, mS/cm	4.77	4.176	4.93	4.39	4.453	3.045	4.716	4.798	3.097	2.996	4.846	
Dissolved Oxygen (DO), mg/L	0.58	2.31	0.93	0.73	0.46	0.36	0.35	0.31	0.02	0.41	0.3	
ORP, mV	-88.4	10.2	-51.4	-22.6	-40.7	-22.4	-19.5	-39.3	-64.6	-45.3	-54.9	
Molar Concentration, µmol/L												
PCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
TCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00
DCE (total)	0.48	0.17	0.34	0.34	0.34	0.49	0.46	0.46	0.51	0.40	0.19	0.49
VC	0.13	0.21	0.14	0.08	0.05	0.08	0.19	0.12	0.02	0.09	0.06	0.16
Ethene	0.84	10.47	10.47	10.47	5.23	0.05	0.59	0.17	0.17	5.23	5.23	0.21
Ethane	1.11	0.75	0.82	0.78	0.82	0.69	0.82	0.46	0.65	0.52	0.62	0.72
Total µmol/L	2.57	11.60	11.76	11.68	6.44	1.32	2.06	1.21	1.39	6.26	6.11	1.58
TCB	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.01	0.01	0.00
1,2-DCB	0.44	0.55	0.58	0.44	0.42	0.49	0.58	0.57	0.52	0.36	0.35	0.58
1,4-DCB	0.33	0.37	0.42	0.31	0.30	0.34	0.36	0.39	0.31	0.20	0.20	0.27
Chlorobenzene	10.49	8.68	7.36	5.32	5.06	5.21	4.98	5.23	3.75	2.34	2.35	3.43
Benzene	0.17	0.14	0.10	0.06	0.09	0.09	0.10	0.10	0.08	0.05	0.05	0.09
Total µmol/L	11.43	9.76	8.48	6.15	5.88	6.14	6.04	6.30	4.71	2.97	2.96	4.38

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25IW02A

Days from Day Zero (4/15/04)	-22	25	40	54	75	88	102	116	130	146	159	173	187	202	215	238
Sample ID	IR25IW02A-1000	IR25IW02A-1036	IR25IW02A-1043	IR25IW02A-1050	IR25IW02A-1058	IR25IW02A-1064	IR25IW02A-1071	IR25IW02A-1077	IR25IW02A-1084	IR25IW02A-1090	IR25IW02A-1097	IR25IW02A-1103	IR25IW02A-1110	IR25IW02A-1116	IR25IW02A-1123	IR25IW02A-1130
Sample Collection Date	3/25/04	5/10/04	5/25/04	6/8/04	6/29/04	7/12/04	7/26/04	8/9/04	8/23/04	9/8/04	9/21/04	10/5/04	10/19/04	11/3/04	11/16/04	12/8/04
Parameter																
Volatile Organic Compounds (EPA 8260B), µg/L																
Tetrachloroethene	10	264	65	59	12.5	2.5	2.5	2.5	2.5	0.6	1.2	0.5	0.5	0.6	0.5	2.5
Trichloroethene	6.5	140	65	22	12.5	2.5	2.5	2.5	2.5	0.55	1.2	0.5	0.5	0.6	0.5	2.5
cis-1,2-DCE	341	7,070	3,410	556	330	29	2.5	2.5	2.5	0.85	0.54	0.6	0.6	0.8	0.8	3
trans-1,2-DCE	46	170	100	40	40	8	2.5	2.5	2.5	0.64	0.99	0.47	0.47	0.5	0.5	2.4
1,2-Dichloroethene (total)	387	7,240	3,510	596	370	37	5	5	5	1.4	1.5	1.1	1.1	1.3	1.1	5.4
Vinyl Chloride	347	2,690	4,230	1,140	330	64	15	5	2.5	1	1.2	0.69	0.69	6.7	5	3.5
1,1-Dichloroethene	6.5	6.5	65	12.5	12.5	2.5	2.5	2.5	2.5	0.51	0.92	0.65	0.65	0.51	0.65	3.3
1,2-Dichloroethane	47	430	680	290	140	26	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	12.5
Benzene	6.5	20	65	12.5	12.5	20	19	22	28	25	32	40	53	37	36	30
Chlorobenzene	373	332	430	2,390	1,960	4,750	3,240	3,880	4,180	3,710	4,130	4,030	5,080	4,890	4,350	4,220
1,2-Dichlorobenzene	734	8,000	4,660	1,780	1,260	160	58	61	33	30	21	24	36	138	110	130
1,3-Dichlorobenzene	9	75	65	40	30	11	2.5	2.5	4	4	3	4	4	9	7	12.5
1,4-Dichlorobenzene	266	1,910	1,100	950	717	1,050	785	761	427	142	59	56	66	225	242	200
Methylene Chloride	89	12.5	125	25	100	5	5	5	5	5	5	5	4	5	5	25
1,2,4-Trichlorobenzene	6.5	20	65	12.5	12.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	12.5
Naphthalene	6.5	44	65	12.5	17	14	17	16	21	17	11	2.5	2.5	12	9	12.5
Semivolatile Organic Compounds (EPA 8270C), µg/L																
Phenol	4.8															4.8
2,4-Dimethylphenol	4.8															31
3,4-Methylphenol (m,p-Cresol)	4.8															7
2-Methylphenol(o-Cresol)	4.8															37
PCBs (EPA 8082), µg/L																
Aroclor 1260	0.48	0.1	0.2													0.02
TPH-diesel (EPA 8015B), µg/L																
Diesel	450	18,500	21,900	13,500												2,690
General Chemistry Parameters, mg/L																
Alkalinity (EPA 310.1)	544	814	691	814	614	665	673	656	551	727	697	844	1,010	633	490	509
Bromide	2.8	28.7	75.3	55.5	84.7	104	67.5	77.4	61	63.7	57.4	40.2	69	63.5	65.3	43.8
Nitrate as N (EPA 300)	1.2	0.5	0.4	1	3.4	2	2	2.3	1.6	2.3	0.4	1	1	1	1.1	2
Sulfide (EPA 376.2)	0.5	1.3	2.4	0.8	2.4	0.22	0.17	0.32	0.17	0.13	0.12	0.13	0.14	0.17	0.22	0.22
Sulfate (EPA 300)	66.8	18.2	24.4	23.4	25	25	25	12.5	20	12.5	13.4	12.5	12.5	19.7	37.5	46.5
COD, mg-O2/L	21															95.5
TOC, mg/L	6.8	301	214	157	337	215	137	136	128	107	85.1	68.8	84.7	37.3	28.2	9.6
Metals (EPA 6010B), µg/L																
Arsenic	25															8.2
Cadmium	5															5
Chromium	1.6															1.9
Manganese	650															1,530
Mercury	0.13															0.11
Metabolic Acids (HPLC), mg/L																
Acetic Acid	2.5	300	2.5	5	14	2.5	2.5	2.5	2.5	2.5	2.5	2.5	160	2.5	2.5	2.5
Propionic Acid	5	240	5	160	200	5	150	140	130	60	5	5	76	5	5	5
Ferrous Iron (Hach 8146), mg/L																
Ferrous Iron	0.02	0.25	0.28	0.36	0.06	1.55	0.55	1.89	0.4	2.36	2.07	2.01	2.48	1.9	0.63	0.82
Dissolved Gases (RSK 175), µg/L																
Methane	160	390	360	600	400	400	630	1,100	2,700	2,400	4,000	7,100	6,800	10,000	11,000	12,000
Ethane	6.8	9.4	15	20	15	15	7.5	7.5	60	60	170	180	126	160	160	120
Ethene	12	136	230	362	410	270	280	270	420	130	26	12	8	37	42	27
Field Measurements																
pH, SU	7.72	7.19	7.06	7.1	7.06	7.27	7.14	7.17	6.98	7.09	6.96	7.11	7.14	7.22	7.12	7.28
Temperature, °C	15.27	16.09	15.89	15.98	16.2	15.99	16.28	16.36	16.51	16.81	16.7	16.92	16.9	16.9	16.84	16.72
Specific Conductance, mS/cm	2.05	3	3.43	0.462	4.893	4.874	4.94	5.009	5	4.734	5.32	4.62	3.49	4.14	5.26	4.28
Dissolved Oxygen (DO), mg/L	9.16	1.92	1.02	0.37	1.56	0.01	6.25	4.71	0.8	0.2	3.81	0.28	0.22	0.2	0.14	0.13
ORP, mV	3	-273	-185.1	-220.1	-299.6	-170.7	-170	-142.9	-111.1	-168.5	-179.3	-149	-153.3	-231.1	-179.1	-170.1
Bromide (ISP), mV		-167.1	-143.9	-146.8	-169.4	-159.3		-149.6	-145.1	-158.1	-156.1	-155.9	-162.3	-147.2	-142.6	-148
Field Measurements IW02MP																
pH, SU																
Temperature, °C																
Specific Conductance, mS/cm																
Dissolved Oxygen (DO), mg/L																
ORP, mV																
Molar Concentration, µmol/L																
PCE	0.06	1.59	0.39	0.36	0.08	0.02	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.02
TCE	0.05	1.06	0.49	0.17	0.09	0.02	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.02
DCE (total)	3.99	74.68	36.21	6.15	3.82	0.38	0.05	0.05	0.05	0.01	0.02	0.01	0.01	0.01	0.01	0.06
VC	5.55	43.04	67.68	18.24	5.28	1.02	0.24	0.08	0.04	0.02	0.02	0.01	0.01	0.11	0.08	0.06
Ethene	0.42	4.75	8.03	12.63	14.31	9.42	9.77	9.42	14.66	4.54	0.91	0.42	0.28	1.29	1.47	0.94
Ethane	0.22	0.31	0.49	0.65	0.49	0.49	0.24	0.24	1.96	1.96	5.55	5.87	4.11	5.22	5.22	3.91
Total µmol/L	10.29	125.43	113.29	38.20	24.07	11.35	10.34	9.83	16.74	6.53	6.50	6.32	4.42	6.64	6.78	5.00
TCB	0.04	0.11	0.36	0.07	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
1,2-DCB	4.99	54.42	31.70	12.11	8.57	1.09	0.39	0.41	0.22	0.20	0.14	0.16	0.24	0.94	0.75	0.88
1,4-DCB	1.81	12.99	7.48	6.46	4.88	7.14	5.34	5.18	2.90	0.97	0.40	0.38	0.45	1.53	1.65	1.36
Chlorobenzene	3.32	2.95	3.82	21.24	17.42	42.22	28.80	34.49	37.16	32.98	36.71	35.82	45.16	43.47	38.67	37.51
Benzene	0.08	0.26	0.83	0.16	0.16	0.26	0.24	0.28	0.36	0.32	0.41	0.51	0.68	0.47	0.46	0.36
Total µmol/L	10.24	70.73	44.19	40.04	31.10	50.72	34.79	40.38	40.66	34.48	37.68	36.89	46.54	46.42	41.54	40.21

Appendix C
Groundwater Analyses Data Summary Table for the Treatment Area

IR25IW02A

Days from Day Zero (4/15/04)	271	278	285	292	306	321	334	348	362	376	390	397
Sample ID	IR25IW02A-1162	IR25IW02A-1168	IR25IW02A-1175	IR25IW02A-1181	IR25IW02A-1188	IR25IW02A-1194	IR25IW02A-1201	IR25IW02A-1207	IR25IW02A-1214	IR25IW02A-1220	IR25IW02A-1227	IR25IW02A-1232
Sample Collection Date	1/11/05	1/18/05	1/25/05	2/1/05	2/15/05	3/2/05	3/15/05	3/29/05	4/12/05	4/26/05	5/10/05	5/17/05
Parameter												
Volatile Organic Compounds (EPA 826												
Tetrachloroethene	*0.6*	*0.6*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.61*	*0.66*	*0.66*	*0.66*	2.11
Trichloroethene	*0.56*	*0.56*	*0.49*	*0.49*	*0.49*	*0.49*	*0.49*	*0.36*	*0.5*	*0.5*	*0.5*	0.54
cis-1,2-DCE	*0.85*	*0.85*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.48*	*0.56*	*0.56*	*0.56*	1.84
trans-1,2-DCE	*0.54*	*0.54*	*0.47*	*0.47*	*0.47*	*0.47*	*0.47*	*0.3*	*0.57*	*0.57*	*0.57*	0.66
1,2-Dichloroethene (total)	*1.6*	*1.39*	*1.1*	*1.1*	*1.1*	*1.1*	*1.1*	*0.78*	*1.2*	*1.2*	*1.2*	*2.5*
Vinyl Chloride	5	5.8	*0.69*	*0.69*	*0.69*	*0.69*	*0.69*	1.8	4.4	*0.57*	*0.57*	*0.79*
1,1-Dichloroethene	*0.51*	*0.51*	*0.65*	*0.65*	*0.65*	*0.65*	*0.65*	*0.44*	*0.36*	*0.36*	*0.36*	*0.036*
1,2-Dichloroethane	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5	1.9
Benzene	9	7	5	4	5	4	4	4	3	2.5	2.5	1.7
Chlorobenzene	1,980	1,410	1,210	923	836	998	962	963	760	505	346	316
1,2-Dichlorobenzene	93	120	120	97	83	113	121	130	127	95	56	44.8
1,3-Dichlorobenzene	7	7	7	5	4	6	6	6	6	4	2.5	2.1
1,4-Dichlorobenzene	111	123	126	97	81	109	116	123	112	79	46	31
Methylene Chloride	5	5	5	5	5	5	5	5	5	5	5	*0.5*
1,2,4-Trichlorobenzene	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	*0.25*
Naphthalene	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.6
Semivolatile Organic Compounds (EP/												
Phenol	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	5	*4.8*	*4.8*
2,4-Dimethylphenol	6	6	5	3	2	1	*4.8*	*4.8*	*4.8*	2	*4.8*	*4.8*
3,4-Methylphenol (m,p-Cresol)	*4.8*	*4.8*	*4.8*	0.8	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	1	*4.8*	*4.8*
2-Methylphenol(o-Cresol)	2	2	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	*4.8*	5	*4.8*	*4.8*
PCBs (EPA 8082), µg/L												
Aroclor 1260	*0.05*											*0.48*
TPH-diesel (EPA 8015B), µg/L												
Diesel												230
General Chemistry Parameters, mg/L												
Alkalinity (EPA 310.1)												710
Bromide												12.3
Nitrate as N (EPA 300)												2
Sulfide (EPA 376.2)												*0.041*
Sulfate (EPA 300)												74.1
COD, mg-O_2/L	5.26											62.7
TOC, mg/L												*0.5*
Metals (EPA 6010B), µg/L												
Arsenic												3.1
Cadmium												5
Chromium												2.3
Manganese												1,580
Mercury												0.29
Metabolic Acids (HPLC), mg/L												
Acetic Acid												*7.5*
Propionic Acid												*7.5*
Ferrous Iron (Hach 8146), mg/L												
Ferrous Iron												0.25
Dissolved Gases (RSK 175), µg/L												
Methane	6,400	3,900	2,800	2,600	2,300	2,600	2,900	1,600	1,900	1,900	1,500	1,400
Ethane	55	19	21	22	23	21	21	15	20	16	14	13
Ethene	75	10	9.5	9.5	5	*1.5*	47	4	4	*1.5*	*1.5*	7.3
Field Measurements												
pH, SU	7.19	6.93	7.1	7.25	7.17	7.3	7.17	7.26	7.35	7.34	7.4	7.5
Temperature, °C	16.05	16.07	16.08	15.97	15.84	15.64	15.66	15.47	15.4	15.61	15.56	15.65
Specific Conductance, mS/cm	3.44	3.15	3.167	3.249	3.4	3.303	3.207	3.303	3.312	3.46	3.608	3.82
Dissolved Oxygen (DO), mg/L	2.39	6.32	8.96	9.76	9.44	4.97	9.01	8.54	10.87	9.52	19.02	
ORP, mV	-38.6	-29.4	-39.2	-3.1	39.8	-16.8	-26.3	-33.8	-30.3	-31.4	13.7	
Bromide (ISP), mV												
Field Measurements IW02MP												
pH, SU	7.87	7.62	7.68	7.56	7.34	7.35	7.59	7.34	7.28	7.11	7.2	
Temperature, °C	15.65	15.44	15.8	16.18	15.55	15.2	15.48	15.24	15.04	15.57	15.45	
Specific Conductance, mS/cm	2.306	2.067	2.092	2.348	2.588	2.418	2.148	2.523	2.542	2.785	3.071	
Dissolved Oxygen (DO), mg/L	0.56	4.83	0.51	0.86	0.5	0.44	0.68	0.11	0.59	0.41	0.9	
ORP, mV	-85.2	-33.5	-99.3	-63.5	-75.1	-71.6	-84	-128.7	-99.8	-78.3	-86.7	
Molar Concentration, µmol/L												
PCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
TCE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
DCE (total)	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03
VC	0.06	0.09	0.01	0.01	0.01	0.01	0.01	0.03	0.07	0.01	0.01	0.01
Ethene	2.62	0.35	0.33	0.33	0.17	0.05	1.64	0.14	0.14	0.05	0.05	0.25
Ethane	1.79	0.62	0.69	0.72	0.75	0.69	0.69	0.49	0.65	0.52	0.46	0.42
Total µmol/L	4.52	1.08	1.05	1.06	0.95	0.77	2.35	0.67	0.88	0.61	0.54	0.73
TCB	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
1,2-DCB	0.63	0.82	0.82	0.66	0.56	0.77	0.82	0.88	0.86	0.65	0.38	0.30
1,4-DCB	0.76	0.84	0.86	0.66	0.55	0.74	0.79	0.84	0.78	0.54	0.31	0.21
Chlorobenzene	17.60	12.53	10.76	8.20	7.43	8.87	8.55	8.56	6.76	4.49	3.08	2.81
Benzene	0.12	0.09	0.06	0.05	0.06	0.05	0.05	0.05	0.04	0.03	0.03	0.02
Total µmol/L	19.12	14.29	12.51	9.59	8.62	10.45	10.23	10.35	8.43	5.72	3.82	3.35

Legend

Meaning	Example
NO Data - Not Sampled	
ND - Conc = 1/2 Reporting Limit	*0.5*
J value - Estimated Concentration	0.5
Calculated Field	0.5
MDL value	*1.5*

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Days		-22	237	392	-21	237	396	-21	237	396
Sample ID		IR25MW11A-1011	IR25MW11A-1141	IR25MW11A-1243	IR25MW900B-1016	IR25MW900B-1146	IR25MW900B-1248	IR25MW902B-1019	IR25MW902B-1149	IR25MW902B-1251
Sample Location		IR25MW11A			IR25MW900B			IR25MW902B		
Sample Collection Date		3/24/2004	12/8/2004	5/12/2005	3/25/2004	12/8/2004	5/16/2005	3/25/2004	12/8/2004	5/16/2005
Parameter	Units	Adjacent to degreaser pit area								
Volatile Organic Compounds (EPA 8260B)										
Tetrachloroethene	µg/L	<5	*<1.3*	*<0.066*	886	423	380	31,300	33,400	29,500
Trichloroethene	µg/L	<5	*<1.2*	*<0.08*	1,010	486	456	10,600	15,100	9,840
cis-1,2-DCE	µg/L	176	8.5	1.13	1,010	706	620	24,800	48,500	24,100
trans-1,2-DCE	µg/L	15	*<1.2*	0.52	130	241	116	700	2,560	826
1,2-Dichloroethene (total)	µg/L	191	8.5	1.7	1,140	947	736	25,500	51,060	24,930
Vinyl Chloride	µg/L	198	76	3.6	250	655	59	3,800	30,300	6,120
1,1-Dichloroethene	µg/L	<5	*<1.6*	*<0.036*	<13	*<3.3*	2.48	<500	116	21.5
1,2-Dichloroethane	µg/L	<5	<13	<0.5	150	78	64.8	52,700	85,800	30,600
Benzene	µg/L	<5	<13	0.6	<13	<25	3.7	<500	793	180
Chlorobenzene	µg/L	405	620	220	*12*	53	4.0	<500	340	230
1,2-Dichlorobenzene	µg/L	172	130	24	1,250	944	245	31,200	46,200	30,200
1,4-Dichlorobenzene	µg/L	126	150	34	230	200	48.5	7,600	10,600	6,610
Methylene Chloride	µg/L	28	*10*	*0.6*	73	*21*	<1	2,700	<50	50
1,2,4-Trichlorobenzene	µg/L	<5	<13	<0.5	<13	<25	<0.5	<500	50	57
Naphthalene	µg/L	<5	<13	<0.5	<13	<25	1.0	<500	120	140
Semivolatile Organic Compounds (EPA 8270C)										
Phenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	*730*	930	1,000
2,4-Dimethylphenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	13,000	7,990	8,530
3,4-Methylphenol (m,p-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	5,700	3,790	3,380
2-Methylphenol(o-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	*4*	<9.6	2,800	1,700	3,190
PCBs (EPA 8082)										
Aroclor 1260	µg/L	*0.02*	*0.1*	<1	<1	*0.04*	<1	*0.06*	*0.02*	<1
TPH-diesel (EPA 8015B)										
Diesel	µg/L	2,710	3,320	28,200	490	510	1,020	101,000	117,000	114,000
General Chemistry Parameters										
Alkalinity (EPA 310.1)	mg/L	684	724	828	857	867	870	631	654	645
Bromide	mg/L	*3.7*	*0.83*	3.6	*21.3*	3	13.9	23.9J	1	9.1
Nitrate as N (EPA 300)	mg/L	<1.6	<1	*2.8*	12.9	*7.9*	<20	13.5	10.8	<20
Sulfide (EPA 376.2)	mg/L	*0.12*	*0.19*	*0.10*	<1	<1	*0.036*	<1	<1	*0.033*
Sulfate (EPA 300)	mg/L	39.4	25.7	*45.6*	329	318	397	256	221	264
COD	mg-O_2/L									
TOC	mg/L									
Metals (EPA 6010B)										
Arsenic	µg/L	<50	*12.7*	<50	*15.7*	*5.4*	<50	<50	*11.3*	*3.5*
Cadmium	µg/L	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chromium	µg/L	*0.79*	*2.3*	*2.9*	*1.6*	*5.9*	*5.2*	*0.94*	*6.2*	*5.9*
Manganese	µg/L	841	1,090	792	4,700	4,690	4,430	6,670	8,420	6,680
Mercury	µg/L	*0.1*	*0.18*	0.63	*0.027*	<0.2	0.26	<0.2	<0.2	*0.05*
Ferrous Iron (Hach 8146)										
Ferrous Iron	mg/L	0.21	0.06	0.28	0.03	1.94	0.02	0.66	3.2	2.11
Dissolved Gases (RSK 175)										
Methane	µg/L	940	790	1,700	55	260	<3	870	1,600	750
Ethane	µg/L	29	35	29	<3	<3	<3	<300	<300	7.9
Ethene	µg/L	23	8.8	4	15	24	<3	1,600	3,000	1,600
Field Measurements										
pH	SU	7.56	7.25	8.20	7.02	6.76	6.94	7.44	6.68	7.07
Temperature	°C	15.31	16.64	16.04	15.43	16.69	15.99	15.34	16.77	15.75
Specific Conductance	mS/cm	2.55	2.87	7.22	12.20	11.38	12.70	12.00	11.02	12.64
Dissolved Oxygen (DO)	ppm	10.28	0.11	0.51	8.88	0.28		8.74	0.29	0
ORP	mV	-106	-114.3	-111.6	-21.0	-41.9	14.1	-97	-52	-64.9

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Days		-23	237	396	-22	235	398	-22	235	398
Sample ID		IR25MW15F-1012	IR25MW15F-1142	IR25MW15F-1244	IR25MW55A-1004	IR25MW55A-1134	IR25MW55A-1236	IR25MW57A-1021	IR25MW57A-1151	IR25MW57A-1253
Sample Location		IR25MW15F			IR25MW55A			IR25MW57A		
Sample Collection Date		3/23/2004	12/8/2004	5/16/2005	3/24/2004	12/6/2004	5/18/2005	3/24/2004	12/6/2004	5/18/2005
Parameter	Units	Adjacent to degreaser pit area								
Volatile Organic Compounds (EPA 8260B)										
Tetrachloroethene	µg/L	79.9	52.3	40.6	32,700	19,100	1,810	278	315	82
Trichloroethene	µg/L	7.1	6.67	8.86	30,400	30,700	4,470	764	1,260	316
cis-1,2-DCE	µg/L	5.1	5.15	9.97	20,100	93,000	28,900	3,030	8,310	2,280
trans-1,2-DCE	µg/L	2.7	3.59	5.16	931	2,980	670	364	622	135
1,2-Dichloroethene (total)	µg/L	7.8	8.7	15.1	21,031	95,980	29,570	3,394	8,932	2,415
Vinyl Chloride	µg/L	9.6	3.9	7.3	4,960	6,800	3,580	428	1,270	80
1,1-Dichloroethene	µg/L	<0.5	*<0.065*	*<0.036*	10	147	19.3	6.8	17	<0.9
1,2-Dichloroethane	µg/L	16.4	20.8	30.7	89,500	88,900	43,000	3,450	8,670	2,120
Benzene	µg/L	<0.5	<0.5	<0.5	290	330	150	16.5	18.5	*11*
Chlorobenzene	µg/L	<0.5	<0.5	<0.5	200	240	110	13.3	20.4	<13
1,2-Dichlorobenzene	µg/L	2.2	1	0.8	40,400	67,000	11,100	406	1,040	100
1,4-Dichlorobenzene	µg/L	0.9	*0.4*	<0.5	9,480	15,000	2,250	113	201	20
Methylene Chloride	µg/L	3.4	<1	<1	1,330	1,500	480	7	2.9	*11*
1,2,4-Trichlorobenzene	µg/L	<0.5	<0.5	<0.5	140	74	*13*	0.5J	<0.5	<13
Naphthalene	µg/L	<0.5	<0.5	<0.5	190	170	32	<0.5	<0.5	<13
Semivolatile Organic Compounds (EPA 8270C)										
Phenol	µg/L	<9.6	<9.6	<9.6	*780*	550	750	<9.6	<9.6	<9.6
2,4-Dimethylphenol	µg/L	<9.6	<9.6	<9.6	2,300	2,200	*1,800*	<9.6	<9.6	<9.6
3,4-Methylphenol (m,p-Cresol)	µg/L	<9.6	<9.6	<9.6	2,700	2,600	*3,670*	<9.6	<9.6	<9.6
2-Methylphenol(o-Cresol)	µg/L	<9.6	<9.6	<9.6	3,000	3,300	2,970	<9.6	<9.6	<9.6
PCBs (EPA 8082)										
Aroclor 1260	µg/L	*0.3*	*0.1*	<1	<0.96	*0.2*	<1	*0.2*	*0.2*	<1
TPH-diesel (EPA 8015B)										
Diesel	µg/L	<48	<48	310	93,400	44,800	61,300	270	170	120
General Chemistry Parameters										
Alkalinity (EPA 310.1)	mg/L	650	621	664	626	511	506	655	635	629
Bromide	mg/L	*34.8*	2	16.8	11.7J	3.7	2.4	*21.6*	7.5	12.0
Nitrate as N (EPA 300)	mg/L	17.1	*13*	*18*	6.6	<5	<8	9.7	*3.7*	<16
Sulfide (EPA 376.2)	mg/L	<1	<1	*0.033*	<1	<1	*0.028*	<1	<1	*0.036*
Sulfate (EPA 300)	mg/L	354	276	*397*	411	349	357	322	289	368
COD	mg-O_2/L									
TOC	mg/L									
Metals (EPA 6010B)										
Arsenic	µg/L	<50	*11.2*	<50	<50	*8.8*	*13.6*	<50	<50	<50
Cadmium	µg/L	*0.19*	<10	<10	*0.4*	*1.2*	<10	*0.1*	<10	<10
Chromium	µg/L	*1.5*	*5.5*	*3.5*	<10	*7.1*	*4.1*	<10	*7.4*	*5.2*
Manganese	µg/L	135	<10	<10	2,890	3,420	3,970	4,450	5,140	6,240
Mercury	µg/L	*0.086*	*0.056*	0.25	*0.071*	<0.2	<0.2	<0.2	<0.2	<0.2
Ferrous Iron (Hach 8146)										
Ferrous Iron	mg/L	0.01	0	0.02	0.02	0.25	2.87	0.67	0.38	2.49
Dissolved Gases (RSK 175)										
Methane	µg/L	3	18	6	190	400	600	270	500	1,300
Ethane	µg/L	<3	<3	<3	<30	<30	11	<3	4	<3
Ethene	µg/L	<3	<3	<3	748	656	920	21	63	43
Field Measurements										
pH	SU	7.68	7.42	7.53	7.09	6.95	6.55	7.75	6.84	6.66
Temperature	°C	15.2	16.99	16.93	14.75	16.76	16.38	15.17	16.97	16.17
Specific Conductance	mS/cm	14.9	14.92	16.13	6.92	4.56	7.308	5.46	6.818	8.215
Dissolved Oxygen (DO)	ppm	9.81	0.72	4.21	10	0.19		10.47	1.85	
ORP	mV	86	3.6	14.0	68	-127	-54.3	163	19	-23.9

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Days		-22	235	398	-21	238	391	-23	236	391
Sample ID		IR25MW904B-1018	IR25MW904B-1148	IR25MW904B-1250	IR25MW51A-1015	IR25MW51A-1145	IR25MW51A-1247	IR06MW44A-1005	IR06MW44A-1135	IR06MW44A-1237
Sample Location		IR25MW904B			IR25MW51A			IR06MW44A		
Sample Collection Date		3/24/2004	12/6/2004	5/18/2005	3/25/2004	12/9/2004	5/11/2005	3/23/2004	12/7/2004	5/11/2005
Parameter	Units	Adjacent to degreaser pit area			Outside of degreaser pit area					
Volatile Organic Compounds (EPA 8260B)										
Tetrachloroethene	µg/L	<0.5	*<0.06*	29.7	0.7	*<0.05*	*<0.066*	<0.5	*<0.06*	*<0.066*
Trichloroethene	µg/L	<0.5	0.3	103	<0.5	*<0.05*	*<0.080*	<0.5	*<0.056*	*<0.080*
cis-1,2-DCE	µg/L	1.2	1.6	845	<0.5	*<0.06*	*<0.056*	<0.5	*<0.085*	*<0.056*
trans-1,2-DCE	µg/L	0.4J	0.43	48.5	<0.5	*<0.05*	*<0.067*	<0.5	*<0.054*	*<0.067*
1,2-Dichloroethene (total)	µg/L	1.6	2	894	<0.5	*<0.06*	*<0.067*	<0.5	*<0.085*	*<0.067*
Vinyl Chloride	µg/L	<0.5	*<0.1*	27.3	<0.5	*<0.07*	*<0.057*	<0.5	*<0.1*	*<0.057*
1,1-Dichloroethene	µg/L	<0.5	*<0.051*	1.06	<0.5	*<0.065*	*<0.036*	<0.5	*<0.051*	*<0.036*
1,2-Dichloroethane	µg/L	<0.5	<0.5	807	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	µg/L	<0.5	<0.5	3.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	µg/L	<0.5	<0.5	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	µg/L	0.9	1	14.3	1.2	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	µg/L	<0.5	<0.5	3.2	0.4J	<0.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	µg/L	3.5	<1	<1	<1	<1	0.4	2.5	<1	0.7
1,2,4-Trichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Semivolatile Organic Compounds (EPA 8270C)										
Phenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
2,4-Dimethylphenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
3,4-Methylphenol (m,p-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
2-Methylphenol(o-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
PCBs (EPA 8082)										
Aroclor 1260	µg/L	*0.03*	<0.96	<1	*0.04*	<0.96	<1	*0.9*	*0.03*	*0.08*
TPH-diesel (EPA 8015B)										
Diesel	µg/L	<48	*36*	*23*	<48	*8*	<48	150	66	<48
General Chemistry Parameters										
Alkalinity (EPA 310.1)	mg/L	1,000	949	801	722	778	803	289	293	316
Bromide	mg/L	*48.1*	4.1	15.7	*33.6*	13	13.3	<6.3	<1	1.1
Nitrate as N (EPA 300)	mg/L	26.3	<16	<20	18.2	*8*	*10.6*	0.76	0.82	<0.8
Sulfide (EPA 376.2)	mg/L	<1	<1	*0.028*	<1	<1	*0.03*	<1	<1	*0.03*
Sulfate (EPA 300)	mg/L	26.3	*172*	279	410	358	407	359	326	506
COD	mg-O_2/L	66.1								
TOC	mg/L	19								
Metals (EPA 6010B)										
Arsenic	µg/L	<50	*3.2*	<50	<50	*3*	<50	<50	*2.9*	*2.2*
Cadmium	µg/L	*0.21*	<10	<10	*0.17*	<10	<10	*0.13*	<10	*0.26*
Chromium	µg/L	<10	*5*	*3.4*	*1.3*	*3.1*	*4.3*	<13	*1.8*	*2.8*
Manganese	µg/L	4,780	4,620	4,320	664	1,380	913	98.8	290	515
Mercury	µg/L	<0.2	<0.2	<0.2	*0.025*	<0.2	0.24	*0.16*	0.29	0.50
Ferrous Iron (Hach 8146)										
Ferrous Iron	mg/L	0.05	0.03	0.52	0.01	0	0.01	0.08	0.03	0.02
Dissolved Gases (RSK 175)										
Methane	µg/L	310	<3	28	<3	17	<3	6.4	<3	22
Ethane	µg/L	<3	<3	<3	<3	<3	<3	<3	<3	<3
Ethene	µg/L	<3	<3	3	<3	<3	<3	<3	<3	<3
Field Measurements										
pH	SU	7.35	7.22	6.95	7.44	7.02	7.36	7.25	6.97	7.39
Temperature	°C	15.78	16.82	16.28	15.46	16.94	16.46	14.79	17.31	16.83
Specific Conductance	mS/cm	18.4	17.52	20.06	13.5	12.74	13.50	1.47	1.54	1.868
Dissolved Oxygen (DO)	ppm	10.2	0.19		9.07	0.5	0.48	10.09	4.02	0.09
ORP	mV	20	-78.5	23.2	38	57.1	16.0	41	14.5	-14.7

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Days		-23	236	391	-22	235	392	-22	235	392
Sample ID		IR25MW42B-1010	IR25MW42B-1040	IR25MW42B-1242	IR25MW37A-1007	IR25MW37A-1137	IR25MW37A-1239	IR25MW37B-1008	IR25MW37B-1138	IR25MW37B-1240
Sample Location		IR25MW42B			IR25MW37A			IR25MW37B		
Sample Collection Date		3/23/2004	12/7/2004	5/11/2005	3/24/2004	12/6/2004	5/12/2005	3/24/2004	12/6/2004	5/12/2005
Parameter	Units	Outside of degreaser pit area								
Volatile Organic Compounds (EPA 8260B)										
Tetrachloroethene	µg/L	<0.5	*<0.06*	*<0.066*	<0.5	15.2	*<0.066*	<0.5	*<0.06*	*<0.066*
Trichloroethene	µg/L	<0.5	*<0.056*	*<0.080*	<0.5	5.13	*<0.080*	<0.5	*<0.056*	*<0.080*
cis-1,2-DCE	µg/L	<0.5	*<0.085*	*<0.056*	<0.5	5.51	*<0.056*	<0.5	*<0.085*	*<0.056*
trans-1,2-DCE	µg/L	<0.5	*<0.054*	*<0.067*	<0.5	*<0.054*	*<0.067*	<0.5	*<0.054*	*<0.067*
1,2-Dichloroethene (total)	µg/L	<0.5	*<0.085*	*<0.067*	<0.5	5.51	*<0.067*	<0.5	*<0.085*	*<0.067*
Vinyl Chloride	µg/L	<0.5	*<0.1*	*<0.057*	<0.5	0.41	*<0.057*	<0.5	*<0.1*	*<0.057*
1,1-Dichloroethene	µg/L	<0.5	*<0.051*	*<0.036*	<0.5	*<0.051*	*<0.036*	<0.5	*<0.051*	*<0.036*
1,2-Dichloroethane	µg/L	<0.5	<0.5	<0.5	<0.5	2.7	<0.5	<0.5	<0.5	<0.5
Benzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	59.2	0.6	0.3J	*0.4*	<0.5
1,4-Dichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	17.5	<0.5	<0.5	<0.5	<0.5
Methylene Chloride	µg/L	3.2	<1	*0.4*	3.3	<1	<1	2.4	<1	1
1,2,4-Trichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Semivolatile Organic Compounds (EPA 8270C)										
Phenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
2,4-Dimethylphenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
3,4-Methylphenol (m,p-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
2-Methylphenol(o-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
PCBs (EPA 8082)										
Aroclor 1260	µg/L	<0.96	*0.03*	<1	<0.96	*0.04*	<1	*0.02*	*0.04*	<1
TPH-diesel (EPA 8015B)										
Diesel	µg/L	<48	48	<48	<48	90	60	<48	100	<48
General Chemistry Parameters										
Alkalinity (EPA 310.1)	mg/L	1,000	1,110	924	468	316	56.2	241	63.3	69.6
Bromide	mg/L	<200	4.4	14.1	<2.5	<1	<1	<63	<1	<1
Nitrate as N (EPA 300)	mg/L	<16	*13.7*	*16.9*	0.22	<0.8	0.46	5.4	0.33	0.33
Sulfide (EPA 376.2)	mg/L	<1	<1	*0.027*	<1	<1	*0.035*	<1	<1	<1
Sulfate (EPA 300)	mg/L	303	282	270	165	364	34.6	3,920	50.3	78.6
COD	mg-O_2/L									
TOC	mg/L									
Metals (EPA 6010B)										
Arsenic	µg/L	<50	*12.2*	<50	*1.9*	*2.7*	<50	<50	<50	<50
Cadmium	µg/L	*0.16*	<10	<10	*0.52*	*0.16*	<10	*0.3*	<10	<10
Chromium	µg/L	<10	*4.1*	*4.1*	<10	*6.8*	<10	*0.54*	*7.7*	*1.0*
Manganese	µg/L	2,260	3,960	1,930	97.8	324	311	<10	77.4	*0.6*
Mercury	µg/L	*0.027*	<0.2	0.56	*0.11*	0.38	0.58	*0.077*	0.21	0.76
Ferrous Iron (Hach 8146)										
Ferrous Iron	mg/L	0.09	4.4	0.01	0.01	0.06	0.09	0.01	0	0.01
Dissolved Gases (RSK 175)										
Methane	µg/L	120	180	60	<3	6.7	6	<3	6	<3
Ethane	µg/L	<3	<3	<3	<3	<3	<3	<3	<3	<3
Ethene	µg/L	<3	<3	<3	<3	<3	<3	<3	<3	<3
Field Measurements										
pH	SU	7.2	7.01	7.15	7.72	7.4	7.12	8.11	7.99	8.29
Temperature	°C	16.3	17.6	17.04	16.72	18.17	17.32	16.89	18.32	17.25
Specific Conductance	mS/cm	14	13.67	14.63	1.16	1.38	0.266	7.1	1.01	0.362
Dissolved Oxygen (DO)	ppm	9.37	0.38	0.02	8.91	0.32		9.55	4.67	3.42
ORP	mV	-15	-97	-36.0	38	-11.6	24.5	75	68.1	14.6

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Days		-22	236	392	-22	236	398	-21	236	391
Sample ID		IR25MW17A-1006	IR25MW17A-1136	IR25MW17A-1238	IR25MW38B-1009	IR25MW38B-1139	IR25MW38B-1241	IR25MW39A-1013	IR25MW39A-1143	IR25MW39A-1245
Sample Location		IR25MW17A			IR25MW38B			IR25MW39A		
Sample Collection Date		3/24/2004	12/7/2004	5/12/2005	3/24/2004	12/7/2004	5/18/2005	3/25/2004	12/7/2004	5/11/2005
Parameter	Units	Outside of degreaser pit area								
Volatile Organic Compounds (EPA 8260B)										
Tetrachloroethene	µg/L	<0.5	*<0.06*	*<0.066*	<0.5	*<0.06*	2.56	<0.5	*<0.06*	*<0.066*
Trichloroethene	µg/L	<0.5	*<0.056*	*<0.080*	<0.5	*<0.056*	*<0.080*	<0.5	*<0.056*	*<0.080*
cis-1,2-DCE	µg/L	<0.5	*<0.085*	*<0.056*	<0.5	*<0.085*	0.39	<0.5	0.37	*<0.056*
trans-1,2-DCE	µg/L	<0.5	*<0.054*	*<0.067*	<0.5	*<0.054*	*<0.067*	<0.5	*<0.054*	*<0.067*
1,2-Dichloroethene (total)	µg/L	<0.5	*<0.085*	*<0.067*	<0.5	*<0.085*	0.39	<0.5	0.37	*<0.067*
Vinyl Chloride	µg/L	<0.5	*<0.1*	*<0.057*	<0.5	*<0.1*	*<0.057*	<0.5	*<0.1*	*<0.057*
1,1-Dichloroethene	µg/L	<0.5	*<0.051*	*<0.036*	<0.5	*<0.051*	*<0.036*	<0.5	*<0.051*	*<0.036*
1,2-Dichloroethane	µg/L	0.9	3.5	1.0	<0.5	<0.5	*0.4*	<0.5	<0.5	<0.5
Benzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	0.6
Chlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	1.4	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	7.0	0.7	<0.5	<0.5
1,4-Dichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	1.6	<0.5	<0.5	<0.5
Methylene Chloride	µg/L	3.7	<1	<1	3.4	<1	<1	<1	<1	*0.5*
1,2,4-Trichlorobenzene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Semivolatile Organic Compounds (EPA 8270C)										
Phenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
2,4-Dimethylphenol	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
3,4-Methylphenol (m,p-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
2-Methylphenol(o-Cresol)	µg/L	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6	<9.6
PCBs (EPA 8082)										
Aroclor 1260	µg/L	<0.96	<0.96	<1	*0.01*	<0.96	<1	*0.02J*	<0.96	<1
TPH-diesel (EPA 8015B)										
Diesel	µg/L	<48	70	<48	57	*48*	<48	160	240	190
General Chemistry Parameters										
Alkalinity (EPA 310.1)	mg/L	686	898	731	1,110	1,120	1,140	525	471	479
Bromide	mg/L	*8.6*	4.0	4.4	*46.3*	10.6	15.0	*18.4*	7.7	8.8
Nitrate as N (EPA 300)	mg/L	4.8	*3.1*	<5	<20	*14.2*	*17.3*	<5	*3.3*	<8
Sulfide (EPA 376.2)	mg/L	<1	<1	*0.032*	*0.14*	<1	*0.031*	<1	<1	*0.083*
Sulfate (EPA 300)	mg/L	1,870	1,790	1,840	<250	*172*	*277*	<63	*37.3*	*62.7*
COD	mg-O_2/L									
TOC	mg/L									
Metals (EPA 6010B)										
Arsenic	µg/L	<50	*4.0*	*8.7*	*2.3*	<50	<50	<50	*3.6*	<50
Cadmium	µg/L	*0.17*	<10	<10	<10	<10	<10	<10	<10	<10
Chromium	µg/L	*4.1*	*7.7*	*7.7*	<10	*5.9*	*5.6*	*0.98*	*7*	*6.0*
Manganese	µg/L	619	8,500	1,590	5,770	5,980	5,200	2,550	2,530	2,610
Mercury	µg/L	*0.045*	<0.2	0.52	*0.042*	*0.069*	<0.2	<0.2	<0.2	0.22
Ferrous Iron (Hach 8146)										
Ferrous Iron	mg/L	0.01	1.50	0.11	5.3	0.03	1.79	3.01	6.65	6.50
Dissolved Gases (RSK 175)										
Methane	µg/L	6.2	21	5	1,900	230	40	2,000	2,100	2,700
Ethane	µg/L	<3	<3	<3	<3	<3	<3	<3	<3	<3
Ethene	µg/L	<3	<3	<3	<3	<3	<3	<3	<3	<3
Field Measurements										
pH	SU	7.06	6.77	7.56	6.92	6.80	7.04	7.04	6.8	7.05
Temperature	°C	17.29	19.09	17.90	17.56	19.37	18.06	15.46	17.14	16.02
Specific Conductance	mS/cm	6.60	7.601	8.18	21.2	20.05	23.17	4.56	5.072	5.420
Dissolved Oxygen (DO)	ppm	10.4	0.37	0.39	9.17	0.31		9.45	0.46	0.02
ORP	mV	60	-94.3	-7.4	-120	-113.8	-96.8	-79	-73.6	-61.7

Appendix D
Groundwater Analyses Data Summary Table for Wells Outside of the Treatment Area

Days		-22	236	392
Sample ID		IR25MW39B-1014	IR25MW39B-1144	IR25MW39B-1246
Sample Location		IR25MW39B		
Sample Collection Date		3/24/2004	12/7/2004	5/12/2005
Parameter	Units	Outside of degreaser pit area		
Volatile Organic Compounds (EPA 8260B)				
Tetrachloroethene	µg/L	<0.5	*<0.06*	*<0.066*
Trichloroethene	µg/L	<0.5	*<0.056*	*<0.080*
cis-1,2-DCE	µg/L	<0.5	*<0.085*	*<0.056*
trans-1,2-DCE	µg/L	<0.5	*<0.054*	*<0.067*
1,2-Dichloroethene (total)	µg/L	<0.5	*<0.085*	*<0.067*
Vinyl Chloride	µg/L	<0.5	*<0.1*	*<0.057*
1,1-Dichloroethene	µg/L	<0.5	*<0.051*	*<0.036*
1,2-Dichloroethane	µg/L	<0.5	<0.5	<0.5
Benzene	µg/L	<0.5	<0.5	<0.5
Chlorobenzene	µg/L	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	µg/L	1.2	<0.5	<0.5
1,4-Dichlorobenzene	µg/L	0.4J	<0.5	<0.5
Methylene Chloride	µg/L	<1	<1	*0.9*
1,2,4-Trichlorobenzene	µg/L	<0.5	<0.5	<0.5
Naphthalene	µg/L	<0.5	<0.5	<0.5
Semivolatile Organic Compounds (EPA 8270C)				
Phenol	µg/L	<9.6	<9.6	<9.6
2,4-Dimethylphenol	µg/L	<9.6	<9.6	<9.6
3,4-Methylphenol (m,p-Cresol)	µg/L	<9.6	<9.6	<9.6
2-Methylphenol(o-Cresol)	µg/L	<9.6	<9.6	<9.6
PCBs (EPA 8082)				
Aroclor 1260	µg/L	*0.01*	<0.96	<1
TPH-diesel (EPA 8015B)				
Diesel	µg/L	<48	*42*	<48
General Chemistry Parameters				
Alkalinity (EPA 310.1)	mg/L	691	717	718
Bromide	mg/L	<200	13.4	15.5
Nitrate as N (EPA 300)	mg/L	<16	*11.8*	*17.7*
Sulfide (EPA 376.2)	mg/L	<1	<1	*0.030*
Sulfate (EPA 300)	mg/L	302	226	275
COD	mg-O_2/L			
TOC	mg/L			
Metals (EPA 6010B)				
Arsenic	µg/L	<50	*4.6*	<50
Cadmium	µg/L	<10	<10	<10
Chromium	µg/L	*0.88*	*5*	*5*
Manganese	µg/L	330	793	188
Mercury	µg/L	*0.024*	*0.1*	*0.055*
Ferrous Iron (Hach 8146)				
Ferrous Iron	mg/L		0.3	0.24
Dissolved Gases (RSK 175)				
Methane	µg/L	11	41	11
Ethane	µg/L	<3	<3	<3
Ethene	µg/L	<3	<3	<3
Field Measurements				
pH	SU	7.32	7.13	7.39
Temperature	°C	16.38	16.97	16.38
Specific Conductance	mS/cm	14.2	13.54	14.58
Dissolved Oxygen (DO)	ppm	9.8	0.17	
ORP	mV	-54	-108.7	-56.8

Legend

Meaning	Example
No Data - Not analyzed for	
J value - Estimated Concentration	0.5
Calculated Field	0.5
MDL value	*1.5*

Appendix E
Soil Analyses Data Summary Table

Appendix E
Soil Analyses Data Summary Table

Days from Day Zero (4/15/04)		-50	239	405	-51	239	405
Sample ID		IR25IW02A-372	IR25IW02A-BH-1263	IR25IW02A-BH-1270	IR25MW53A-368	IR25MW53A-BH-1262	IR25MW53A-BH-1274
Sample Location		IR25IW02A	IR25IW02A-BH		IR25MW53A	IR25MW53A-BH	
Sample Depth, feet		15.5 - 16.5	13 - 16	13 - 16	15.5 - 16.5	13 - 16	14 - 16
Sample Collection Date		2/25/2004	12/10/2004	5/25/2005	2/24/2004	12/10/2004	5/25/2005
Parameter	Units						
Volatile Organic Compounds (EPA 8260B)							
Tetrachloroethene	µg/kg	1,000	<0.24	<0.41	<6.7	<0.25	<0.50
Trichloroethene	µg/kg	<630	<0.20	<0.18	<6.7	0.90	<0.22
cis-1,2-DCE	µg/kg	<630	<0.27	<0.21	130	680	4.0
trans-1,2-DCE	µg/kg	<630	<0.32	<0.16	14	144	19
1,2-Dichloroethene (total)	µg/kg	<630	<0.32	<0.21	144	824	23
Vinyl Chloride	µg/kg	<1300	<0.28	<0.28	100	469	53.9
1,1-Dichloroethene	µg/kg	<630	<0.32	<0.26	<6.7	<0.33	<0.32
1,2-Dichloroethane	µg/kg	<630	<4.7	<5.2	2,630	4,590	187
Benzene	µg/kg	<630	2	<5.2	<6.7	<4.9	1
Chlorobenzene	µg/kg	<630	108	195	<6.7	<4.9	3
1,2-Dichlorobenzene	µg/kg	1,500	1	18	1	<4.9	2
1,3-Dichlorobenzene	µg/kg	<630	<4.7	0.8	<6.7	<4.9	<6.5
1,4-Dichlorobenzene	µg/kg	390	6	26	<6.7	<4.9	0.7
1,2,4-Trichlorobenzene	µg/kg	<630	<4.7	<5.2	<6.7	<4.9	<6.5
Naphthalene	µg/kg	<630	<4.7	<5.2	<6.7	<4.9	<6.5
Semivolatile Organic Compounds (EPA 8270C)							
Phenol	µg/kg	<420	<330	<400	<420	<3300	1,400
2,4-Dimethylphenol	µg/kg	<420	<330	<400	<420	<3300	<370
3,4-Methylphenol (m,p-Cresol)	µg/kg	<420	<330	<400	<420	<3300	<370
2-Methylphenol(o-Cresol)	µg/kg	<420	<330	<400	<420	<3300	<370
PCBs (EPA 8082)							
Aroclor 1260	µg/kg	<42	<33	<40	<42	<33	<37
TPH-diesel (EPA 8015B)							
Diesel	mg/kg		8	15		11	<11
Metals (EPA 6010B)							
Arsenic	mg/kg		3.7	3.2		0.85	2.0
Cadmium	mg/kg		<0.5	<0.6		<0.5	0.062
Chromium	mg/kg		130	656		873	38.4
Manganese	mg/kg		526	595		743	225
Mercury	mg/kg		0.42	0.070		0.14	0.091

Notes:

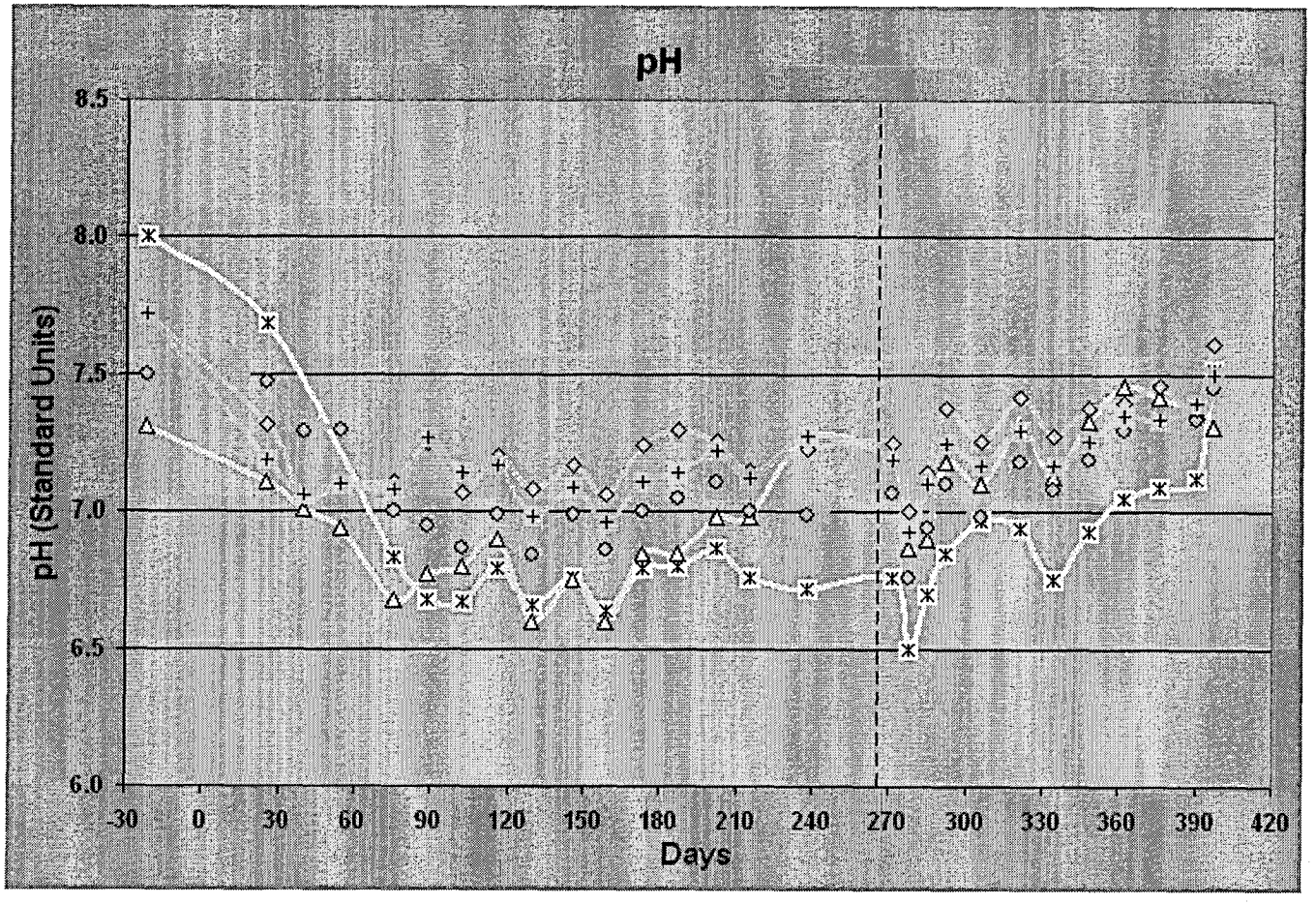
Days -52 to -50 sampling - baseline
Day 239 sampling - after the completion of Stage 1 (anaerobic)
Day 405 sampling - after the completion of Stage 2 (aerobic)

Appendix E
Soil Analyses Data Summary Table

Days from Day Zero (4/15/04)		-51	239	405	-52	239	405
Sample ID		IR25MW54A-365	IR25MW54A-BH-1261	IR25MW54A-BH-1271	IR25MW55A-363	IR25MW55A-BH-1264	IR25MW55A-BH-1273
Sample Location		IR25MW54A	IR25MW54A-BH		IR25MW55A	IR25MW55A-BH	
Sample Depth, feet		15.5 - 16.5	13 - 16	13 - 16	15.5 - 16.5	13 - 16	10 - 13
Sample Collection Date		2/24/2004	12/10/2004	5/25/2005	2/23/2004	12/10/2004	5/25/2005
Parameter	Units						
Volatile Organic Compounds (EPA 8260B)							
Tetrachloroethene	µg/kg	87,700	495,000	21,400	79	919	3,810
Trichloroethene	µg/kg	600	<800	729	5,500	4,590	2,750
cis-1,2-DCE	µg/kg	5,500	<1700	2,180	635	683	18,200
trans-1,2-DCE	µg/kg	<590	<1900	<17	277	110	807
1,2-Dichloroethene (total)	µg/kg	5,500	<1900	2,180	912	793	19,007
Vinyl Chloride	µg/kg	230	<1400	<31	100	220	450
1,1-Dichloroethene	µg/kg	<590	<800	<29	<6.9	<8	<31
1,2-Dichloroethane	µg/kg	14,300	13,000	12,000	3,220	6,800	13,400
Benzene	µg/kg	78	<50000	<580	19	<500	110
Chlorobenzene	µg/kg	71	<50000	140	25	<500	180
1,2-Dichlorobenzene	µg/kg	97,500	600,000	22,200	7,060	5,800	14,400
1,3-Dichlorobenzene	µg/kg	270	5,500	220	28	<500	130
1,4-Dichlorobenzene	µg/kg	7,300	160,000	6,000	1,720	1,400	3,500
1,2,4-Trichlorobenzene	µg/kg	150	<50000	83	8	<500	<610
Naphthalene	µg/kg	170	<50000	140	16	<500	<610
Semivolatile Organic Compounds (EPA 8270C)							
Phenol	µg/kg	280	78	402	<400	220	<400
2,4-Dimethylphenol	µg/kg	3,000	1,200	2,600	<400	<330	<400
3,4-Methylphenol (m,p-Cresol)	µg/kg	1,100	170	1,500	<400	250	<400
2-Methylphenol(o-Cresol)	µg/kg	497	<330	531	<400	80	<400
PCBs (EPA 8082)							
Aroclor 1260	µg/kg	<39	3	38	<40	<33	<40
TPH-diesel (EPA 8015B)							
Diesel	mg/kg		30	2		2	2
Metals (EPA 6010B)							
Arsenic	mg/kg		5.4	3.0		4.7	3.1
Cadmium	mg/kg		<0.5	<0.58		<0.5	<0.61
Chromium	mg/kg		158	122		152	362
Manganese	mg/kg		191	366		689	638
Mercury	mg/kg		0.28	0.14		0.082	0.12

Legend	Meaning	Example
	No Data - Not sampled for	
	J value - Estimated Concentration	0.5
	Calculated Field	0.5

Appendix F
Chemical Data Graphs

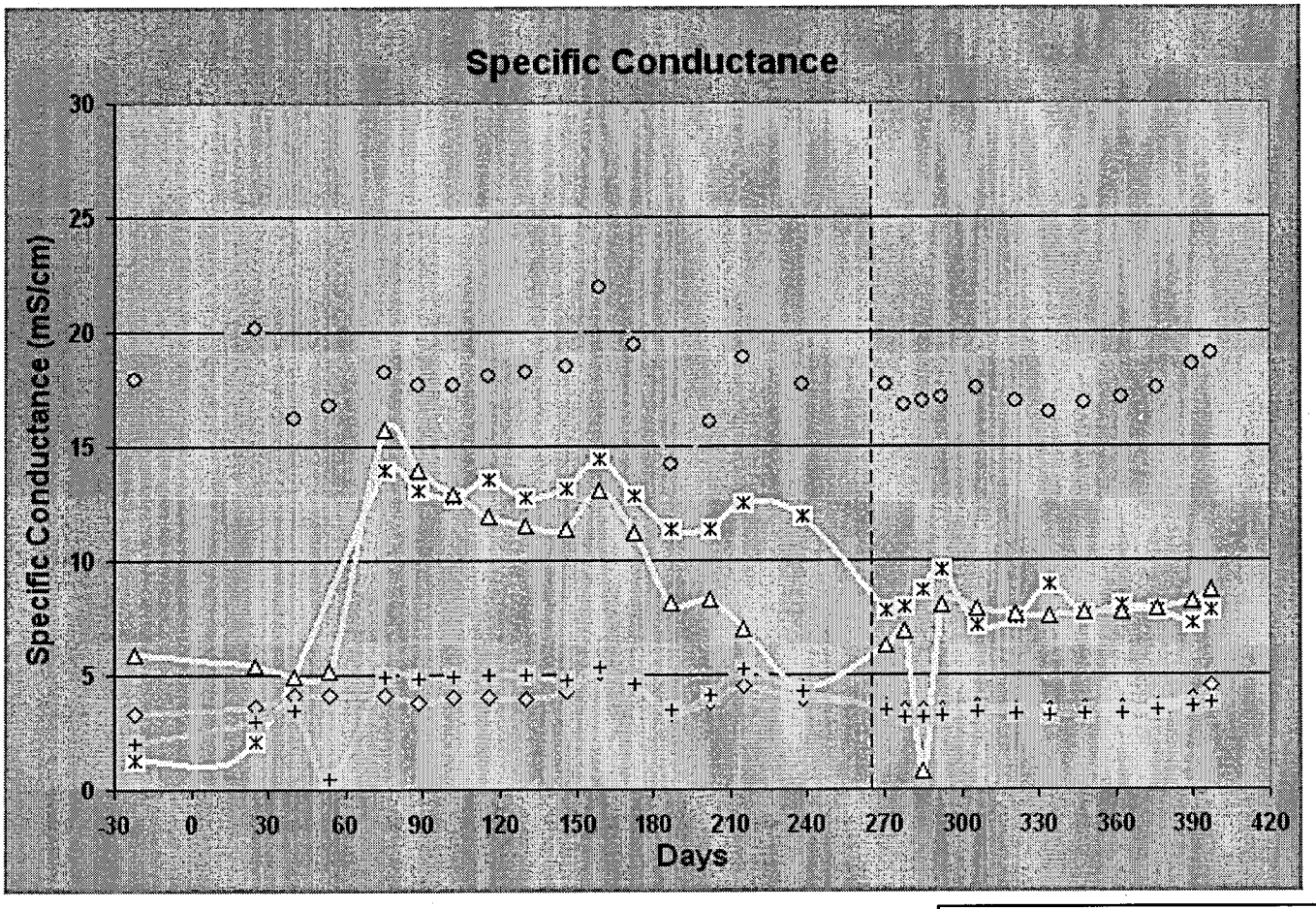


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F1
pH in Treatment Study Area Wells

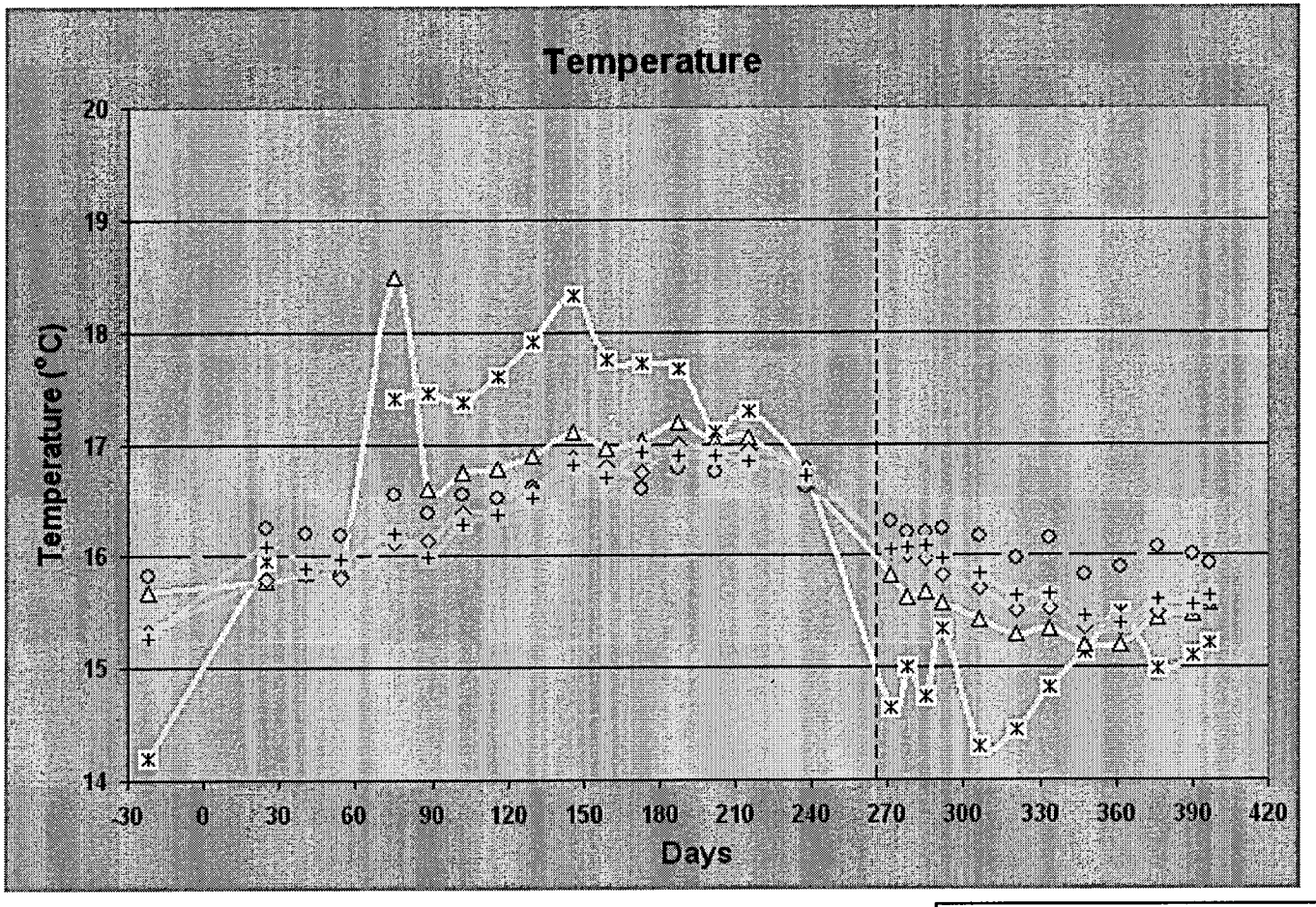


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F2
Specific Conductance in Treatment Study Area Wells

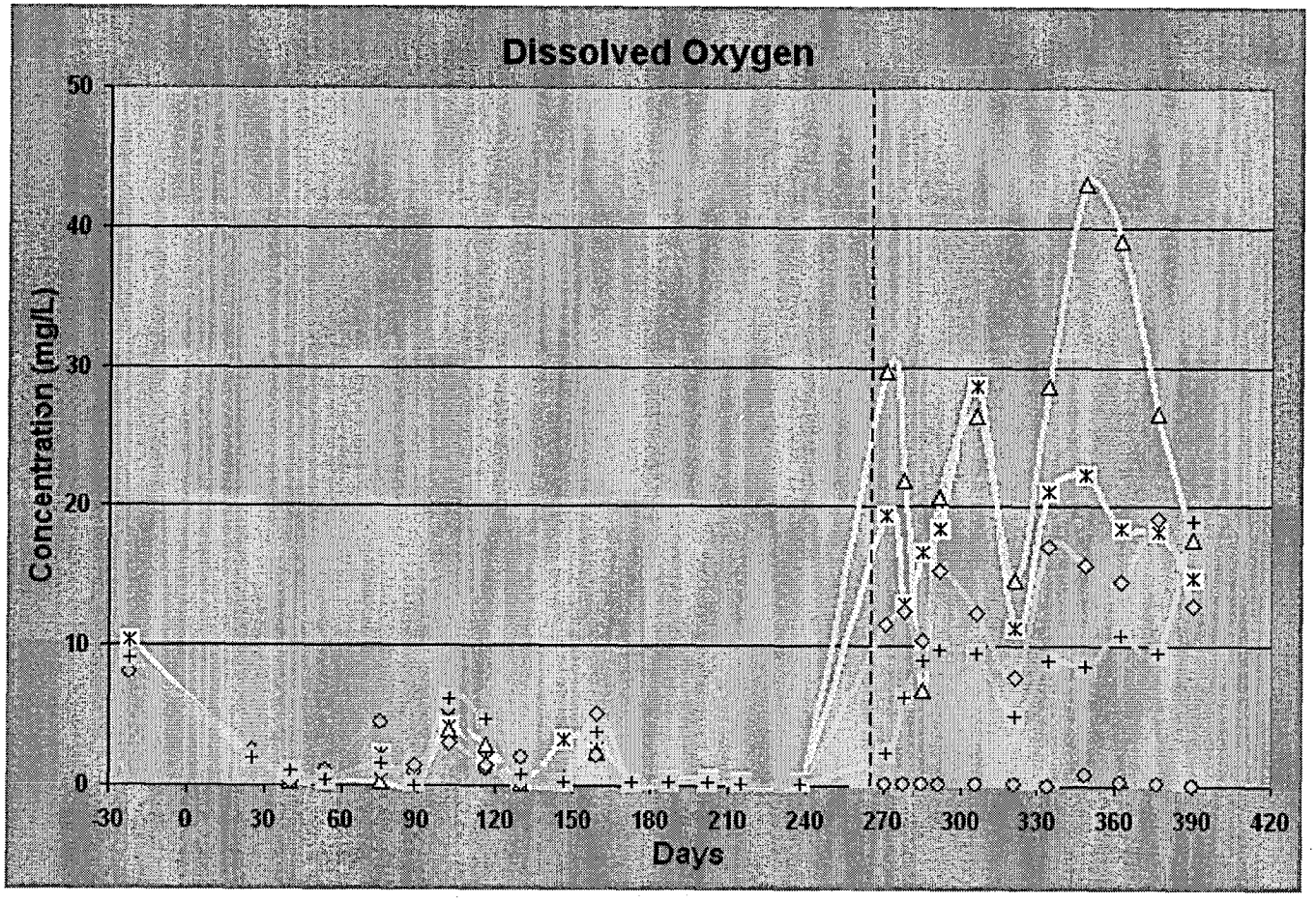


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F3
Temperature in Treatment Study Area Wells

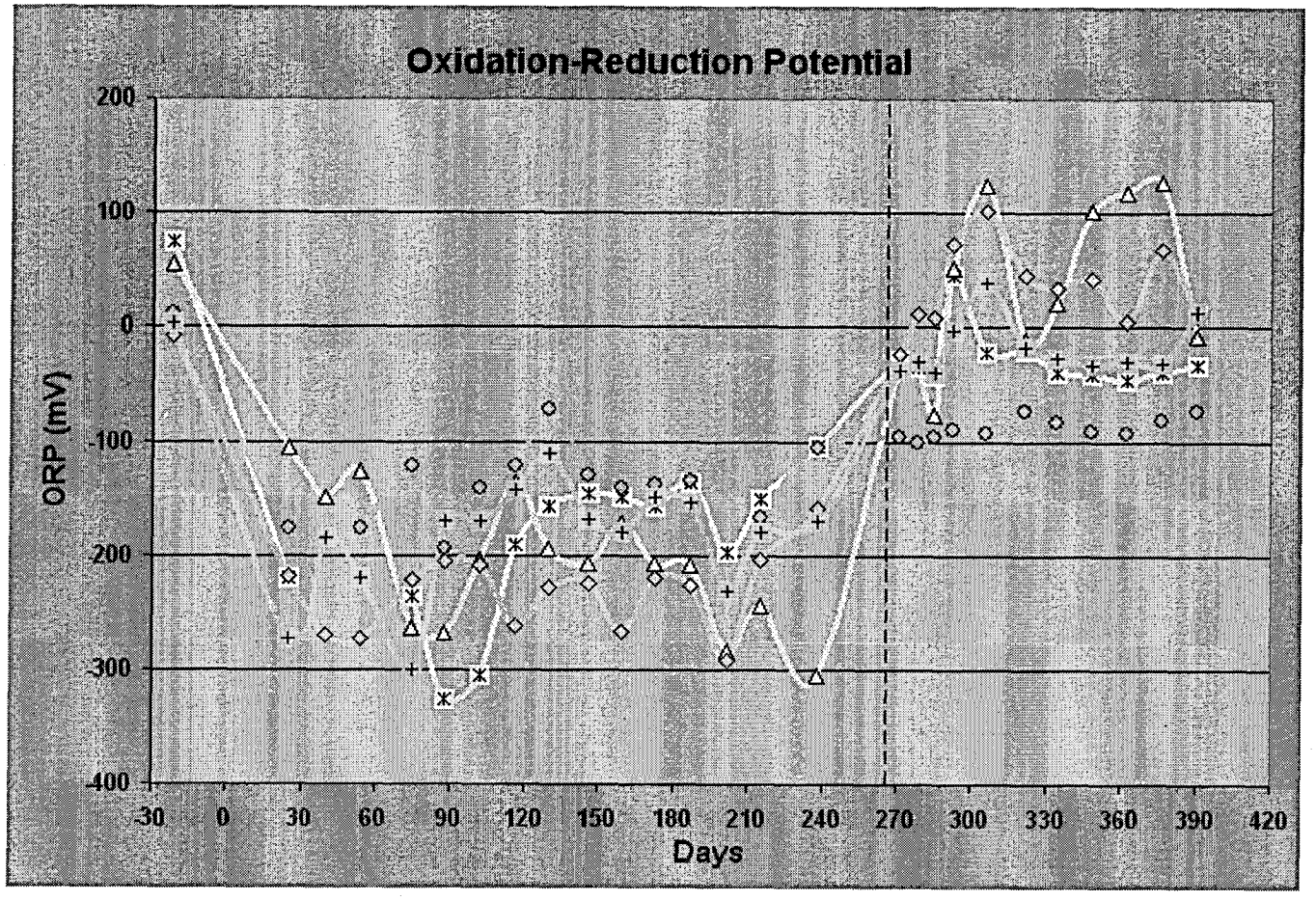


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F4
Dissolved Oxygen Concentration in Treatment Study Area Wells

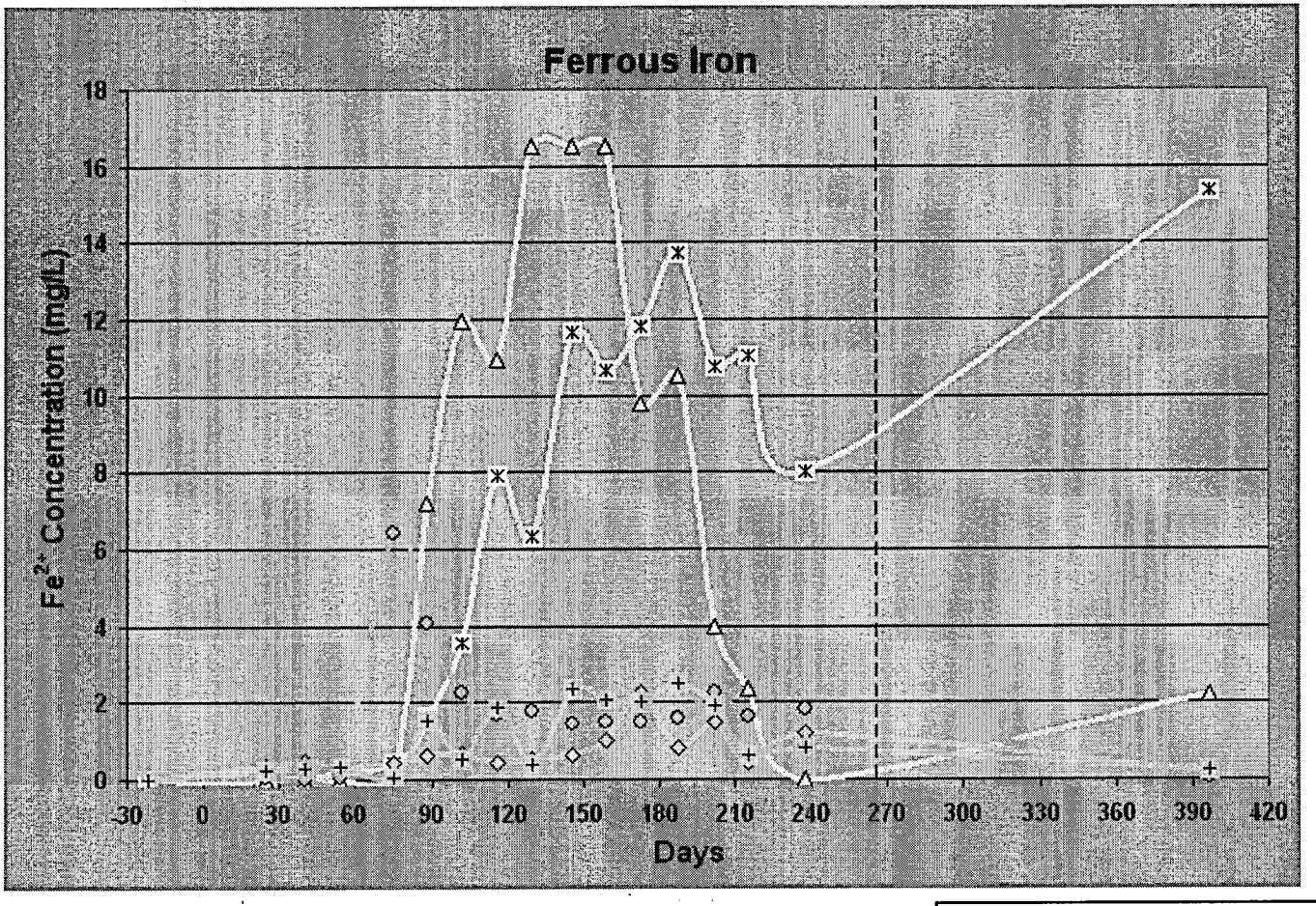


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F5
Oxidation-Reduction Potential in Treatment Study Area Wells

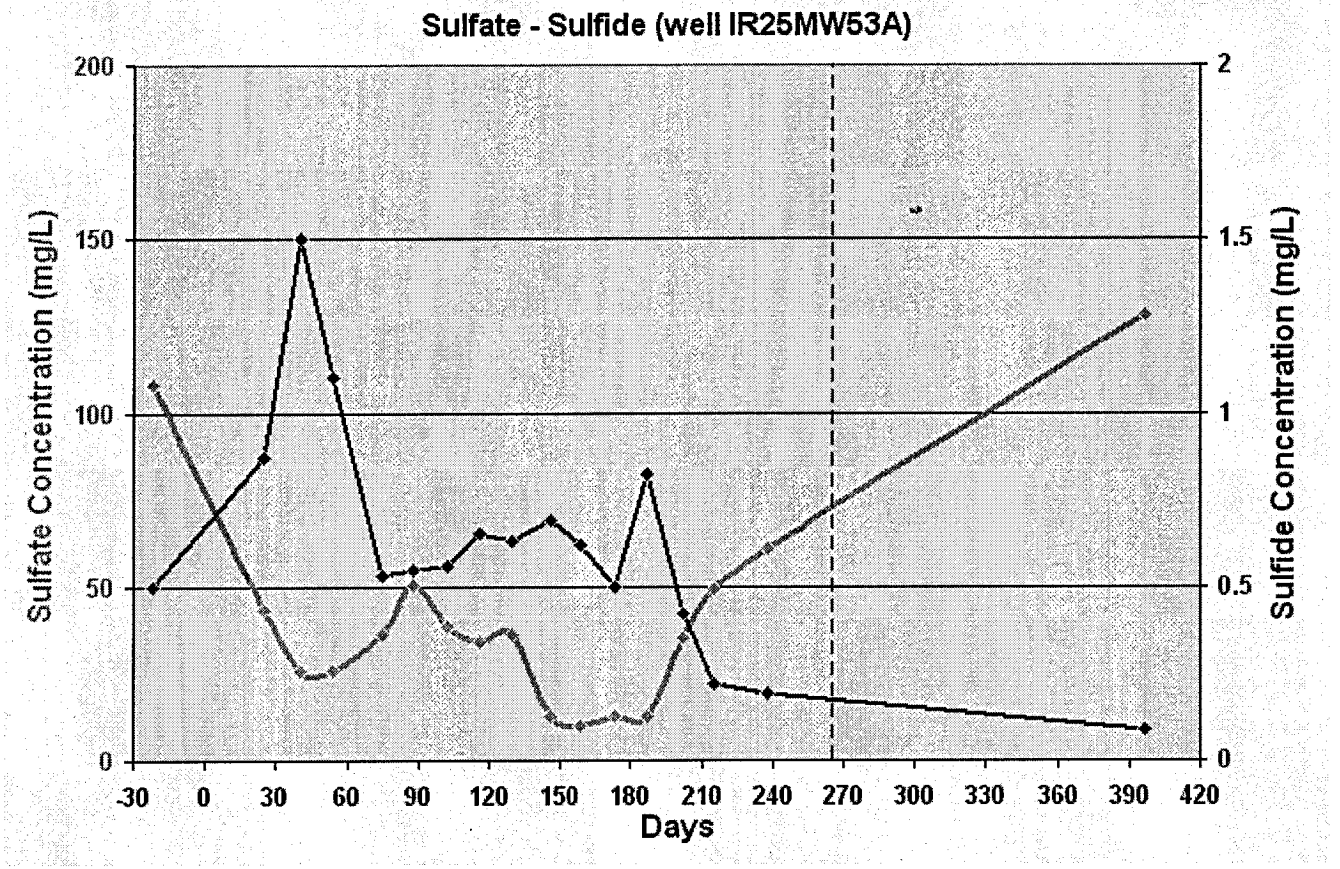


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

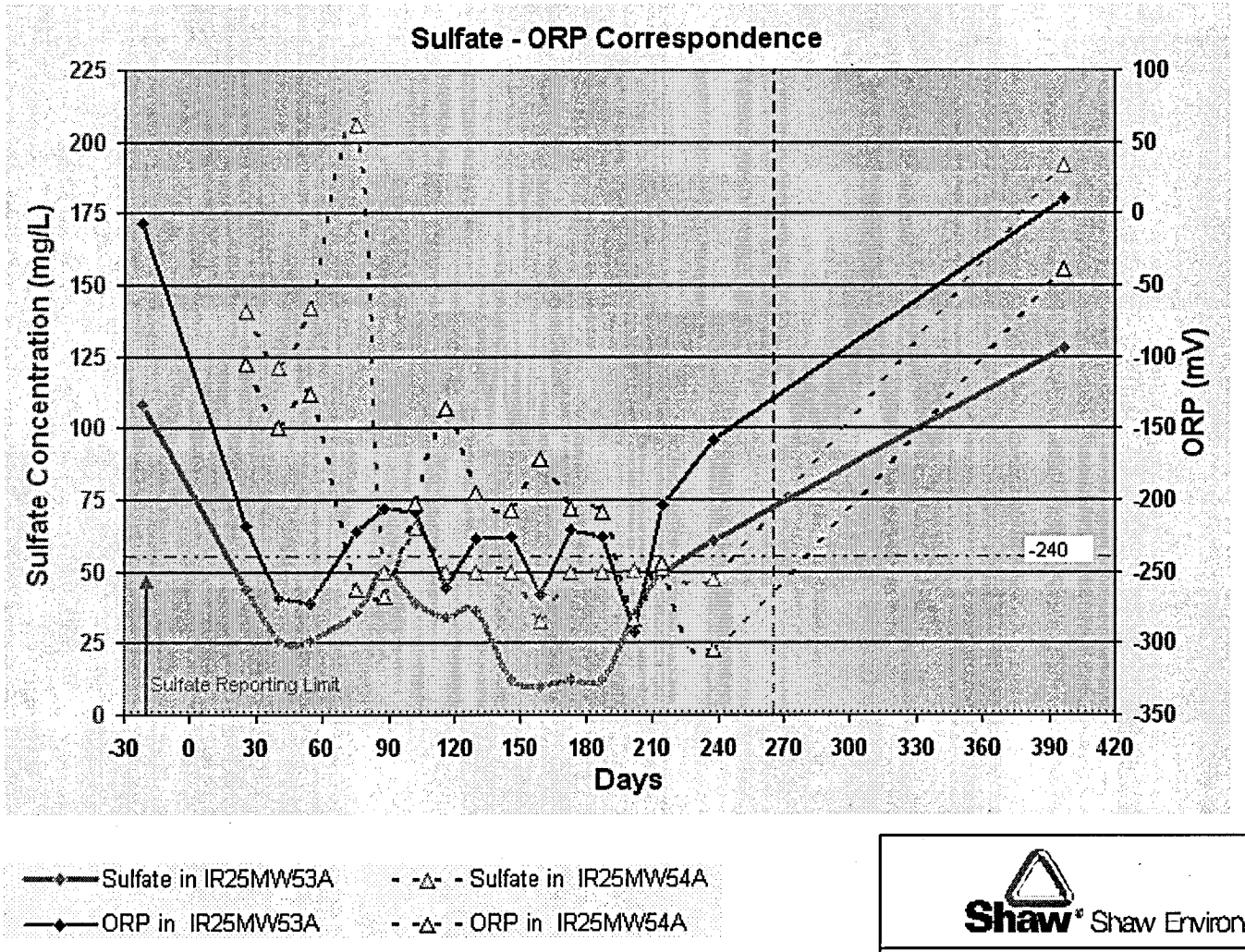
Shaw® Shaw Environmental, Inc.

Figure F6
Ferrous Iron Concentration in Treatment Study Area Wells



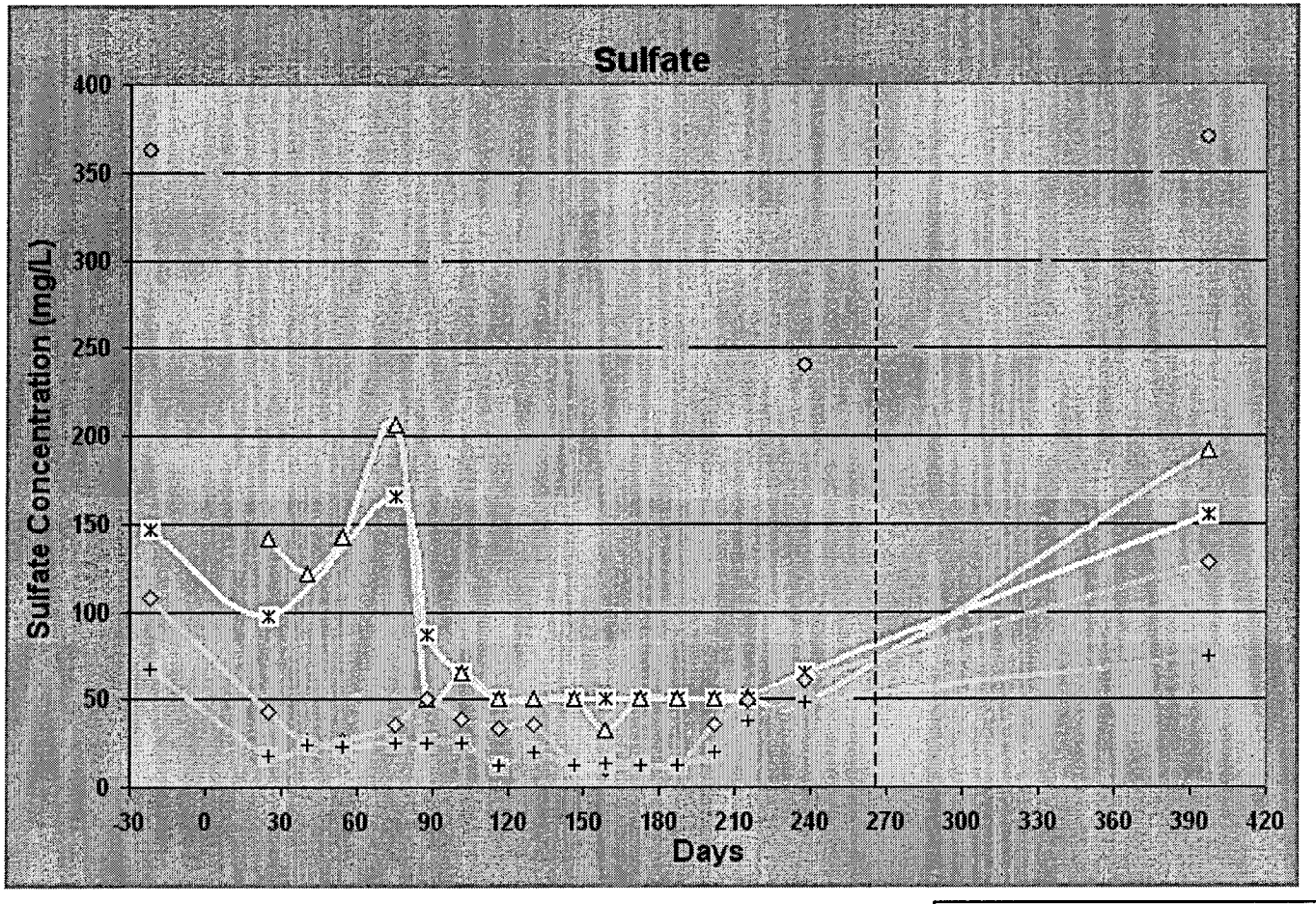
Shaw® Shaw Environmental, Inc.

Figure F7
Sulfate-Sulfide Correspondence in
Treatment Study Area Well



Shaw® Shaw Environmental, Inc.

Figure F8
Sulfate-ORP Correspondence in
Treatment Study Area Wells

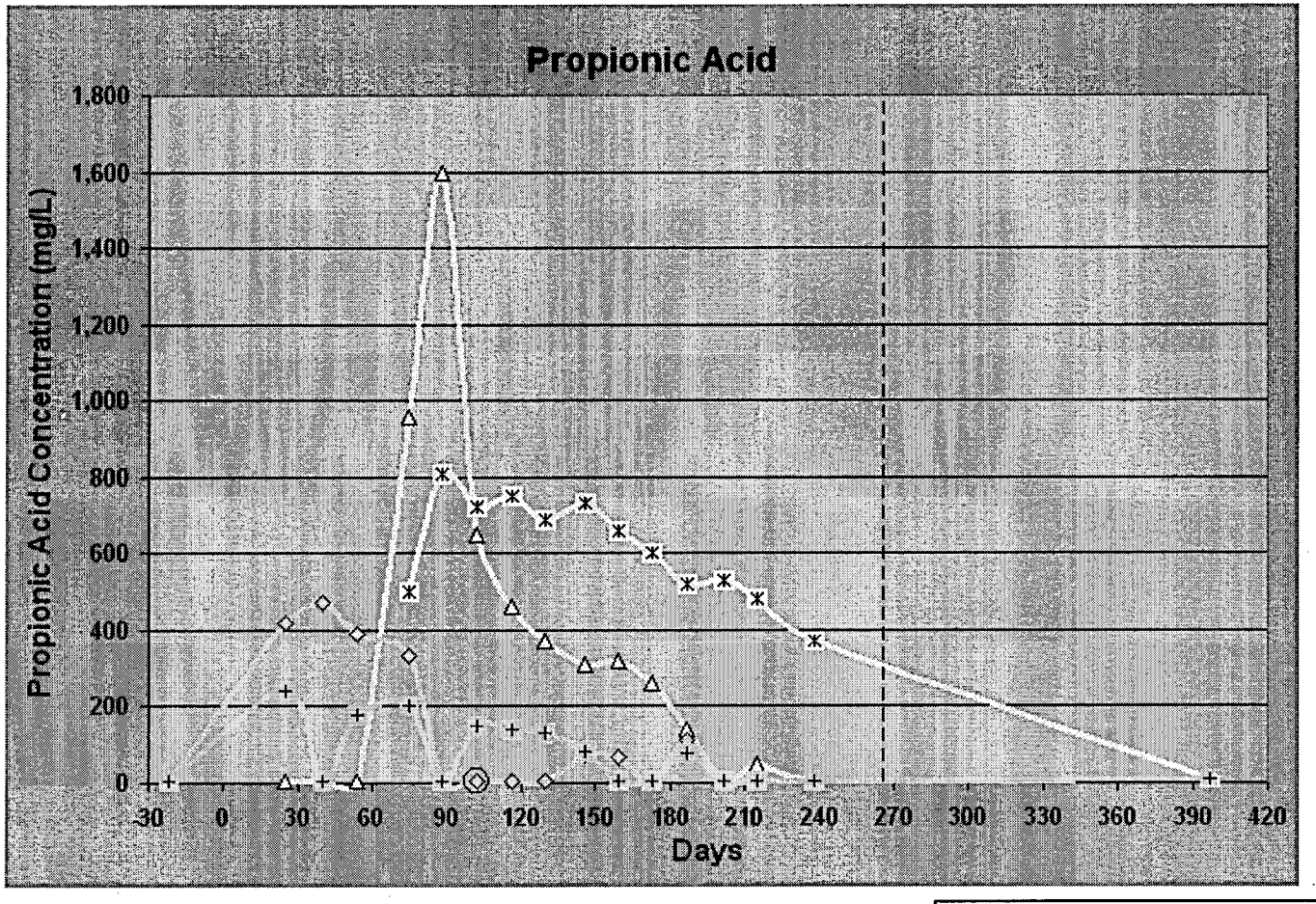


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

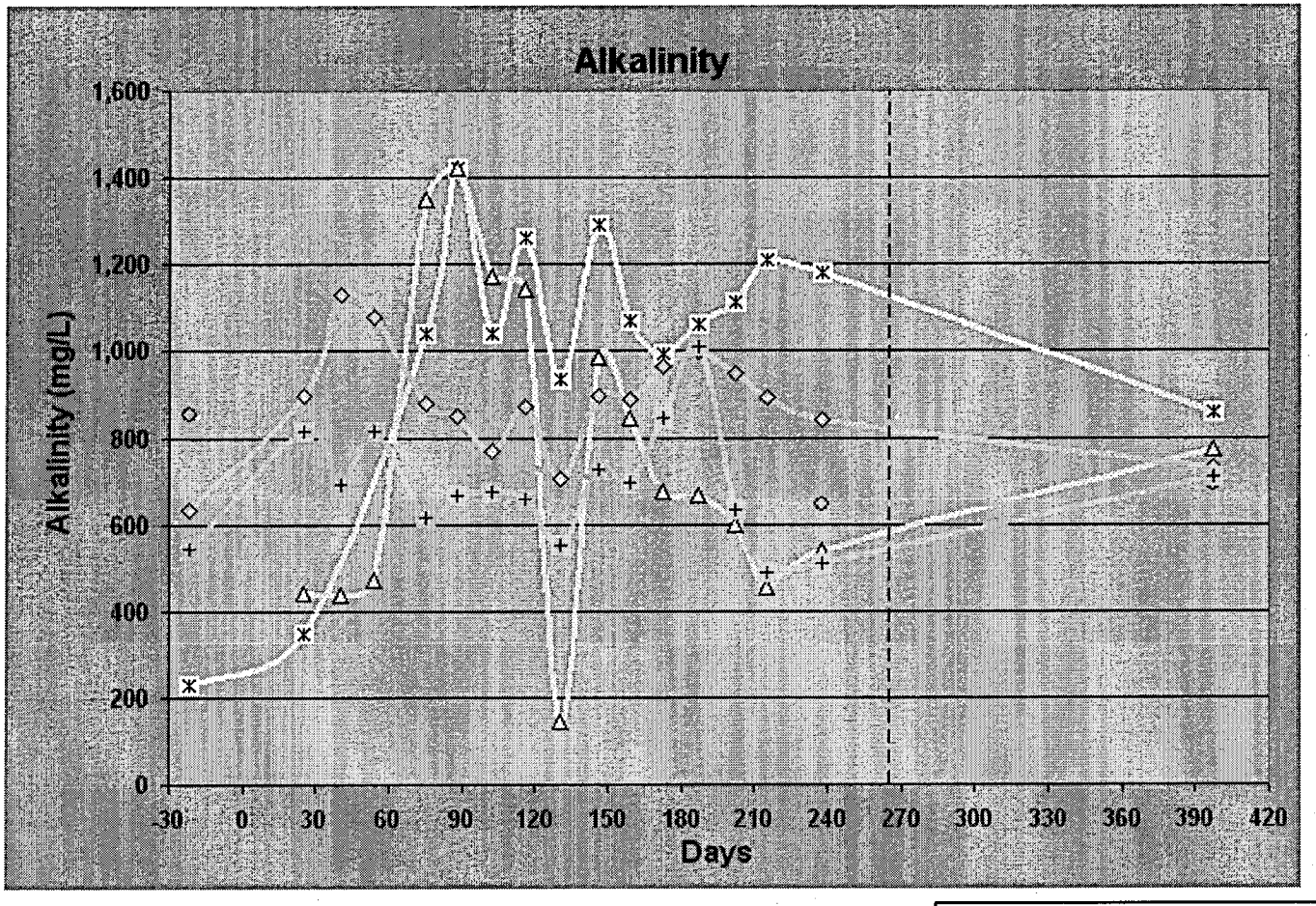
Figure F9
Sulfate Concentration in Treatment Study Area Wells



Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F10
Propionic Acid Concentration in Treatment Study Area Wells

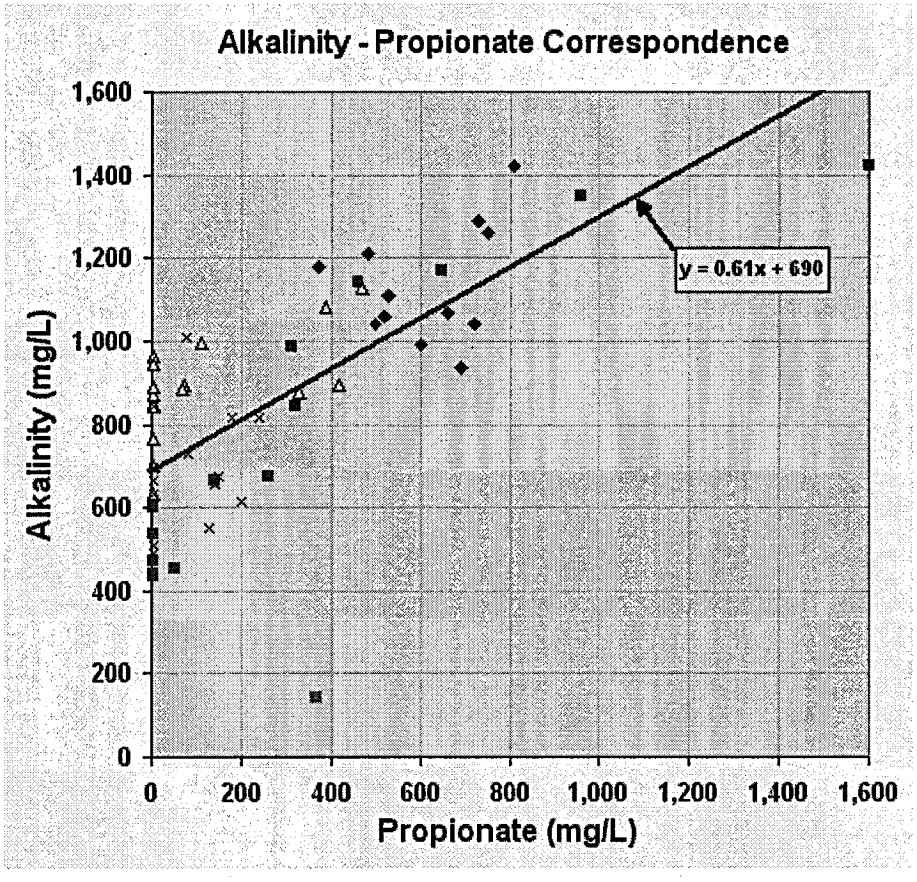


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

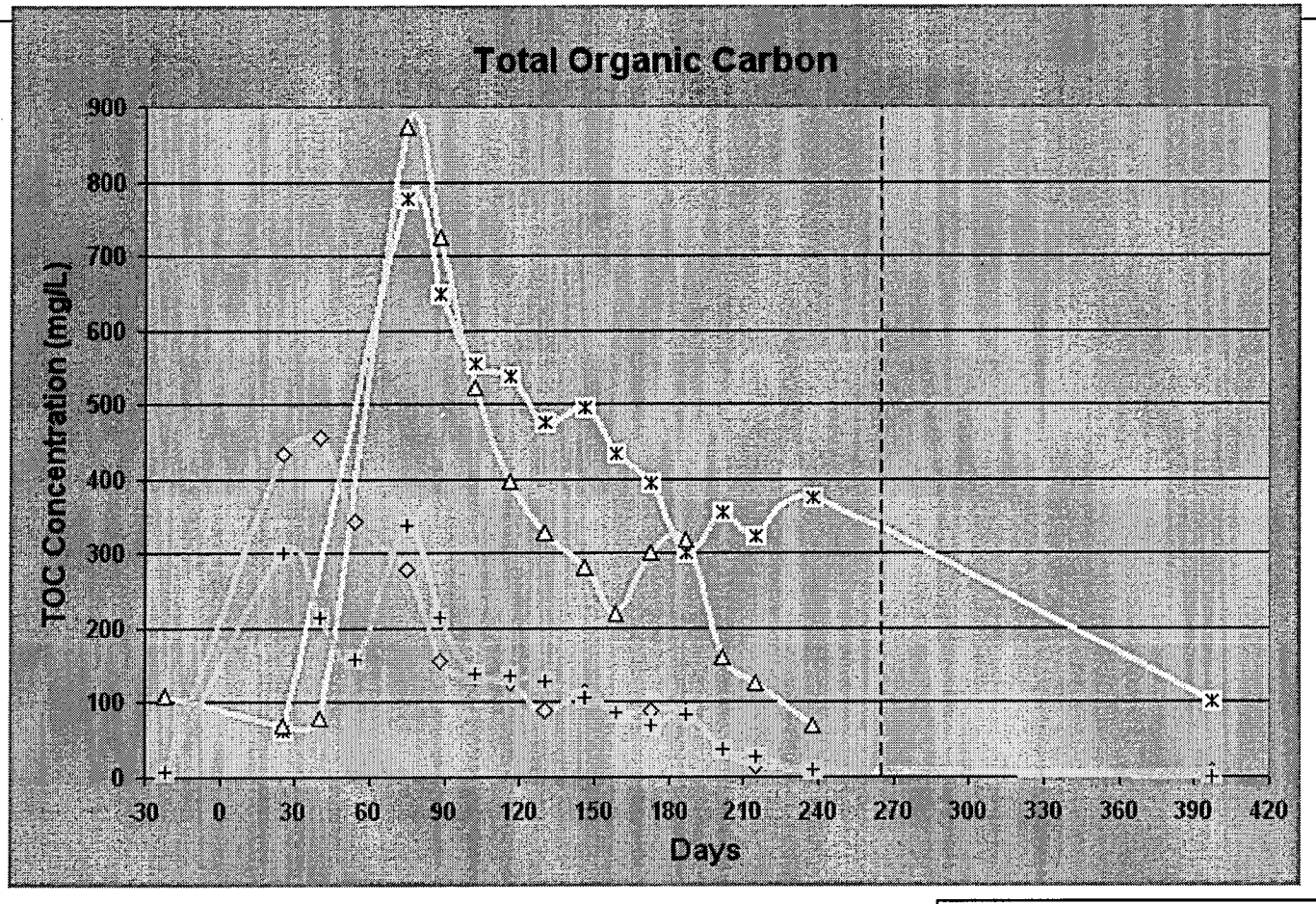
Shaw® Shaw Environmental, Inc.

Figure F11
Alkalinity in Treatment Study Area Wells



Shaw® Shaw Environmental, Inc.

Figure F12
Alkalinity-Propionate Correspondence
in Treatment Study Area

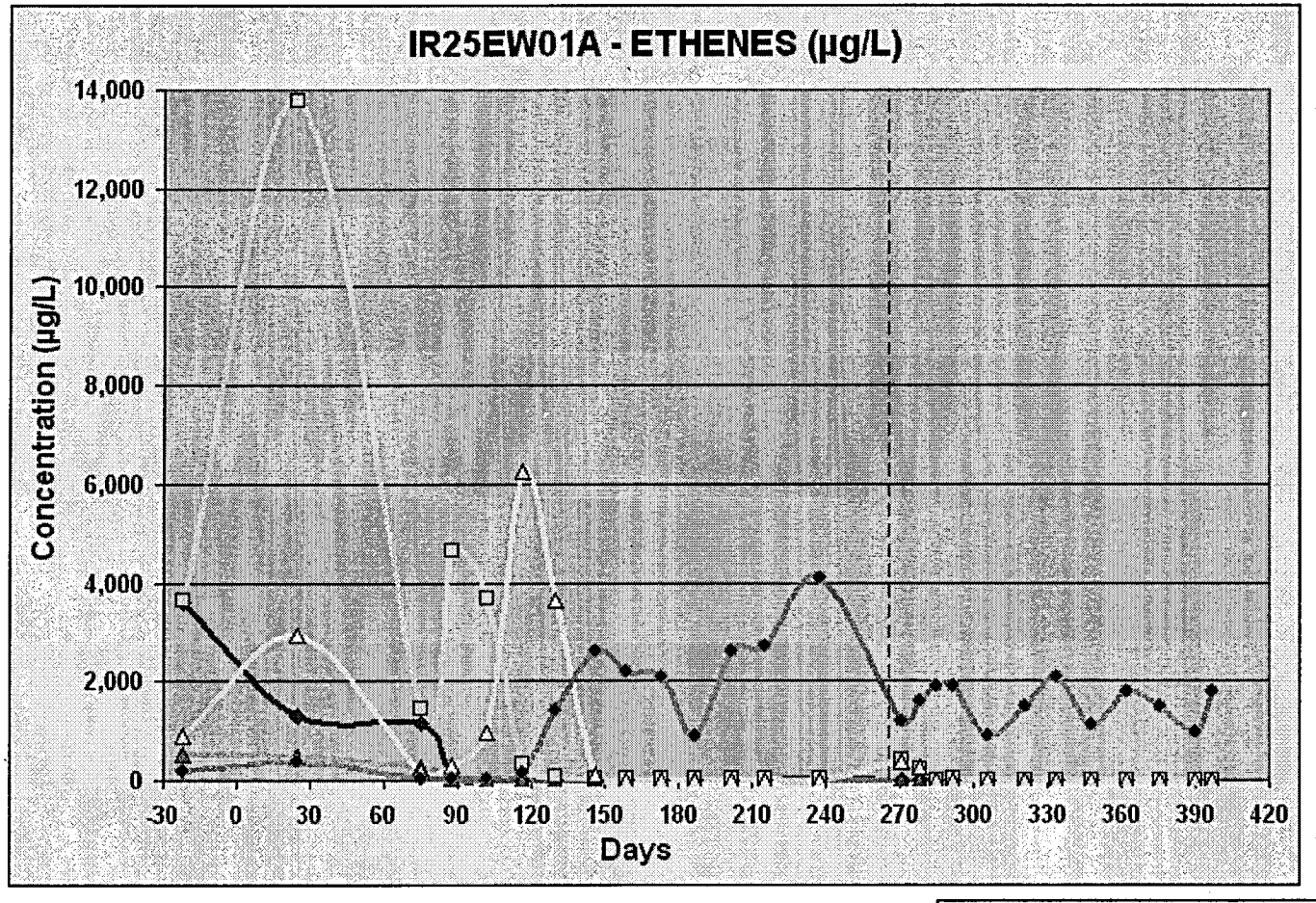


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

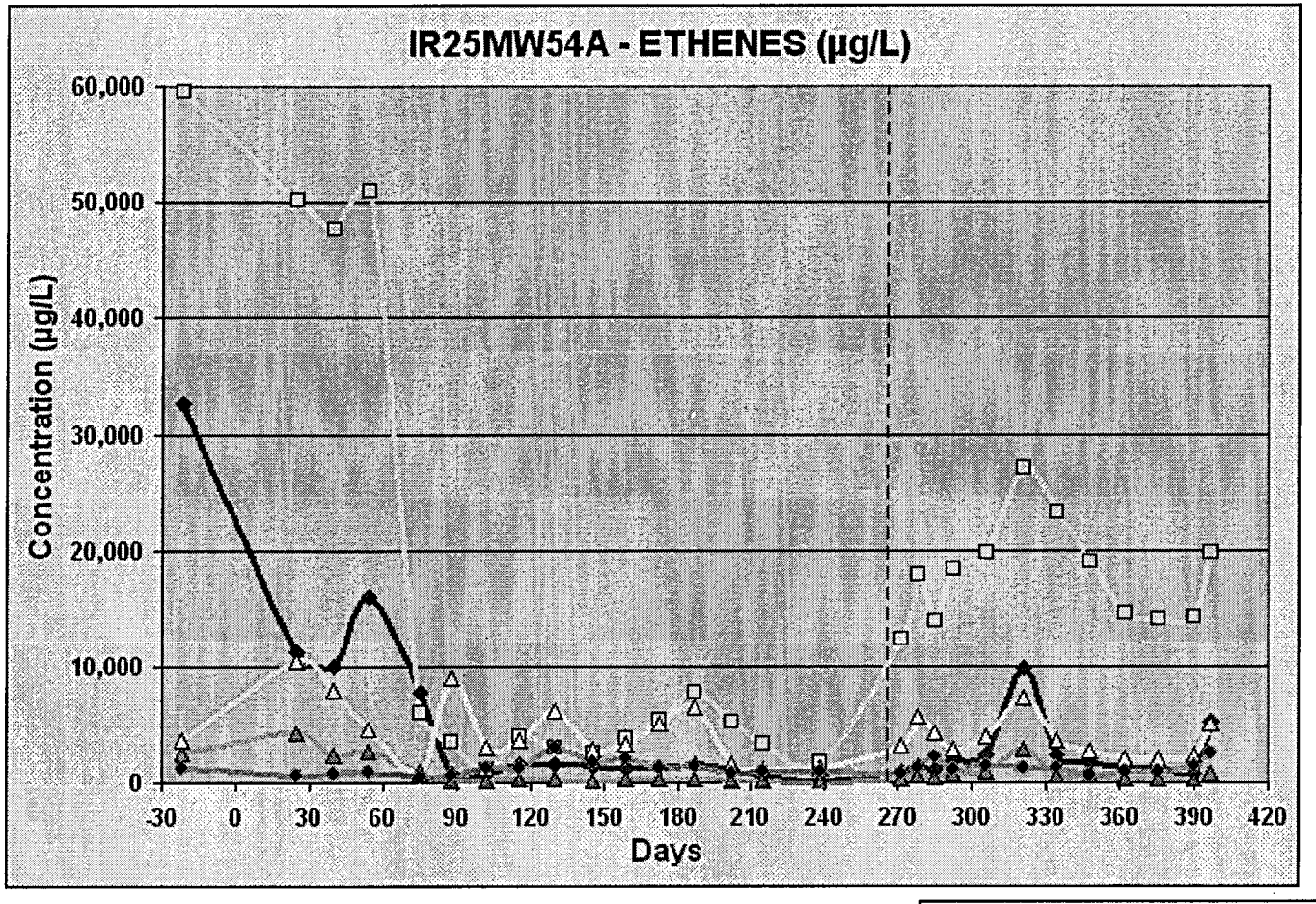
Figure F13
Total Organic Carbon Concentration
in Treatment Study Area Wells



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F14
Chlorinated Ethenes in Well
IR25EW01A

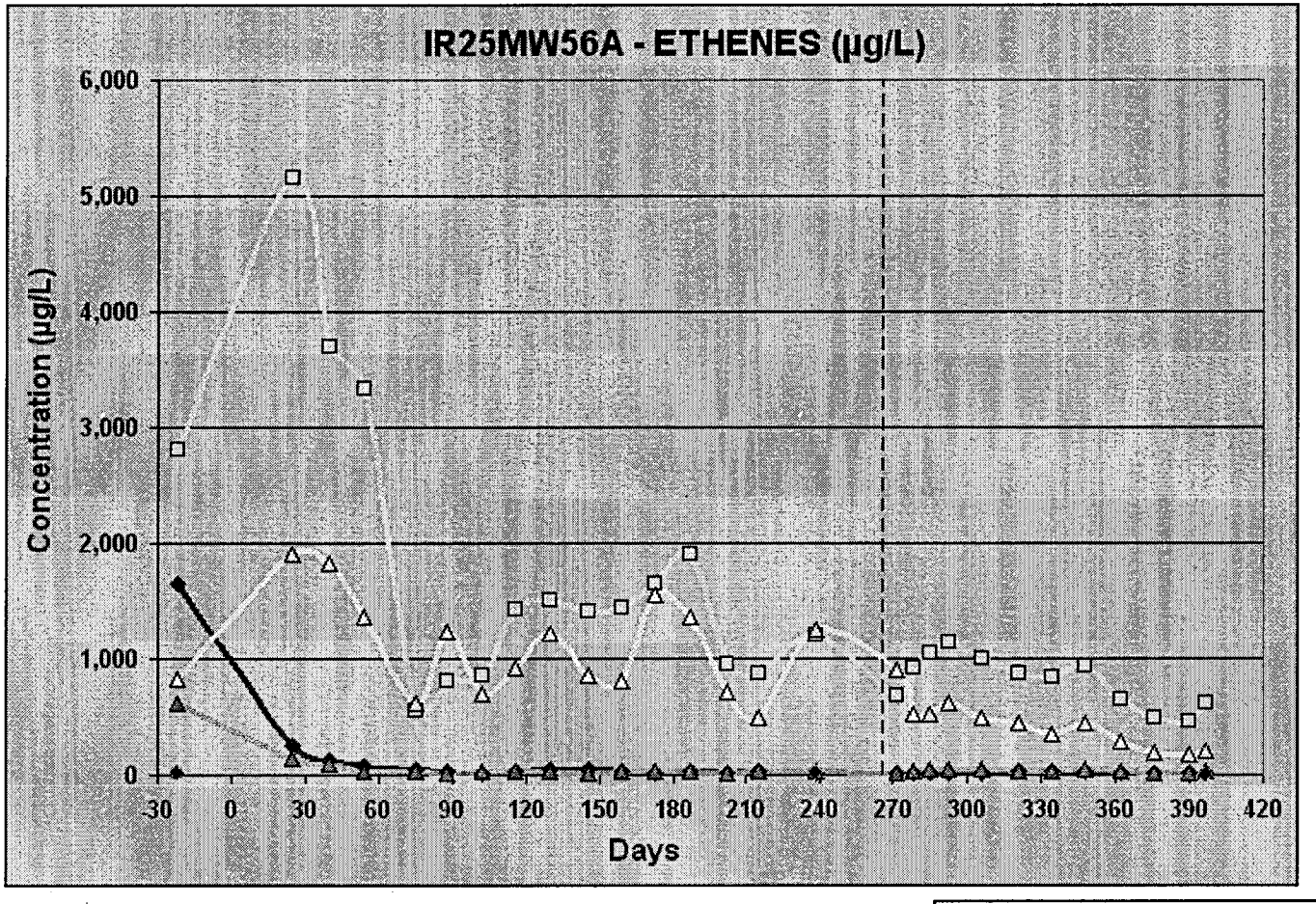


- Tetrachloroethene
- Trichloroethene
- 1,2-Dichloroethene (total)
- Vinyl Chloride
- Ethene

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F15
Chlorinated Ethenes in Well IR25MW54A

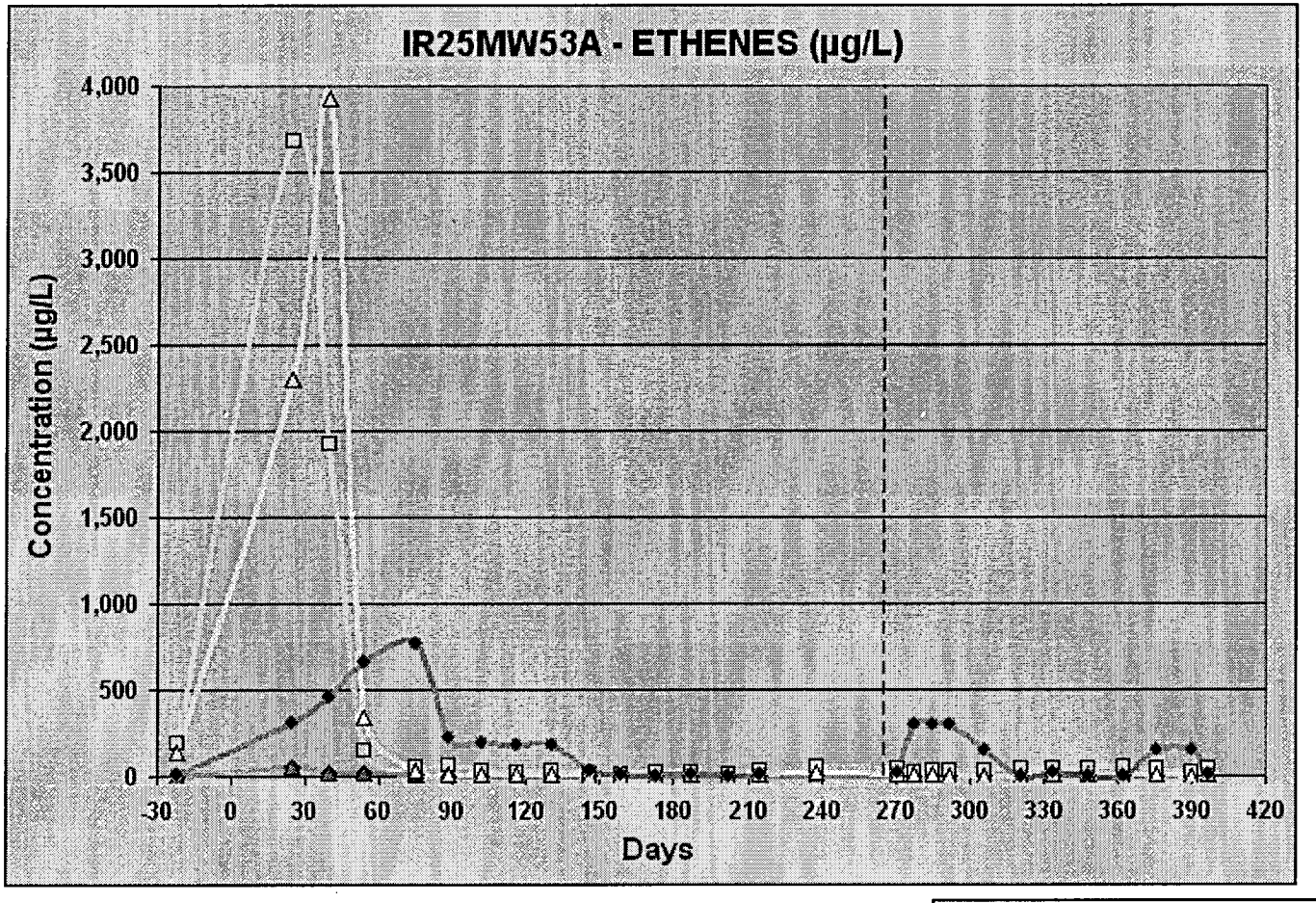


Tetrachloroethene
Trichloroethene
1,2-Dichloroethene (total)
Vinyl Chloride
Ethene

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F16
Chlorinated Ethenes in Well
IR25MW56A

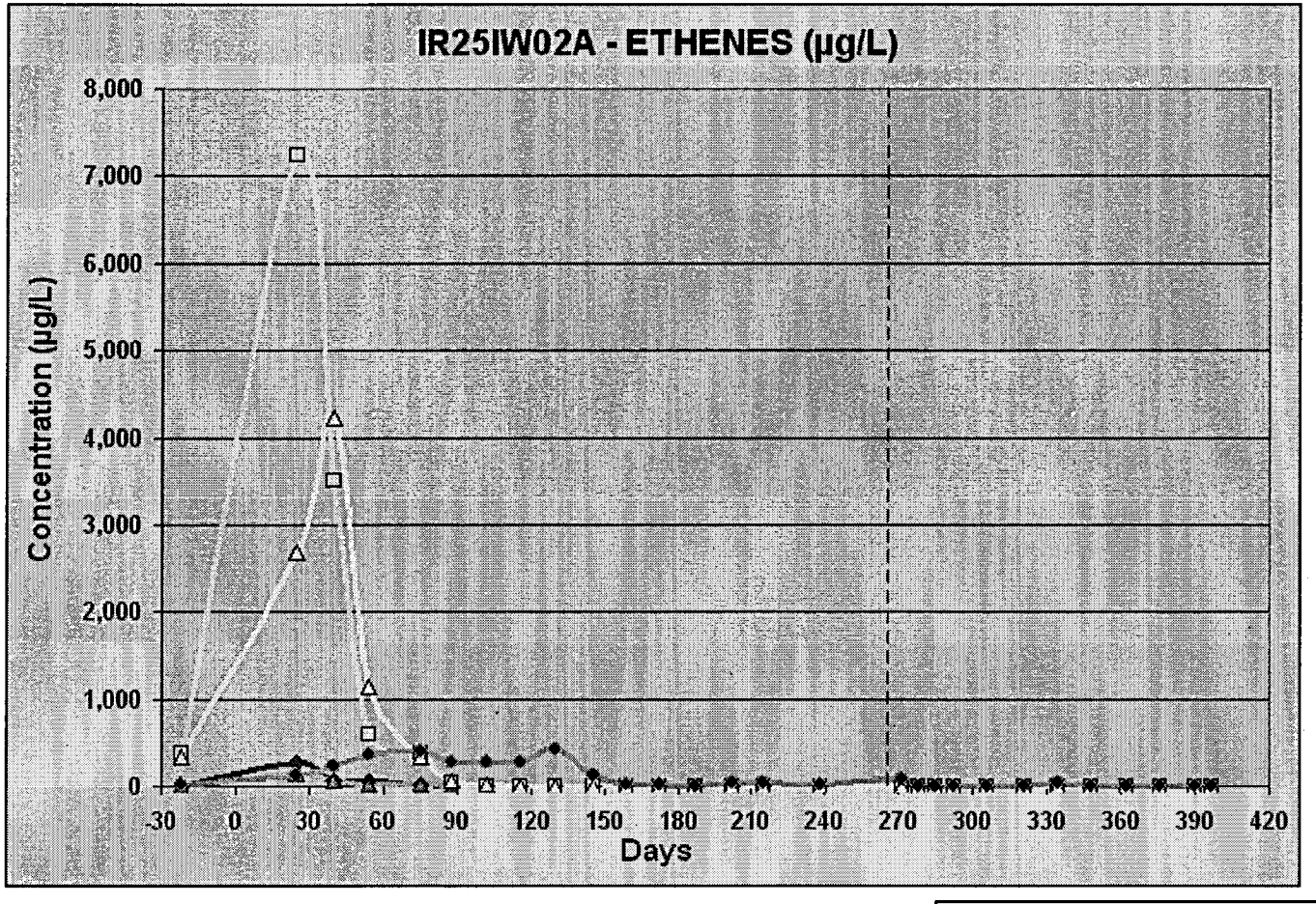


Tetrachloroethene
Trichloroethene
1,2-Dichloroethene (total)
Vinyl Chloride
Ethene

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F17
Chlorinated Ethenes in Well
IR25MW53A

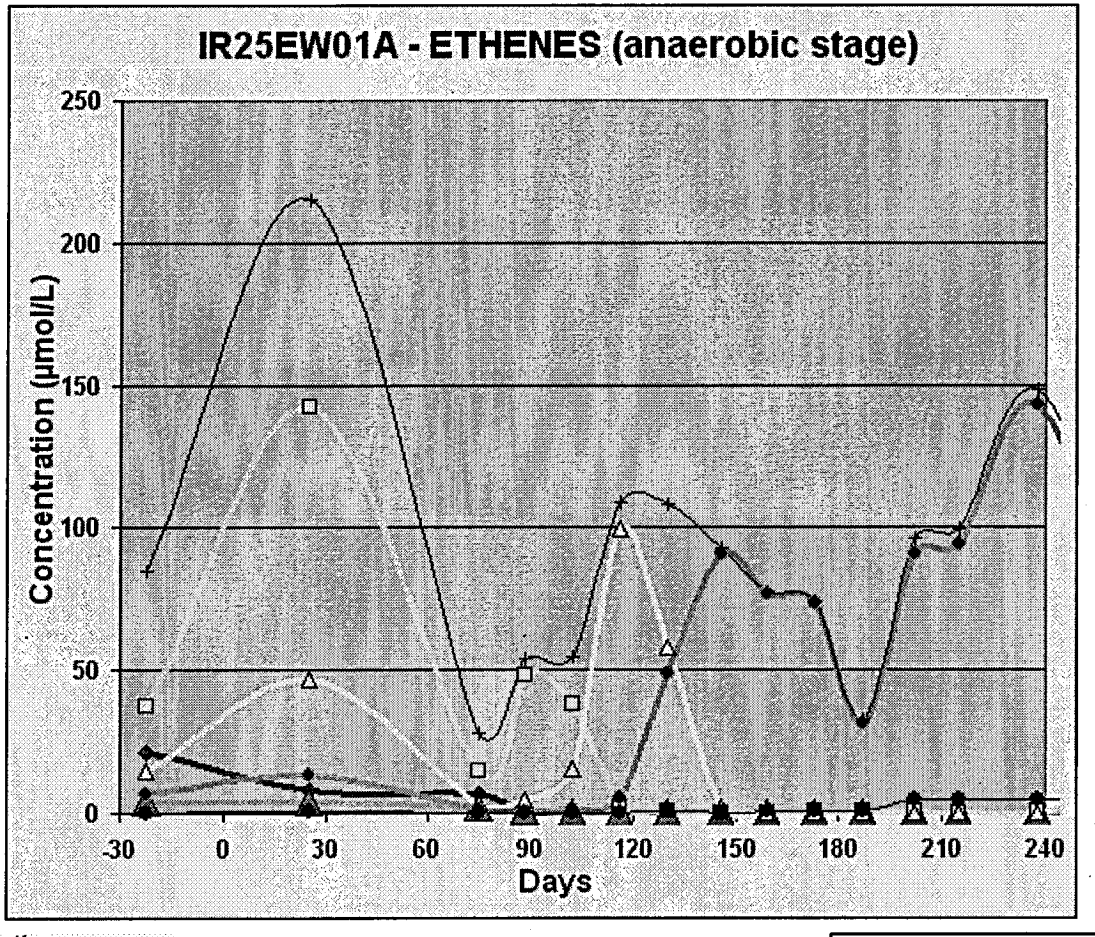


Tetrachloroethene
Trichloroethene
1,2-Dichloroethene (total)
Vinyl Chloride
Ethene

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

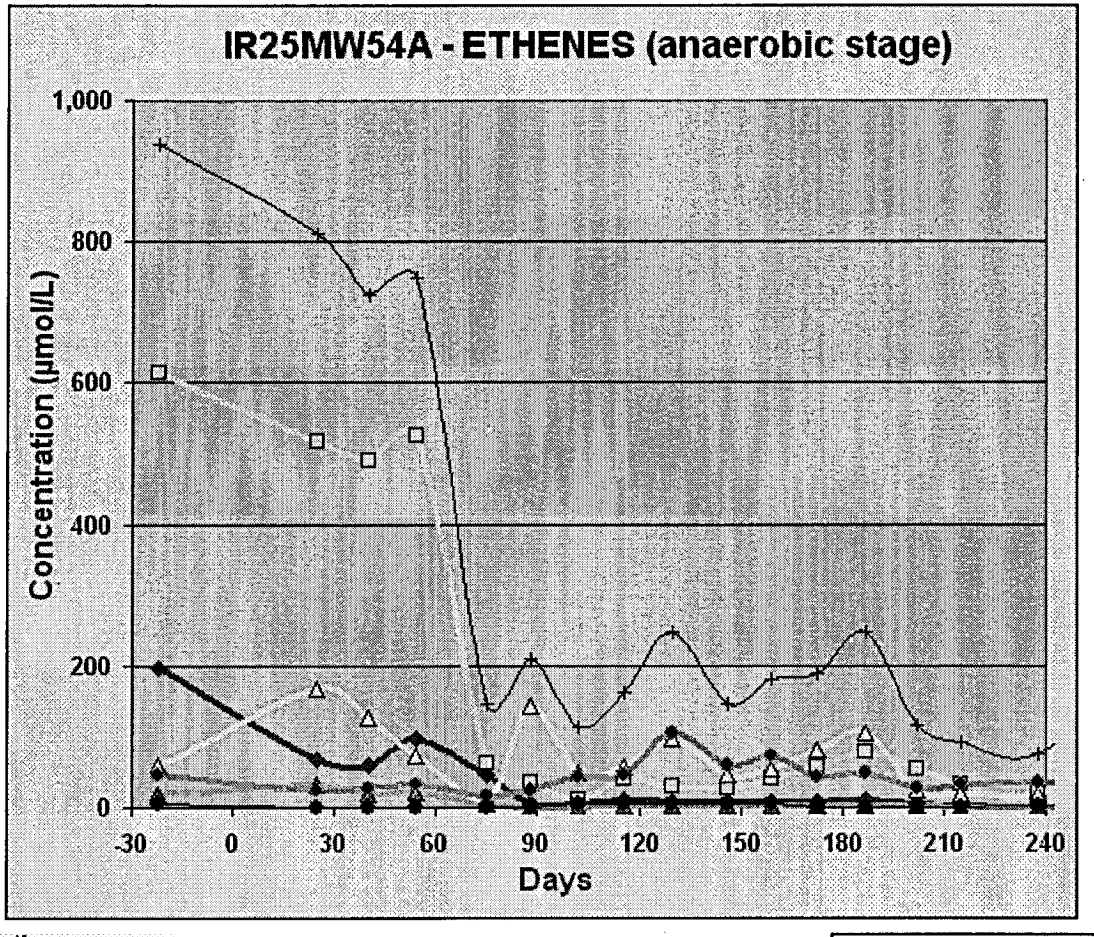
Figure F18
Chlorinated Ethenes in Well
IR25IW02A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study

Shaw® Shaw Environmental, Inc.

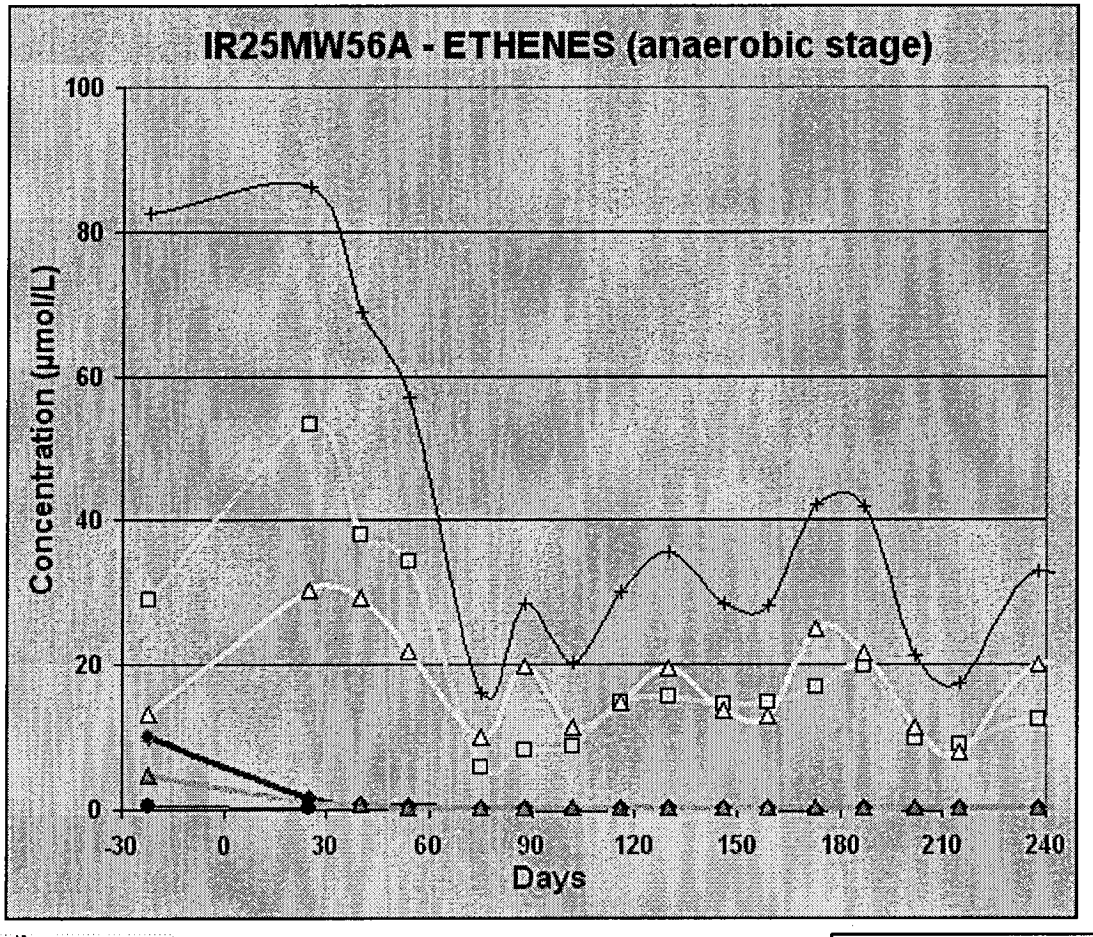
Figure F19
Molar Concentration of Chlorinated Ethenes in Well IR25EW01A



Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study

Shaw® Shaw Environmental, Inc.

Figure F20
Molar Concentration of Chlorinated Ethenes in Well IR25MW54A

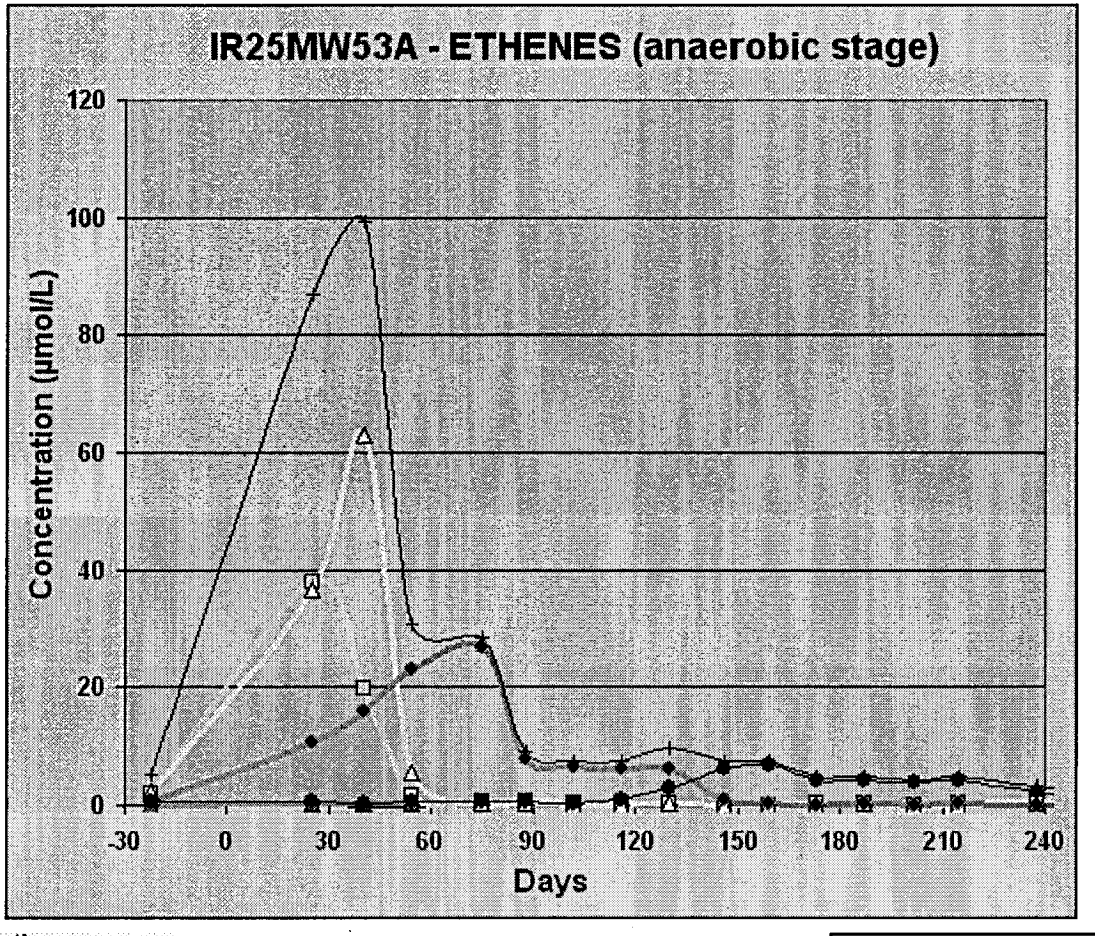


- Tetrachloroethene
- Trichloroethene
- 1,2-Dichloroethene (total)
- Vinyl Chloride
- Ethene
- Ethane
- Total µmol/L

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

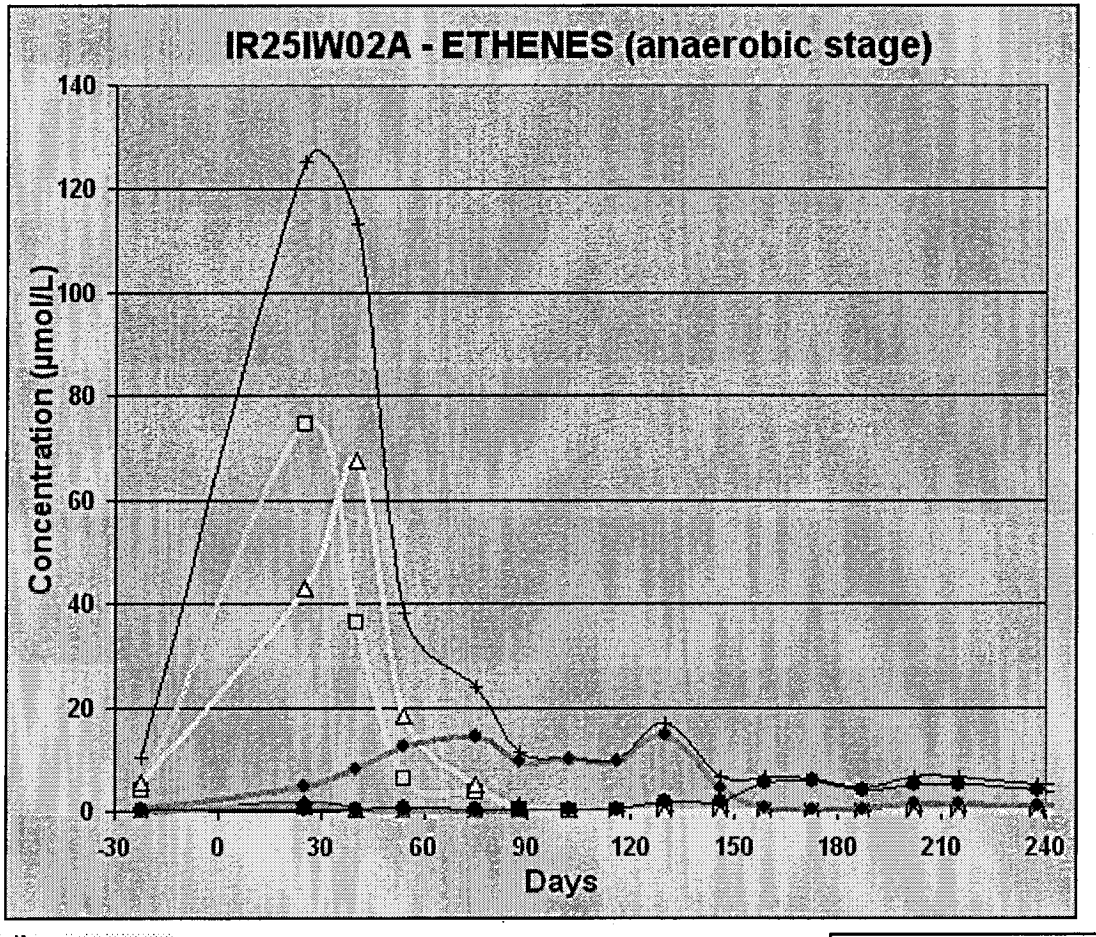
Figure F21
Molar Concentration of Chlorinated Ethenes in Well IR25EW56A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study

Shaw® Shaw Environmental, Inc.

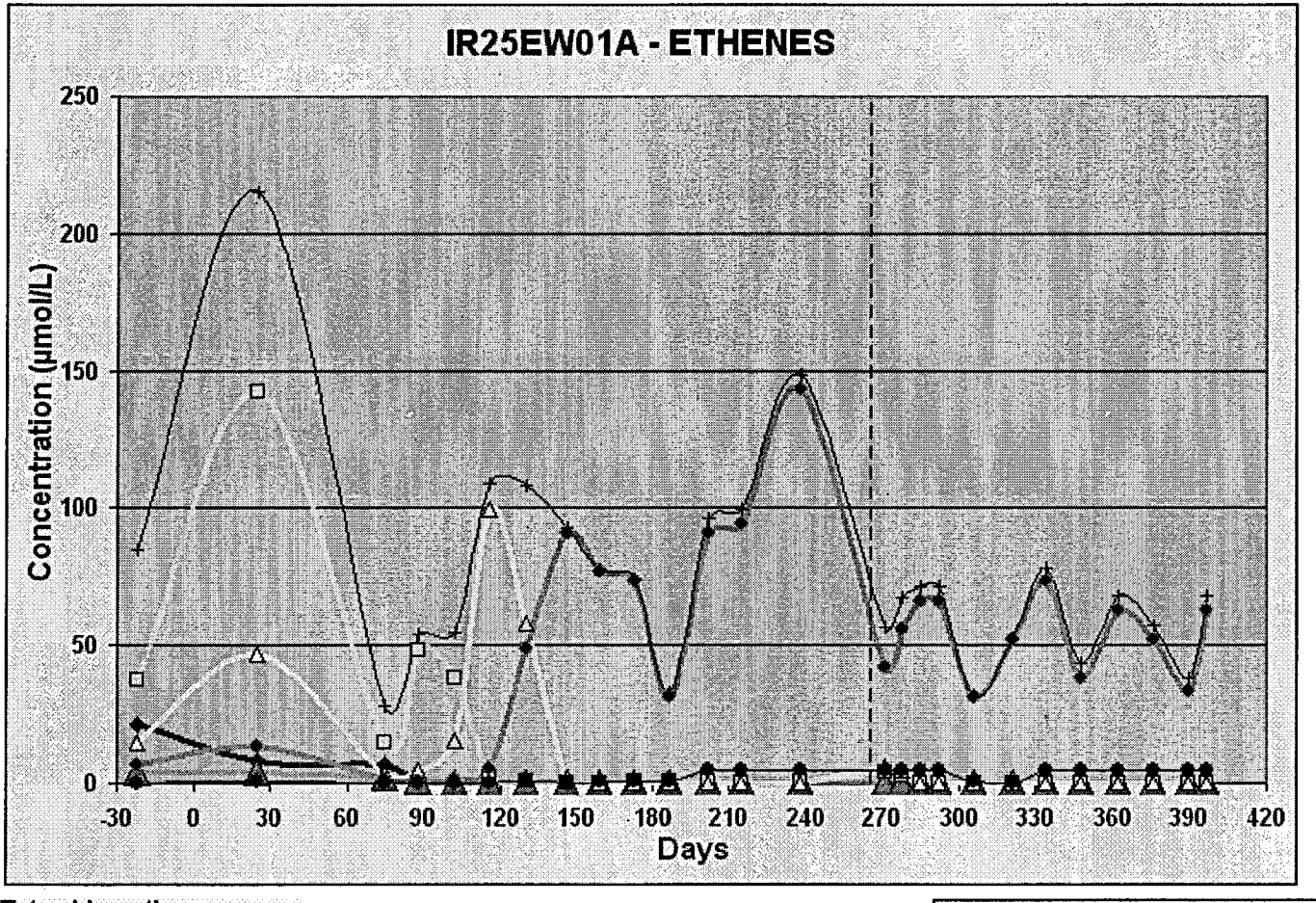
Figure F22
Molar Concentration of Chlorinated Ethenes in Well IR25EW53A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study

Shaw® Shaw Environmental, Inc.

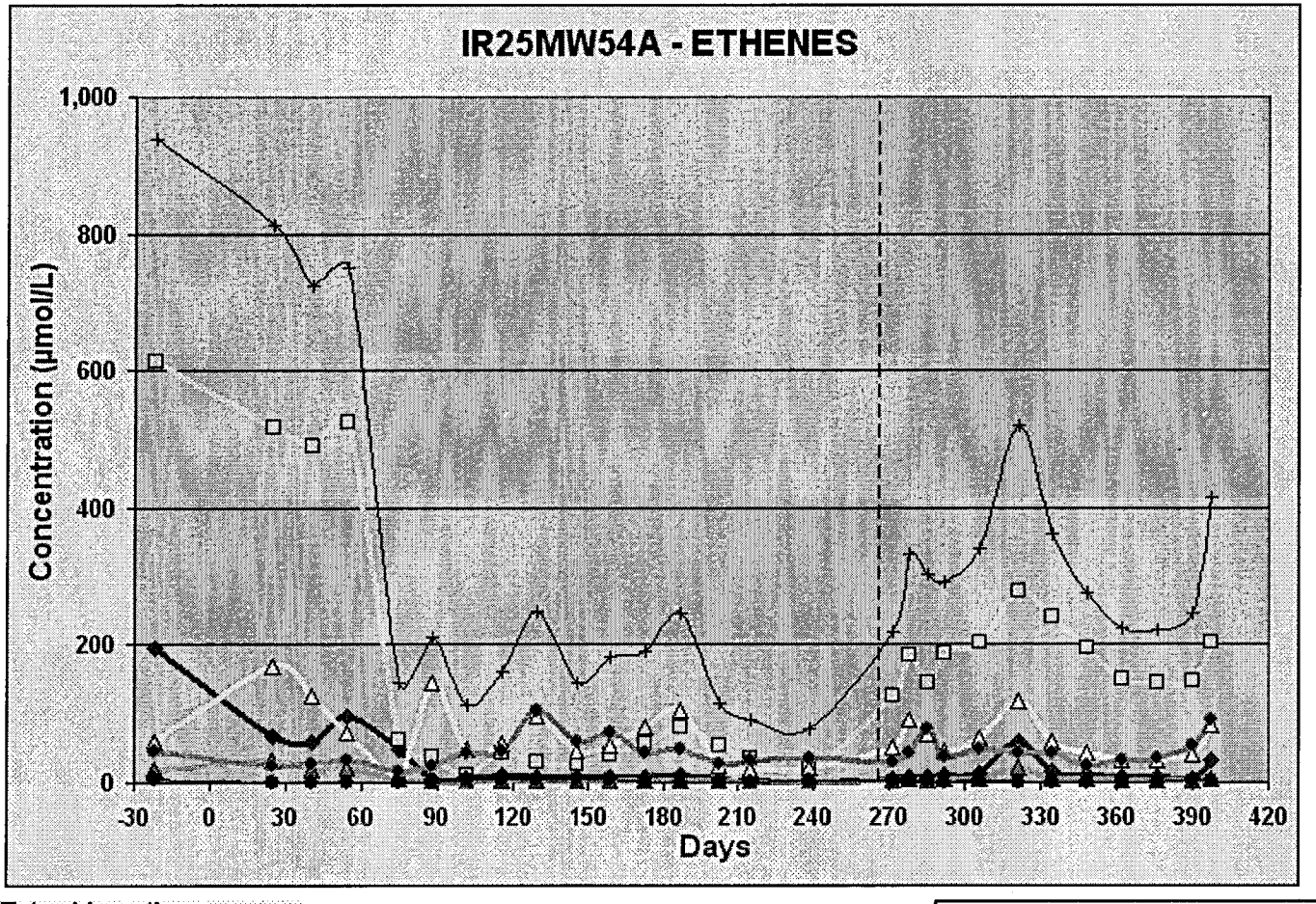
Figure F23
Molar Concentration of Chlorinated Ethenes in Well IR25IW02A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

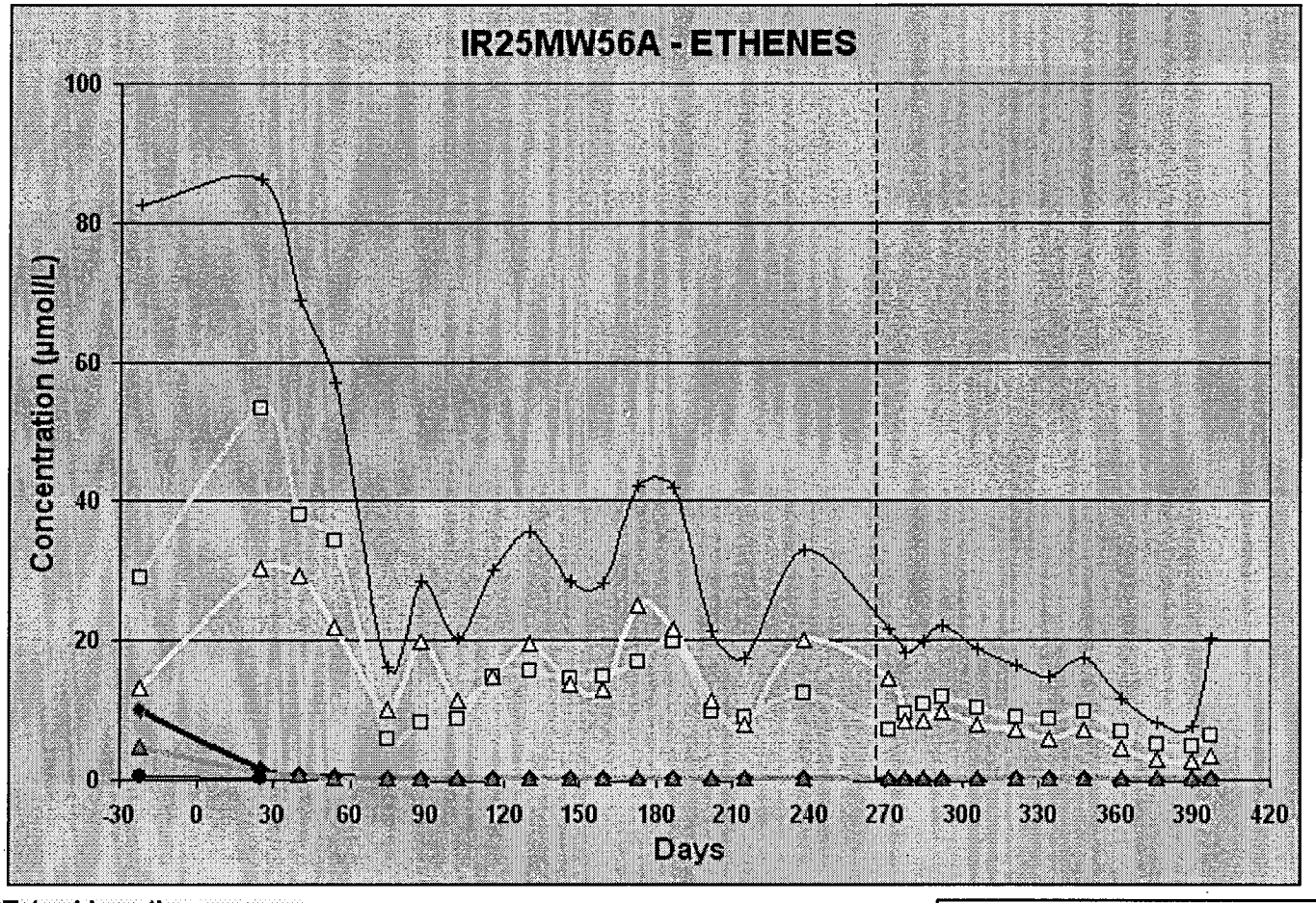
Figure F24
Molar Concentration of Chlorinated Ethenes in Well IR25EW01A



Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F25
Molar Concentration of Chlorinated Ethenes in Well IR25MW54A

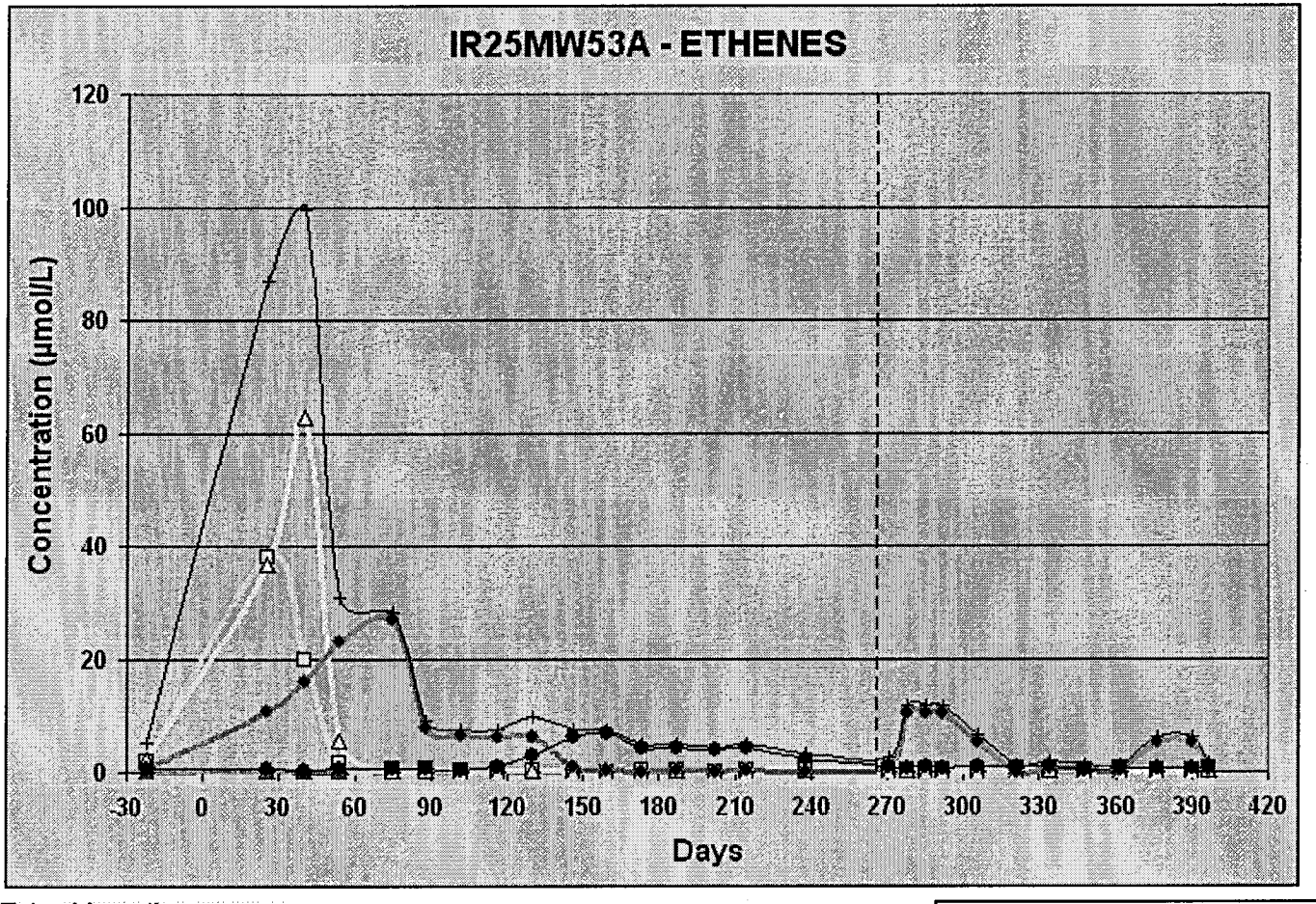


Tetrachloroethene
Trichloroethene
1,2-Dichloroethene (total)
Vinyl Chloride
Ethene
Ethane
Total µmol/L

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

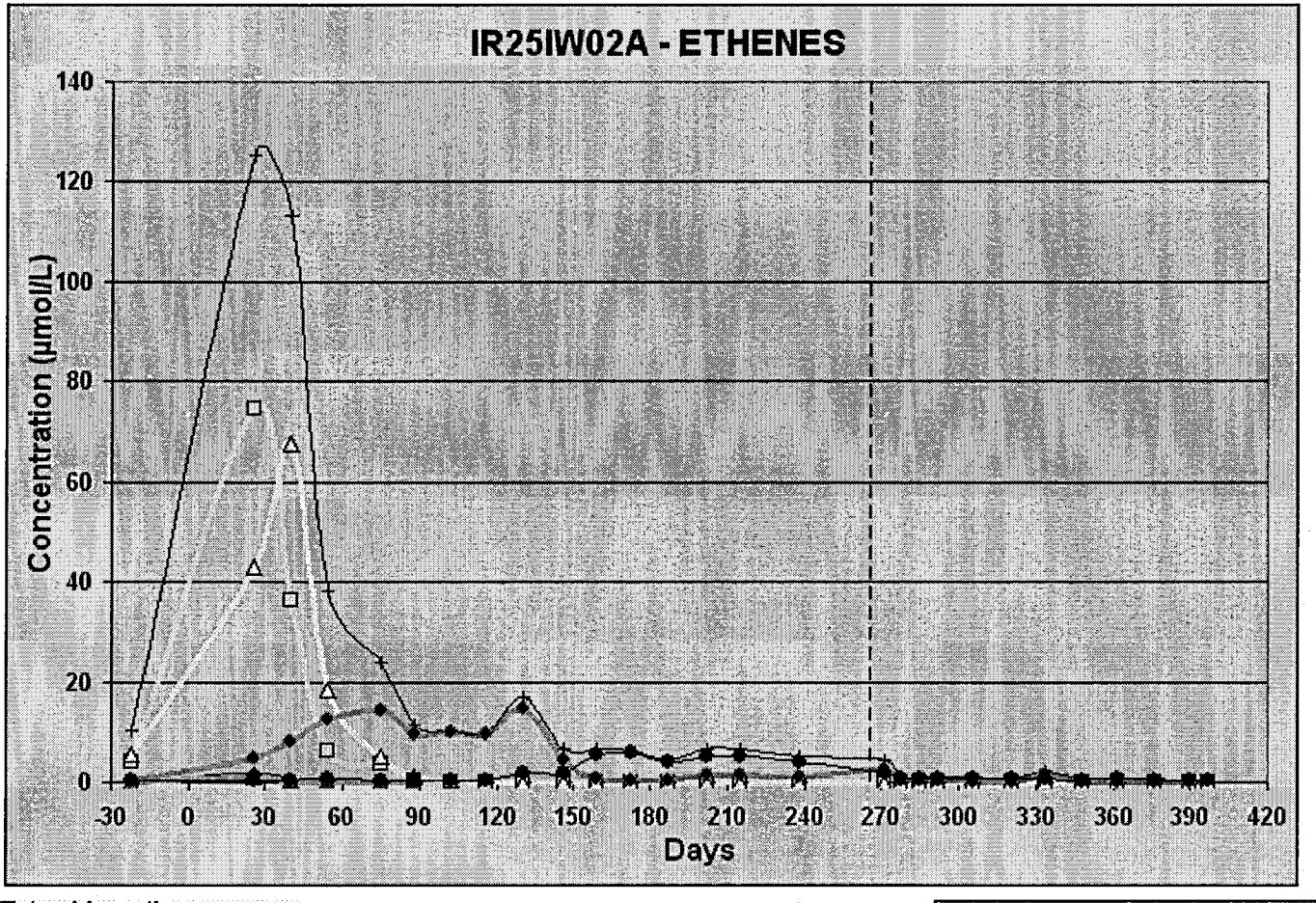
Figure F26
Molar Concentration of Chlorinated Ethenes in Well IR25MW56A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

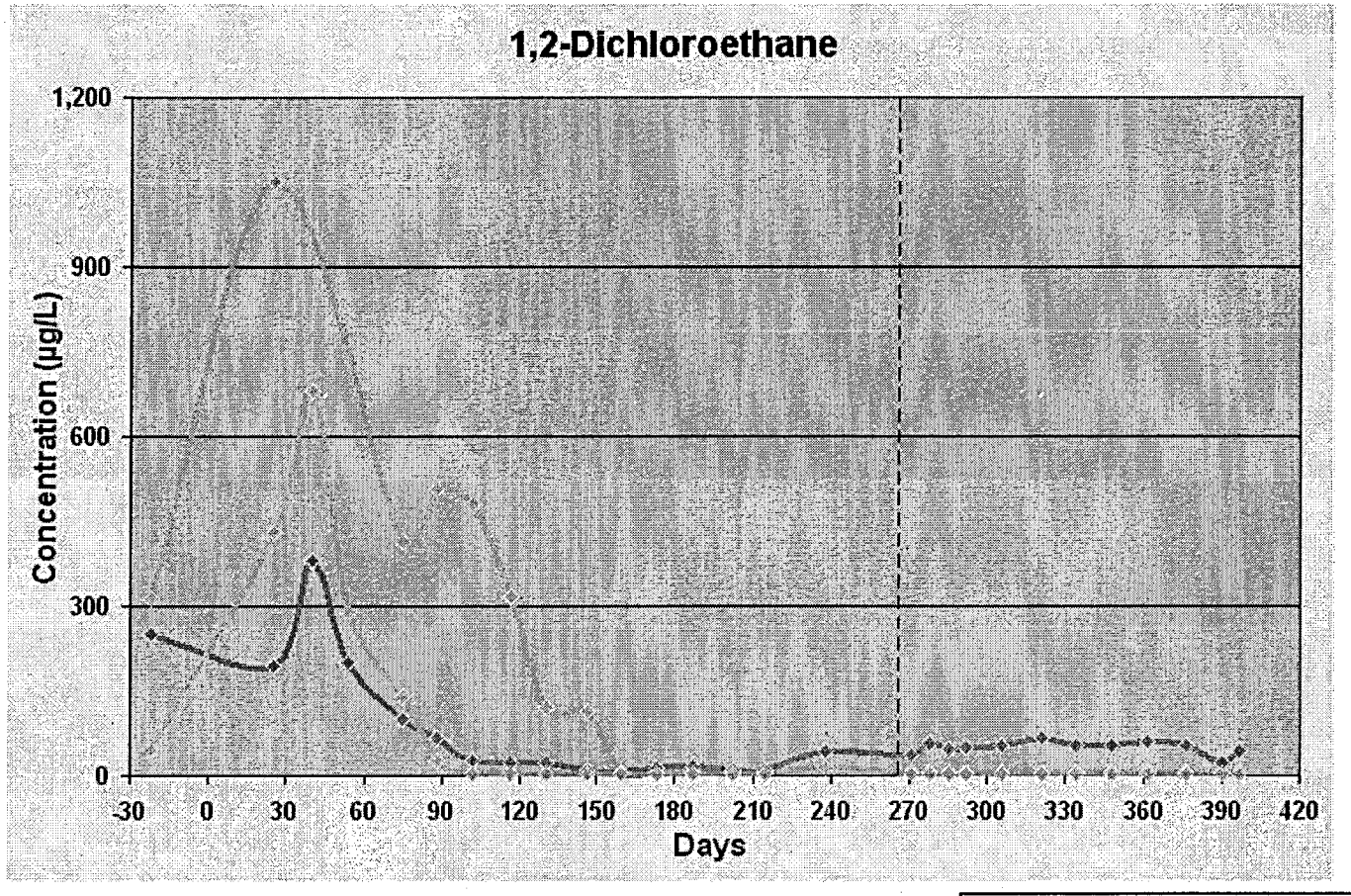
Figure F27
Molar Concentration of Chlorinated Ethenes in Well IR25MW53A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

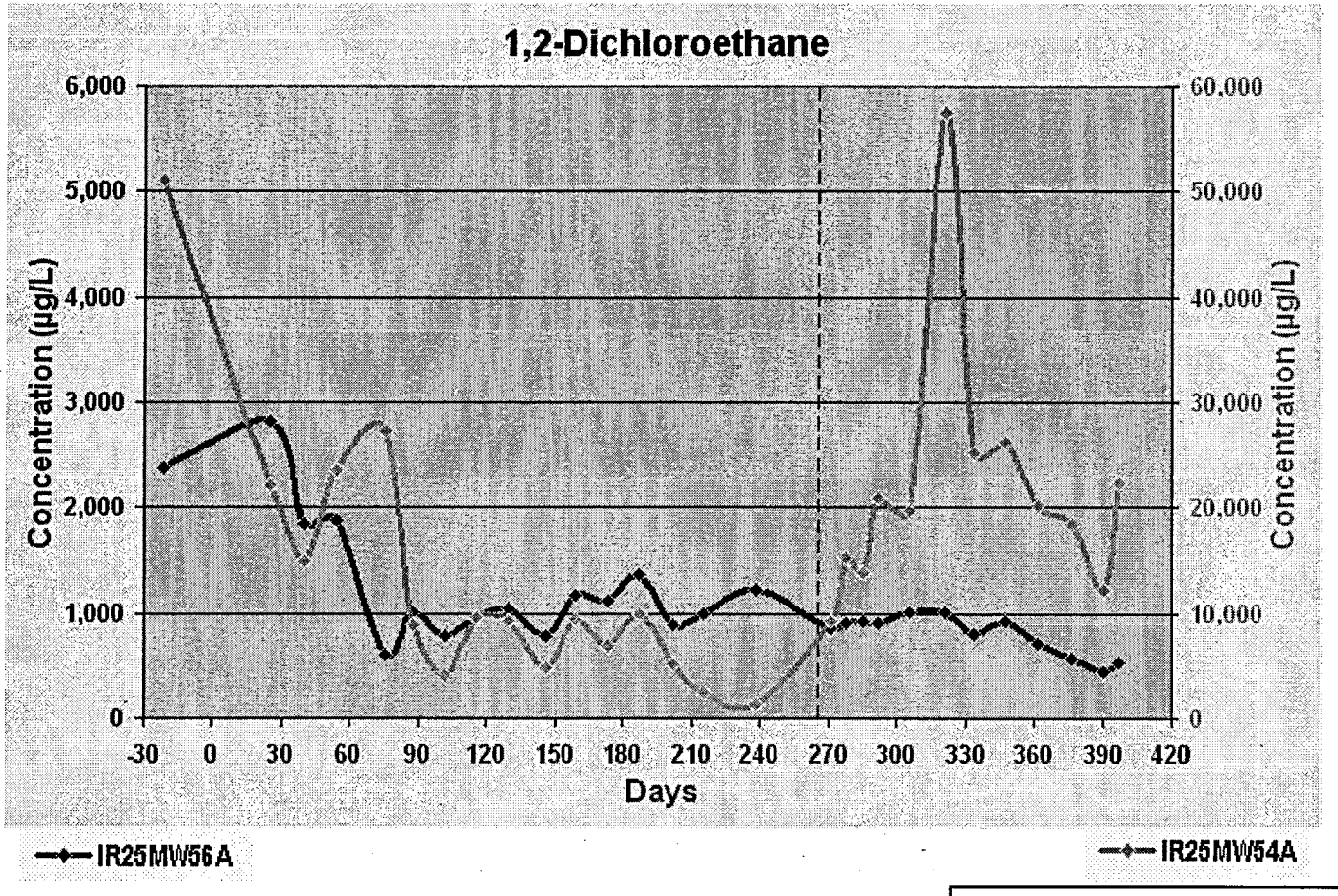
Shaw® Shaw Environmental, Inc.

Figure F28
Molar Concentration of Chlorinated Ethenes in Well IR25IW02A



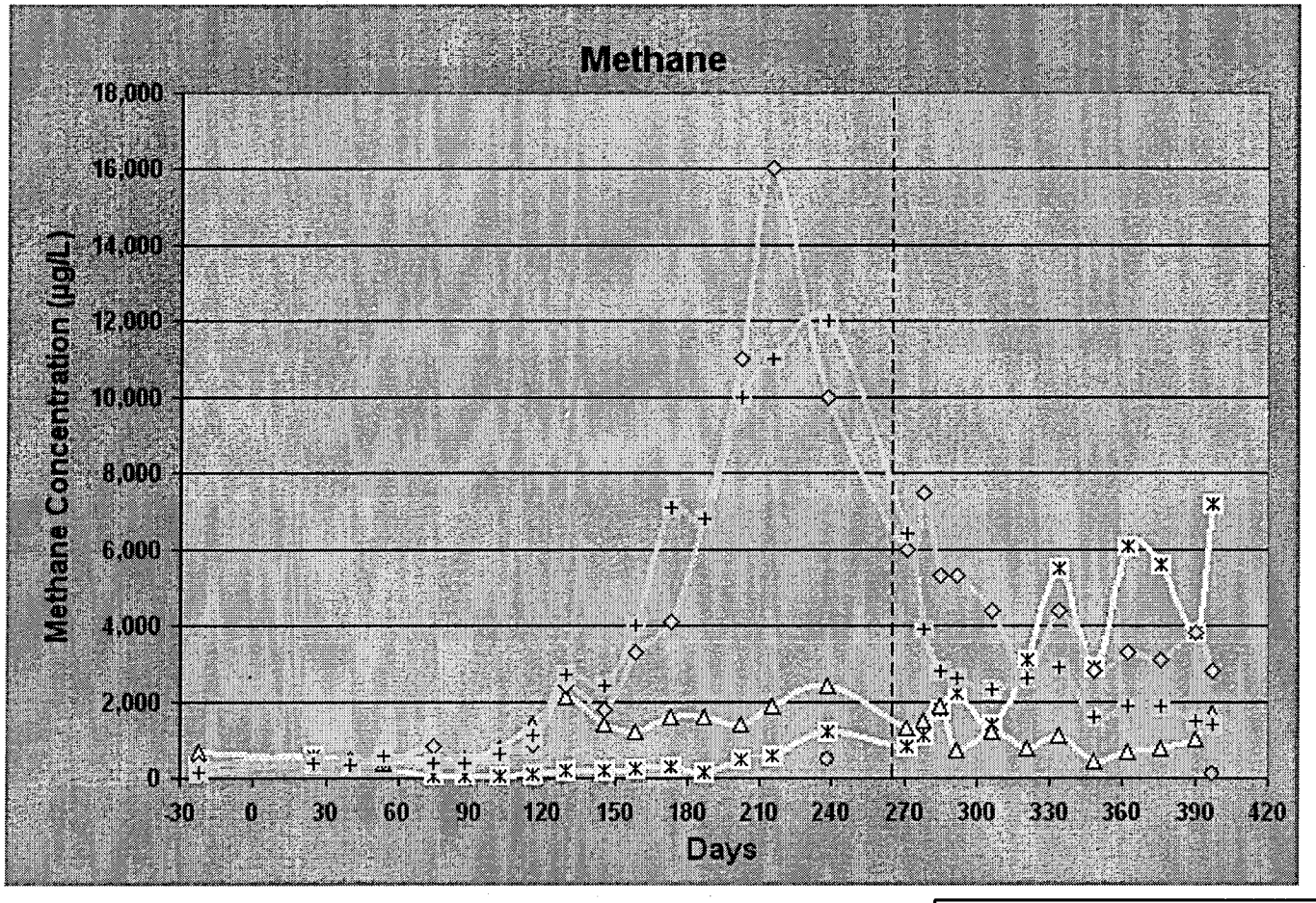
Shaw® Shaw Environmental, Inc.

Figure F29
1,2-Dichloroethane Concentration in Wells IR25 EW01A, MW53A, IW02A



Shaw® Shaw Environmental, Inc.

Figure F30
1,2-Dichloroethane Concentration in Wells IR25MW56A and IR25MW54A

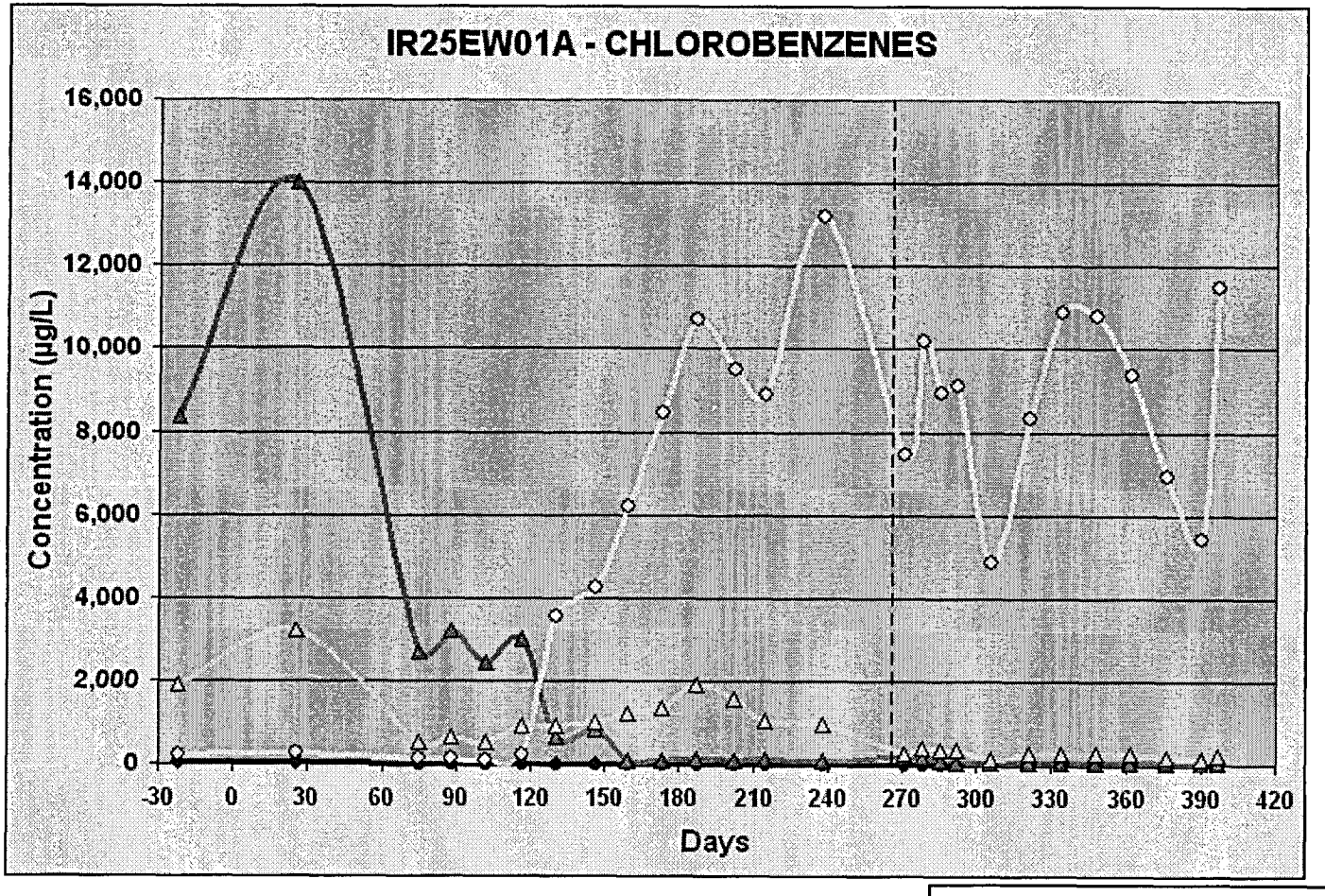


IR25EW01A
IR25MW54A
IR25MW56A
IR25MW53A
IR25IW02A

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

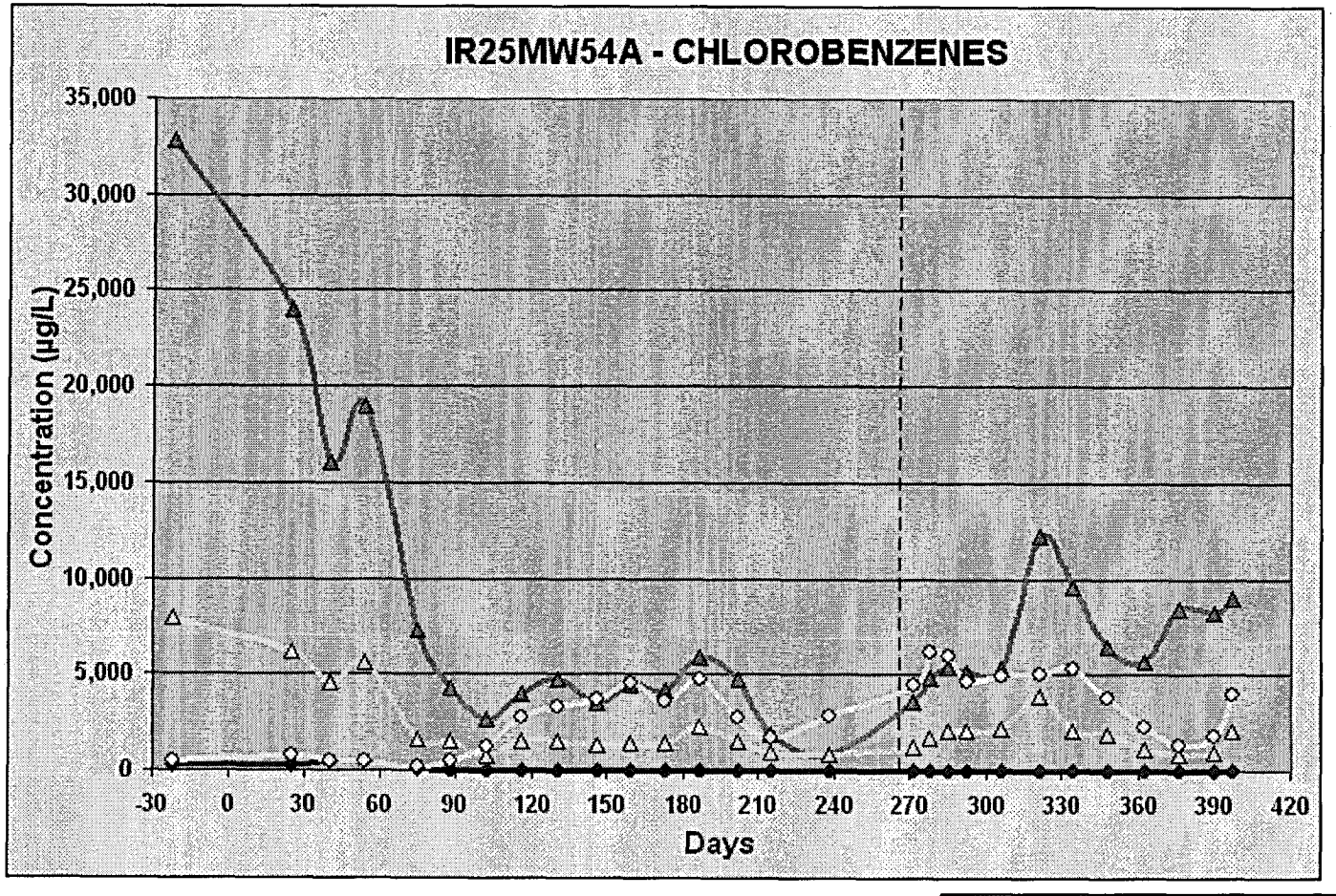
Figure F31
Methane Concentration in Treatment Study Area Wells



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F32
Concentration of Chlorobenzenes in Well IR25EW01A

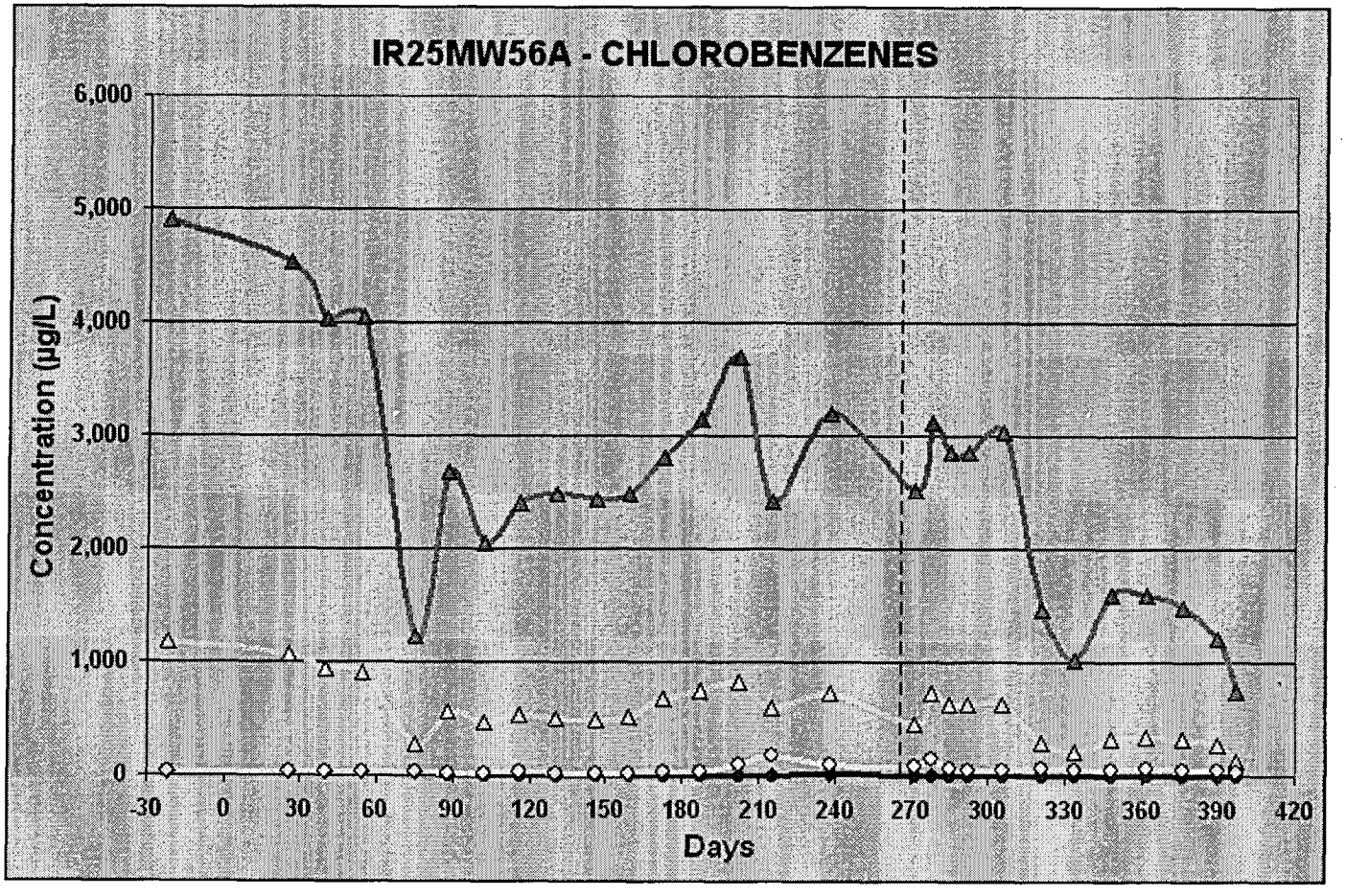


1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
Chlorobenzene

Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F33
Concentration of Chlorobenzenes in Well IR25MW54A

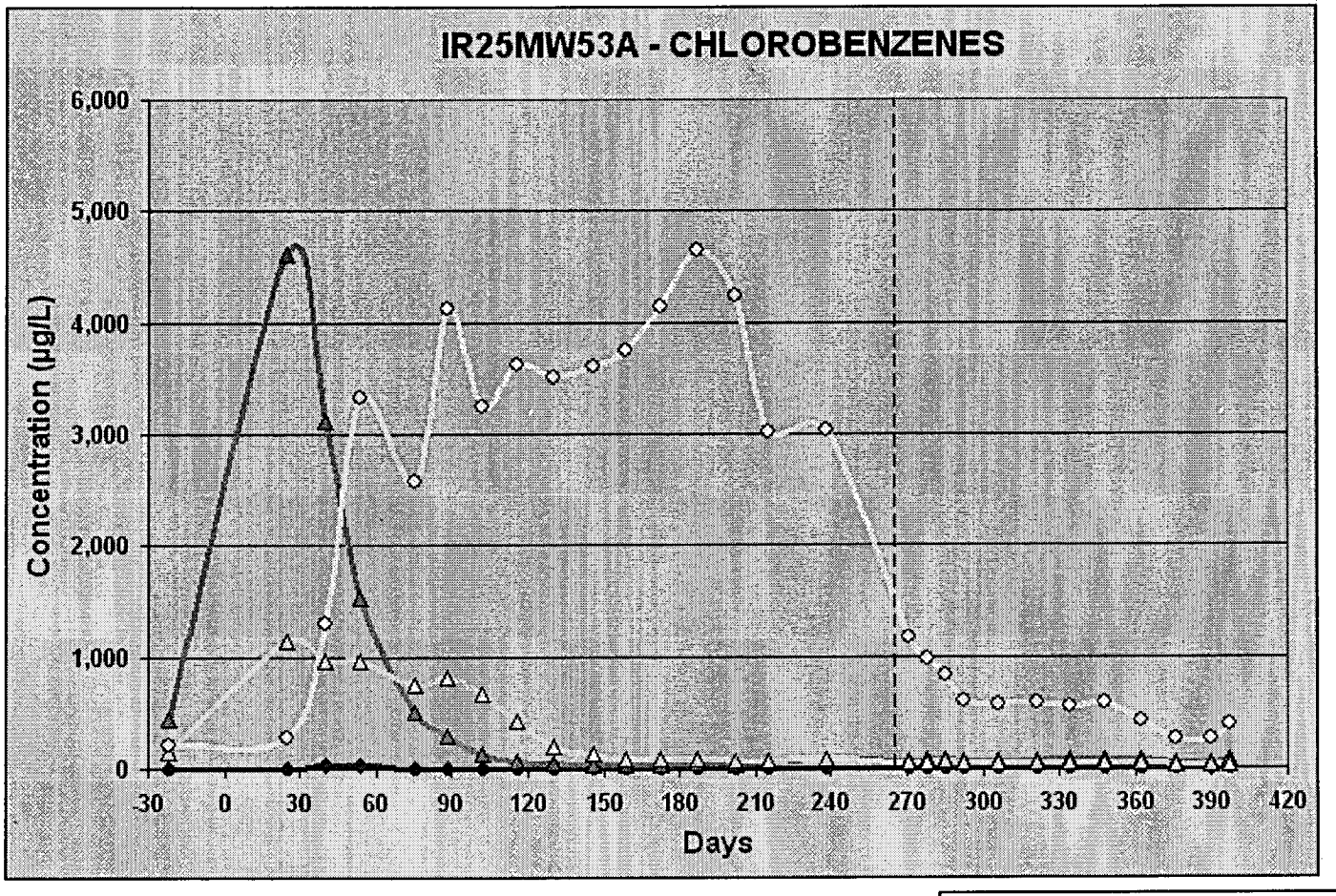


1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
Chlorobenzene

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

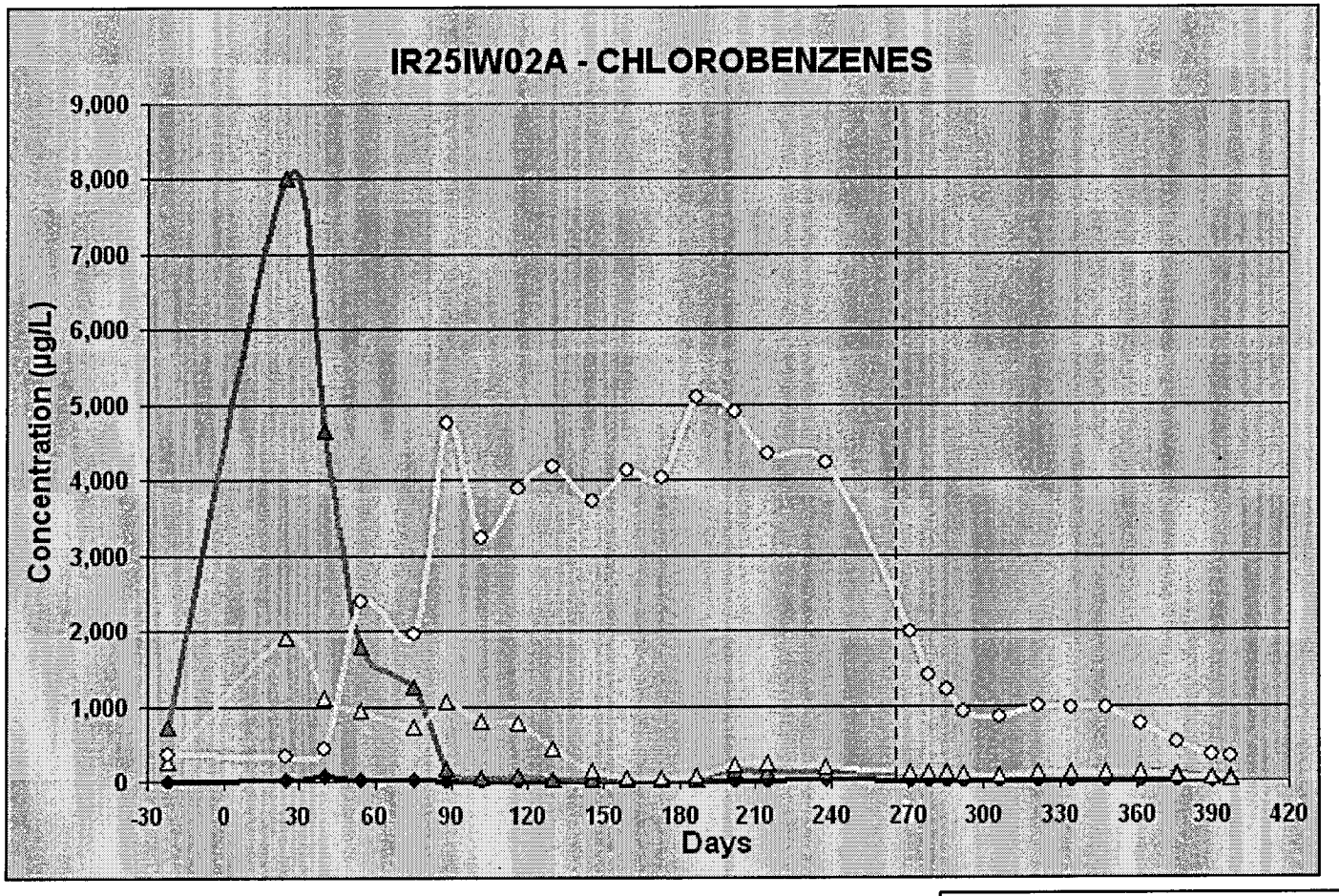
Figure F34
Concentration of Chlorobenzenes in Well IR25MW56A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F35
Concentration of Chlorobenzenes in Well IR25MW53A

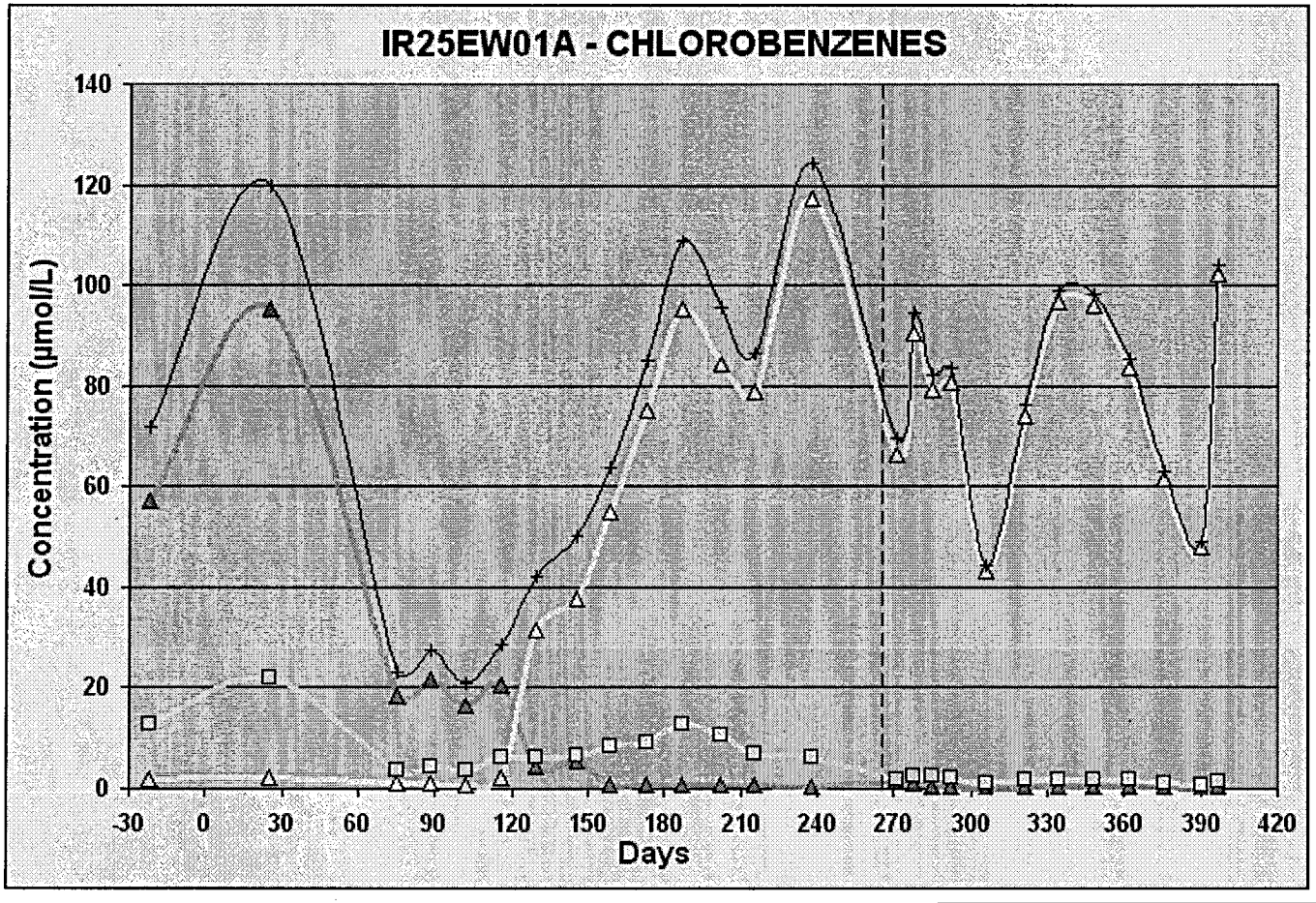


1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene
Chlorobenzene

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F36
Concentration of Chlorobenzenes in Well IR25IW02A

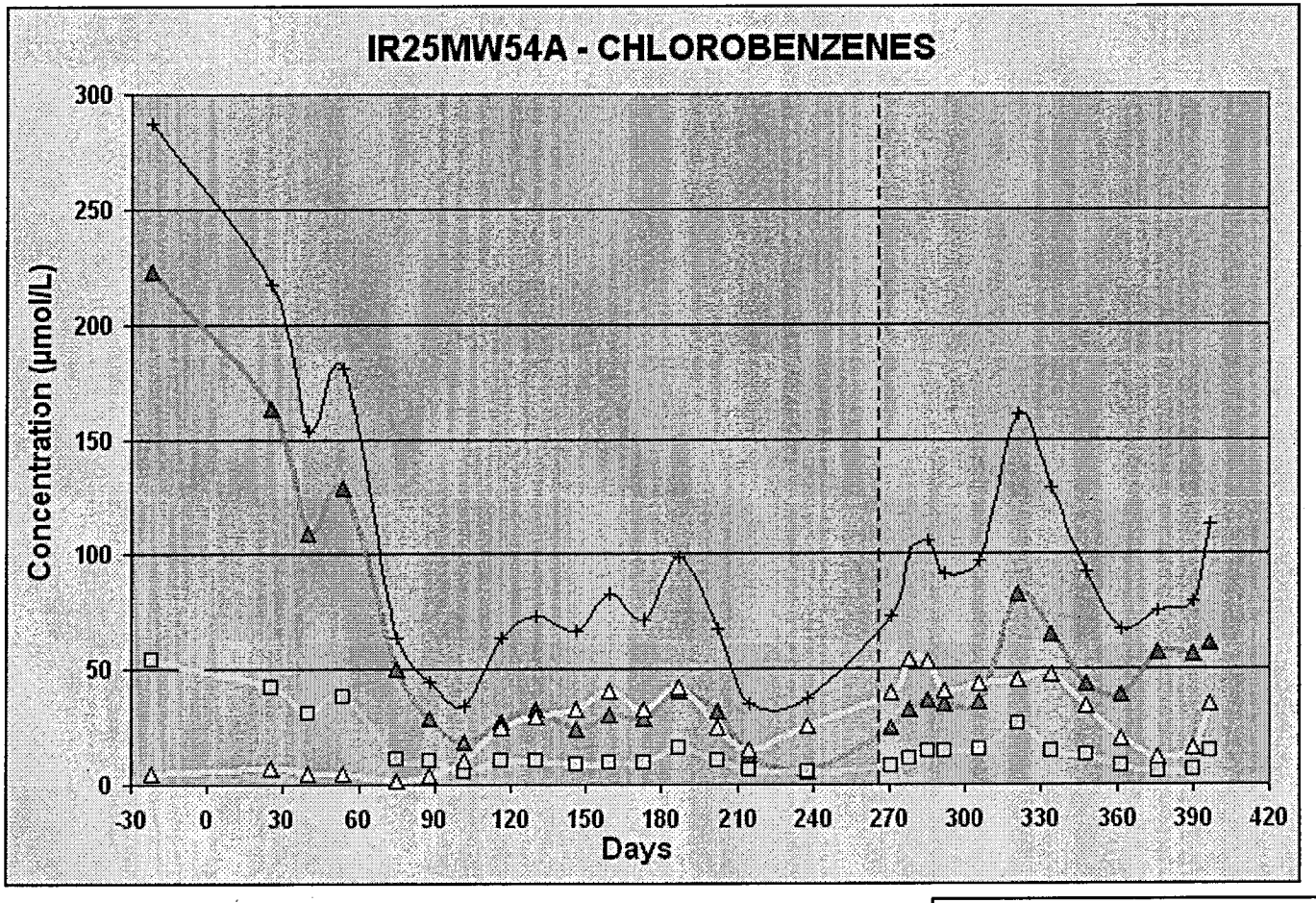


1,2-DCB
1,4-DCB
Chlorobenzene
Total µmol/L

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

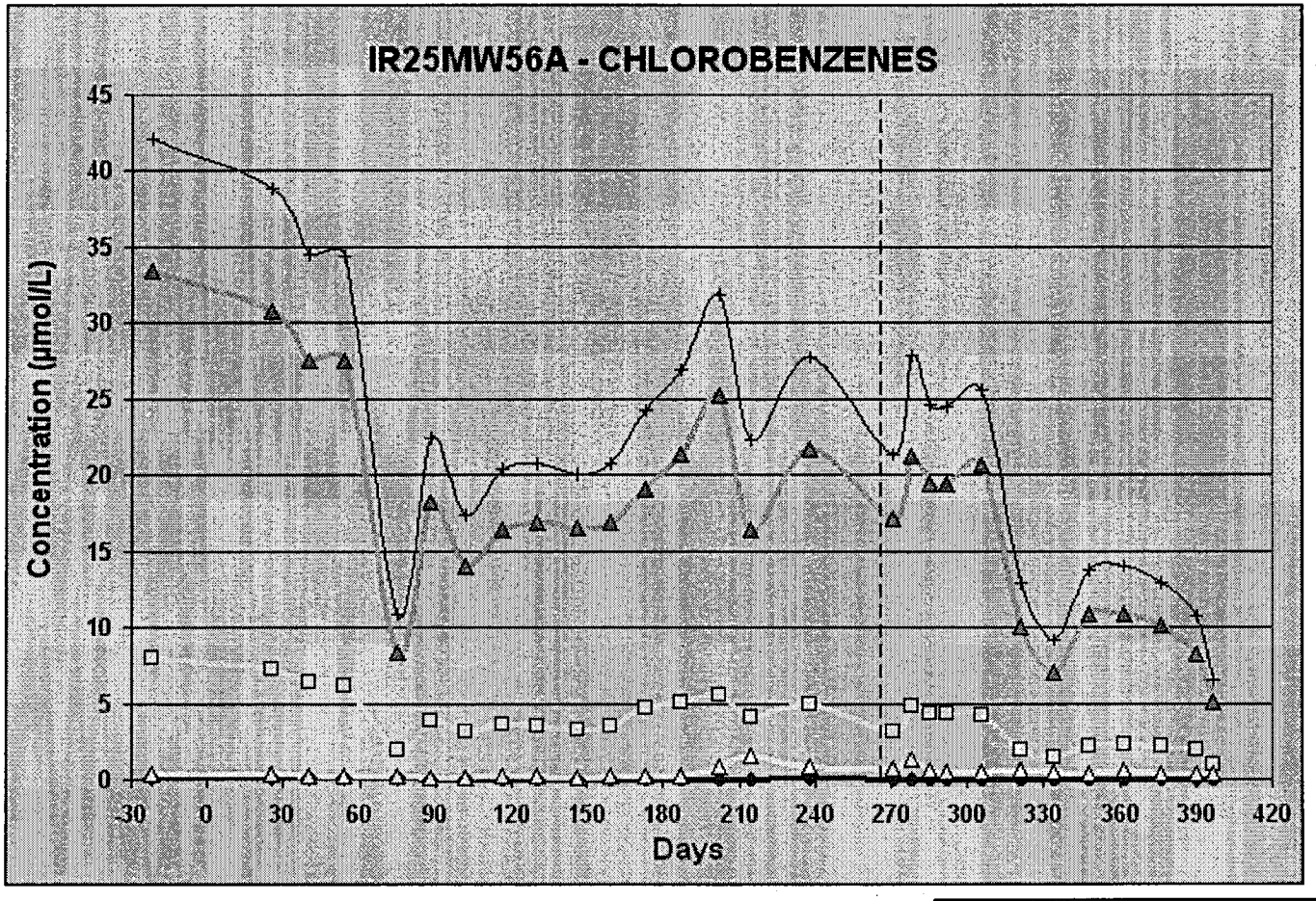
Figure F37
Molar Concentration of
Chlorobenzenes in Well IR25EW01A



Day 0 – Start of re-circulation and lactate injection
Day 75 – Begin lactate injection in well IR25MW54A
Day 159 – Begin hydrogen injection in well IR25MW54A
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F38
Molar Concentration of
Chlorobenzenes in Well IR25MW54A

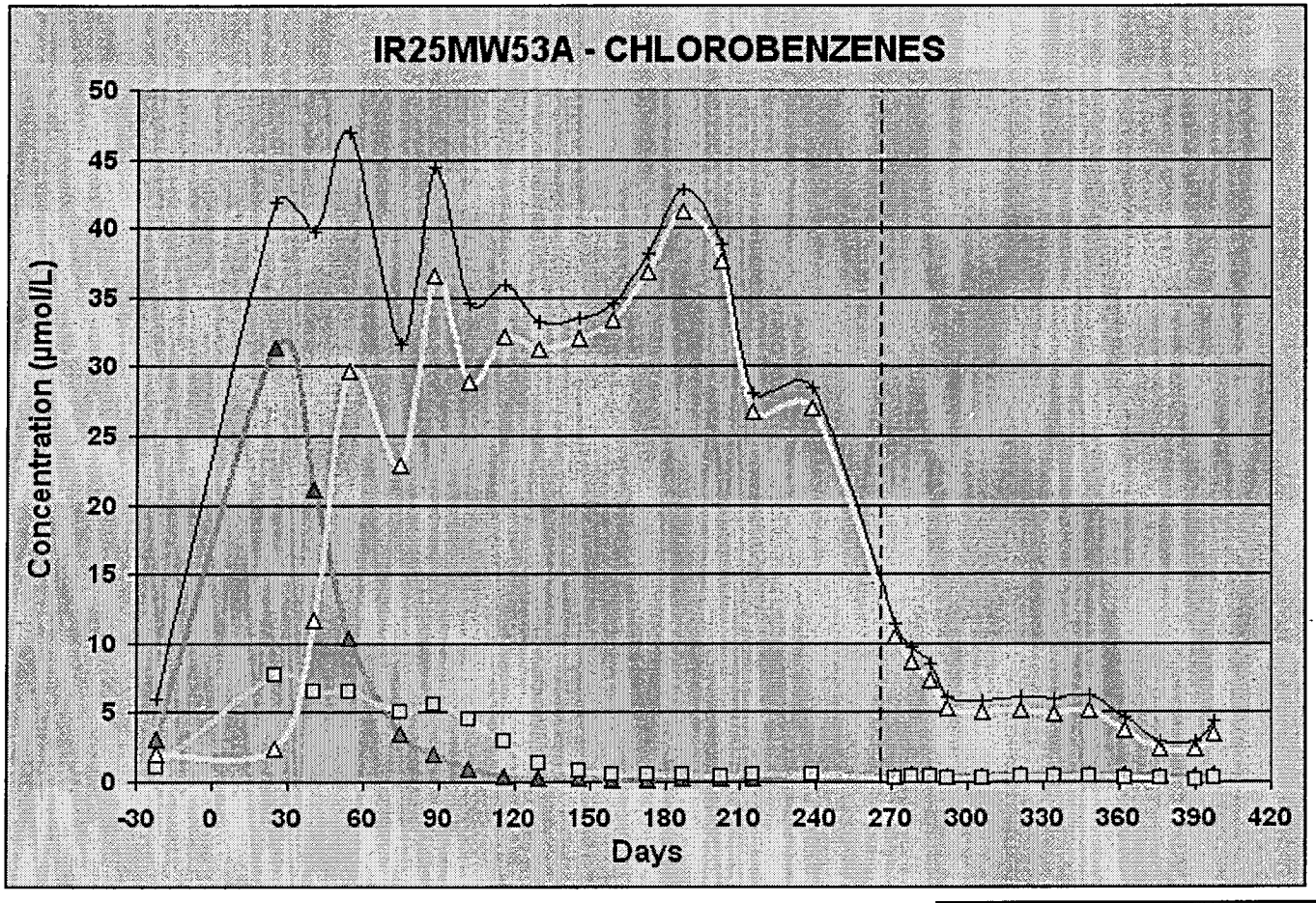


1,2-DCB
1,4-DCB
Chlorobenzene
Total µmol/L

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F39
Molar Concentration of
Chlorobenzenes in Well IR25MW56A

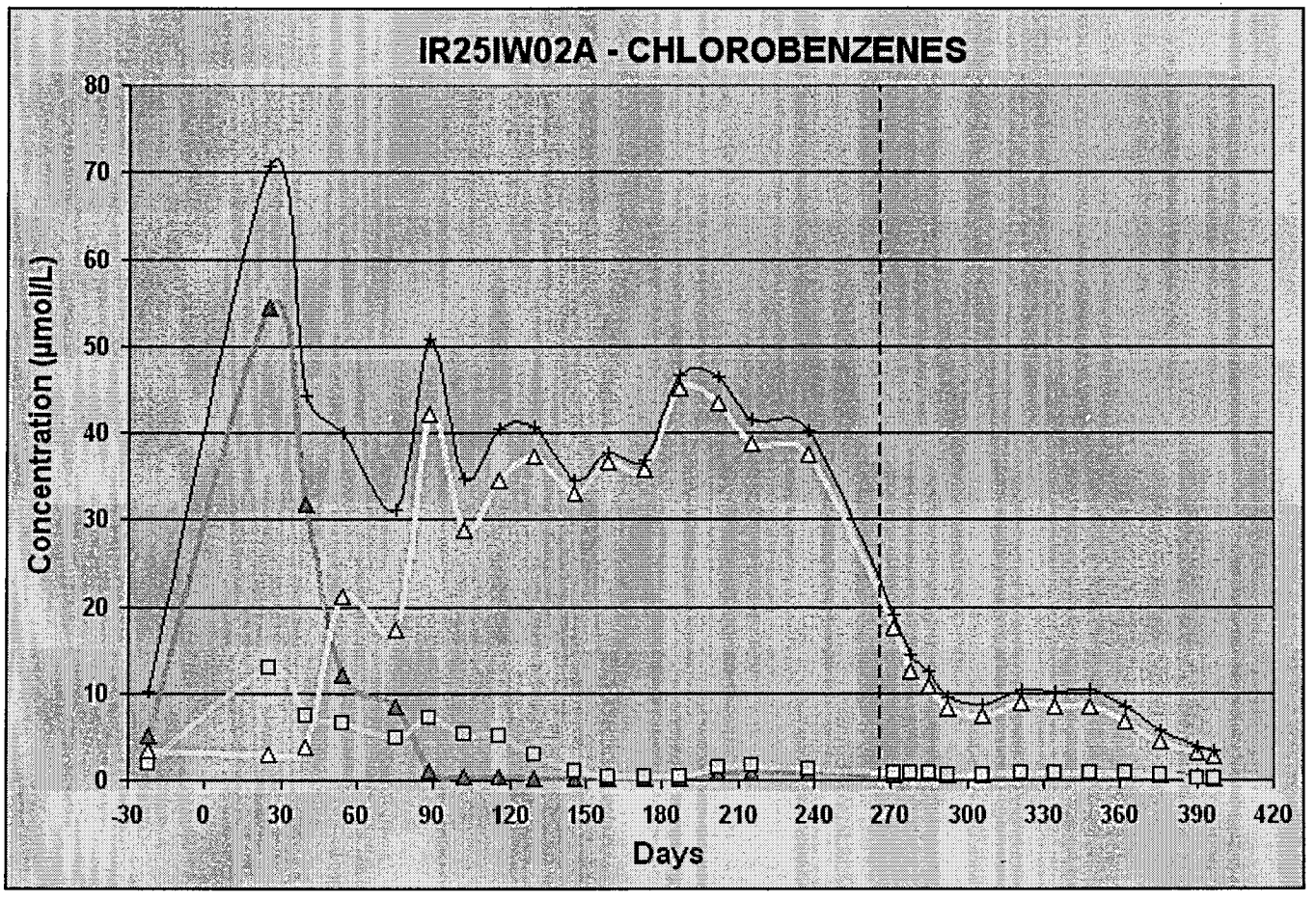


1,2-DCB
1,4-DCB
Chlorobenzene
Total µmol/L

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F40
Molar Concentration of
Chlorobenzenes in Well IR25MW53A

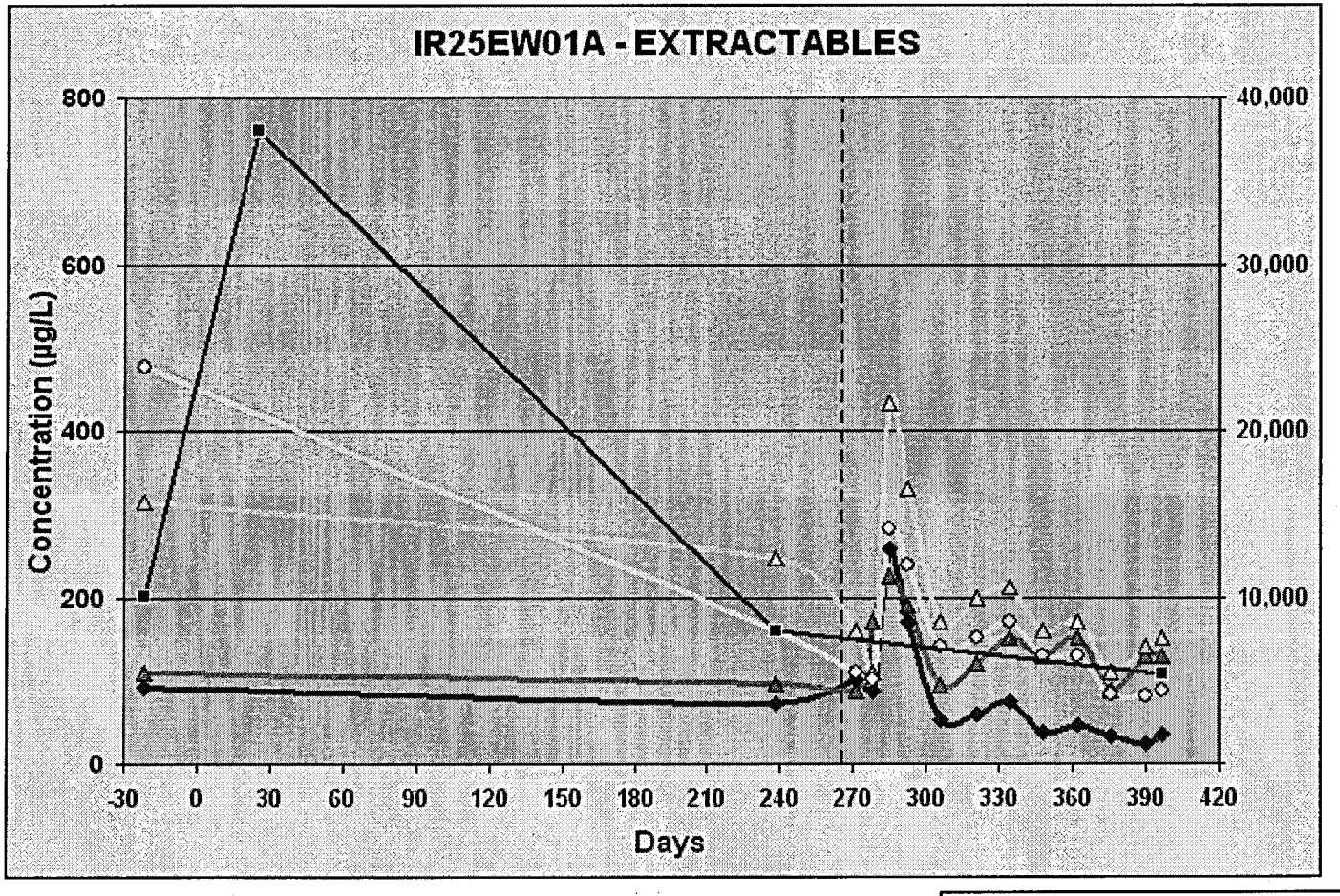


1,2-DCB
1,4-DCB
Chlorobenzene
Total µmol/L

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

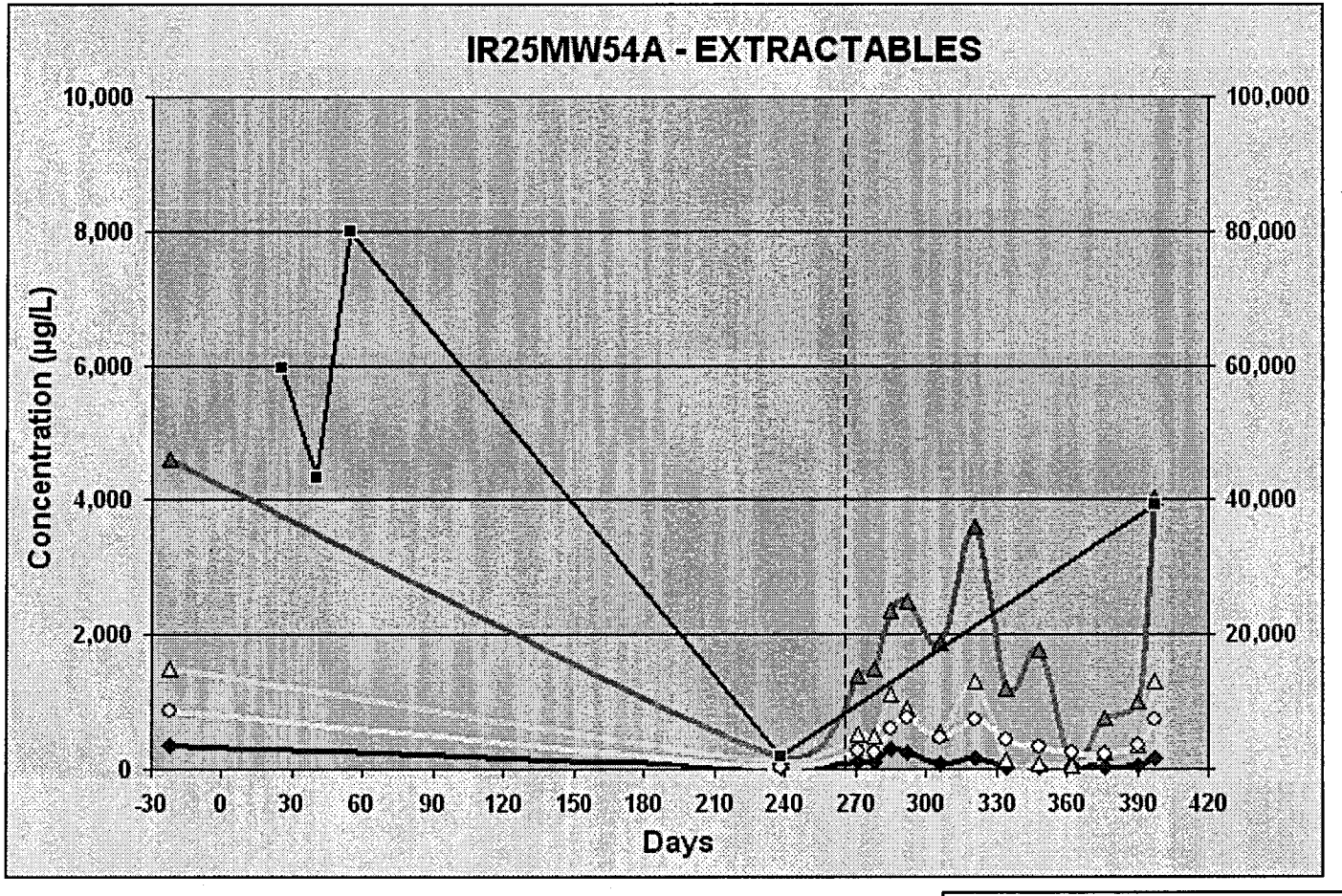
Figure F41
Molar Concentration of
Chlorobenzenes in Well IR25IW02A



Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F42
Concentration of Phenols and TPH as Diesel in Well IR25EW01A

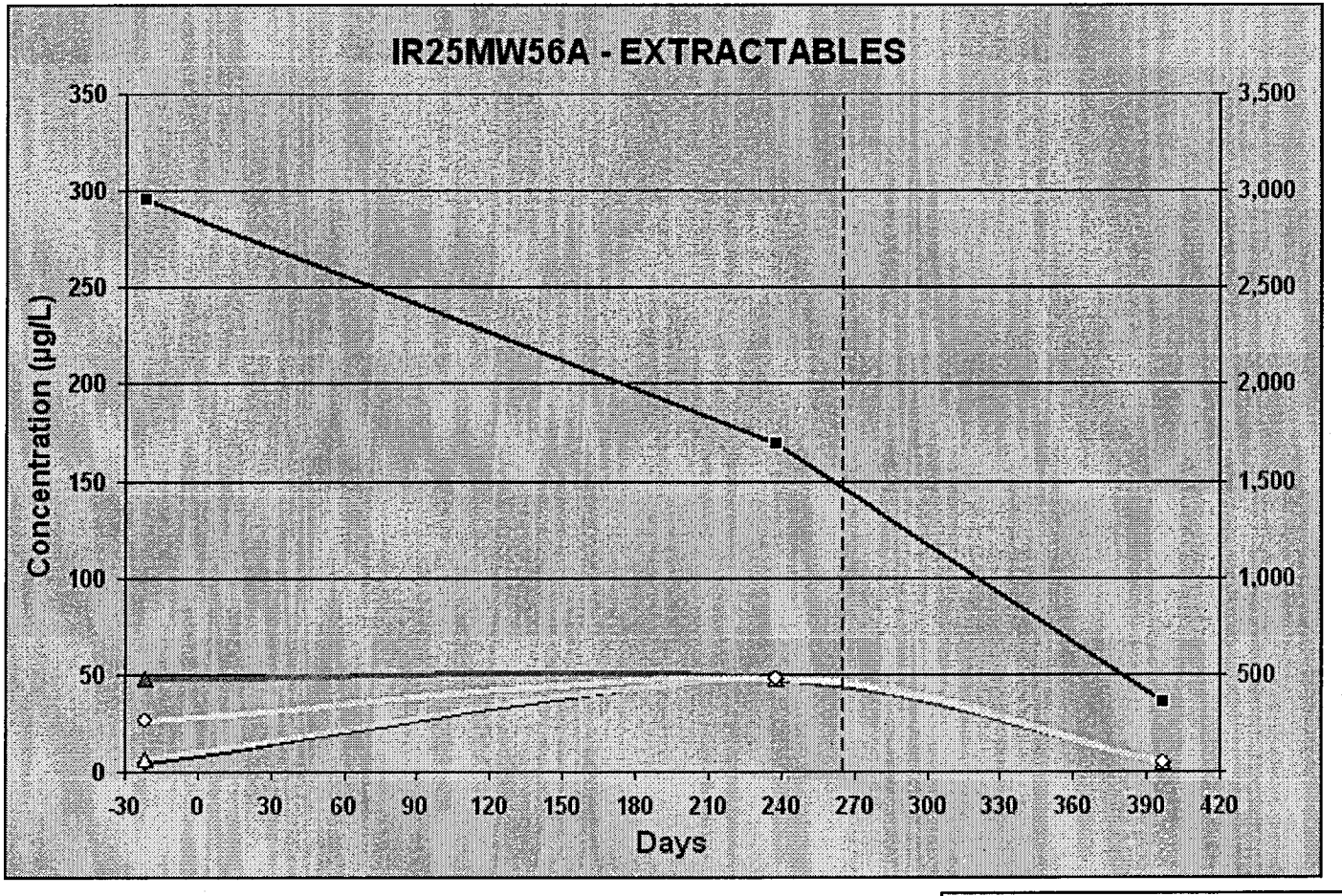


Phenol
2,4-Dimethylphenol
3,4-Methylphenol (m,p-Cresol)
2-Methylphenol(o-Cresol)
Diesel

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobicstudy (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F43
Concentration of Phenols and TPH as Diesel in Well IR25MW54A

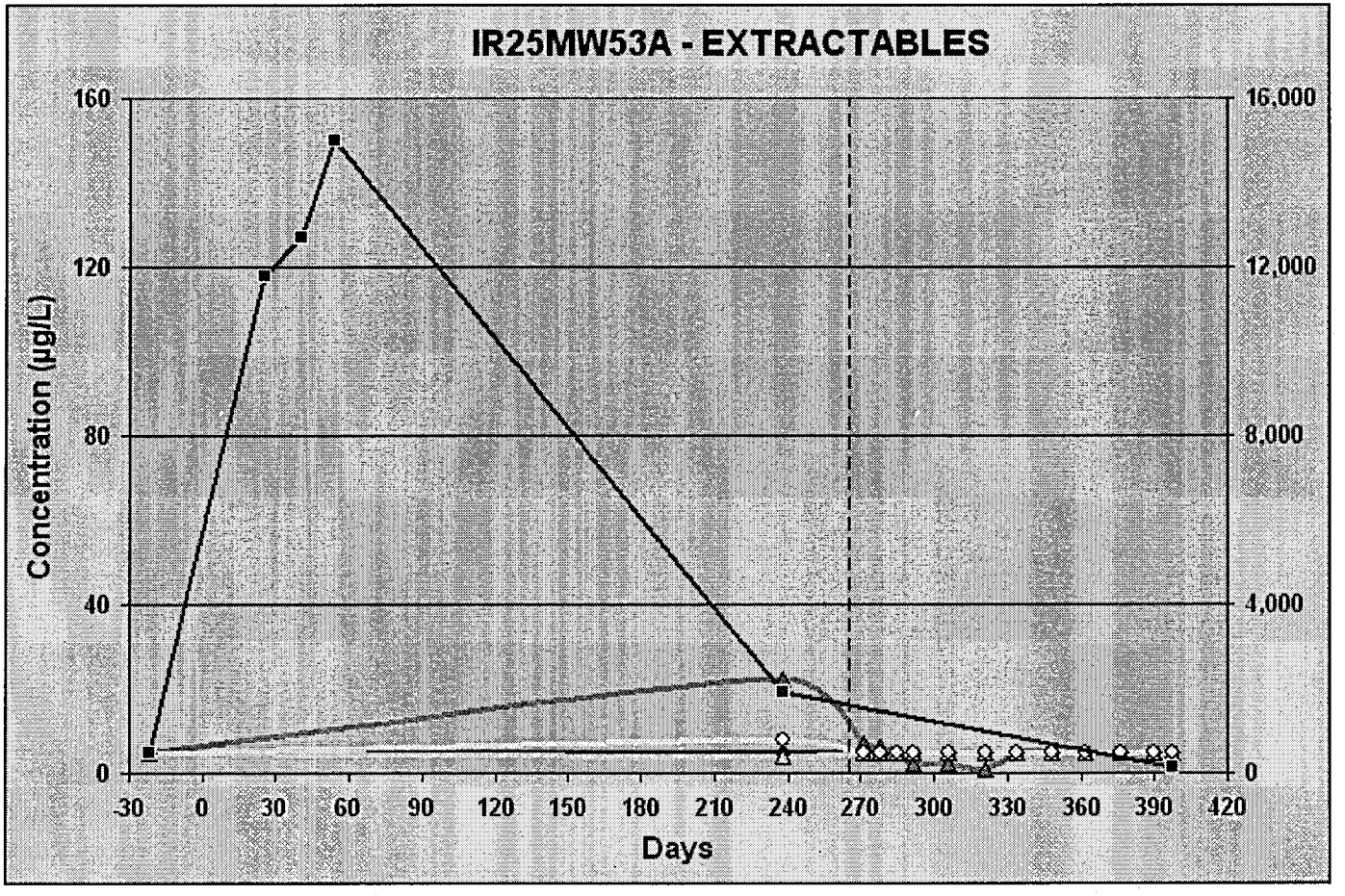


Phenol
2,4-Dimethylphenol
3,4-Methylphenol (m,p-Cresol)
2-Methylphenol(o-Cresol)
Diesel

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F44
Concentration of Phenols and TPH as Diesel in Well IR25MW56A

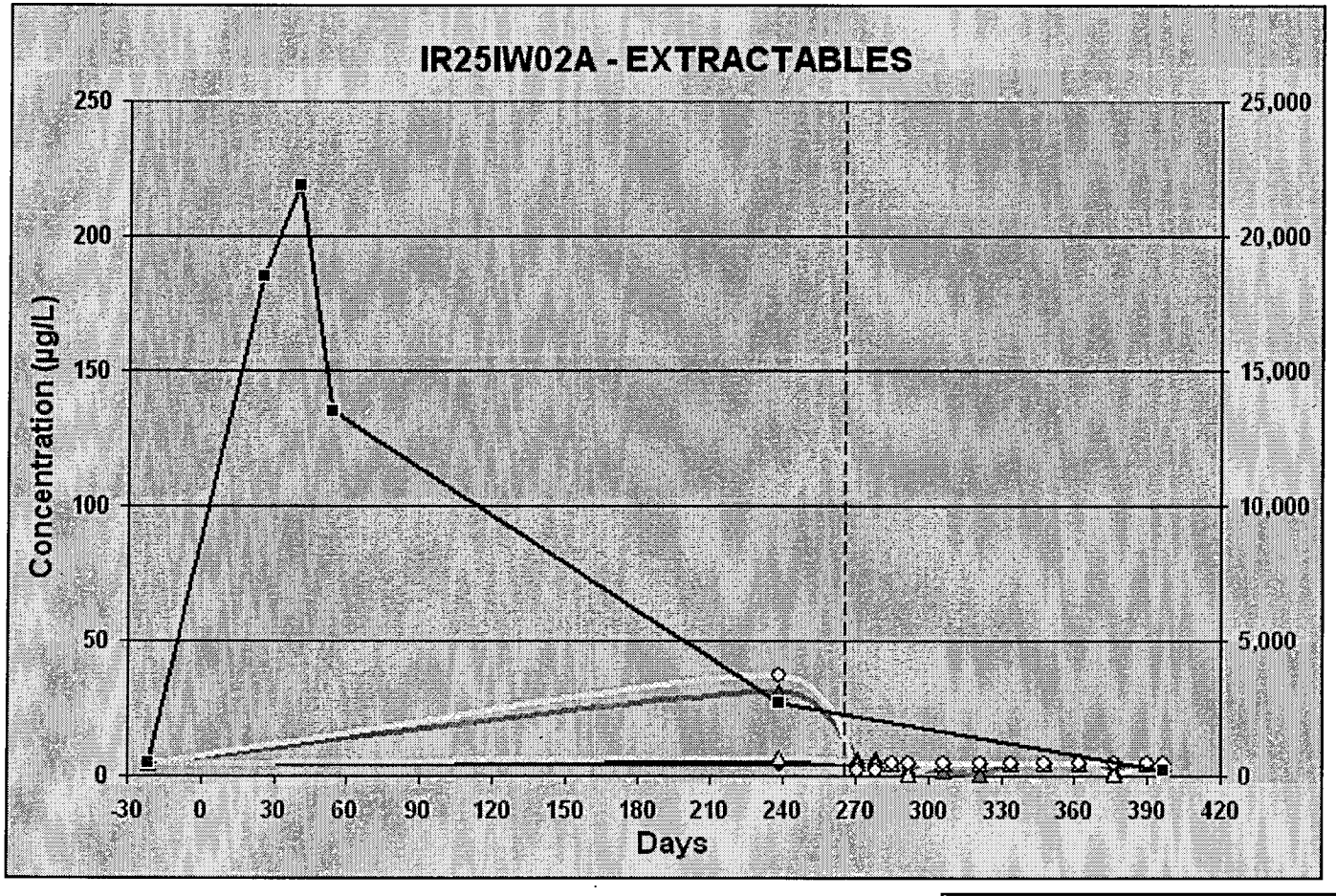


Phenol
2,4-Dimethylphenol
3,4-Methylphenol (m,p-Cresol)
2-Methylphenol(o-Cresol)
Diesel

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F45
Concentration of Phenols and TPH as Diesel in Well IR25MW53A

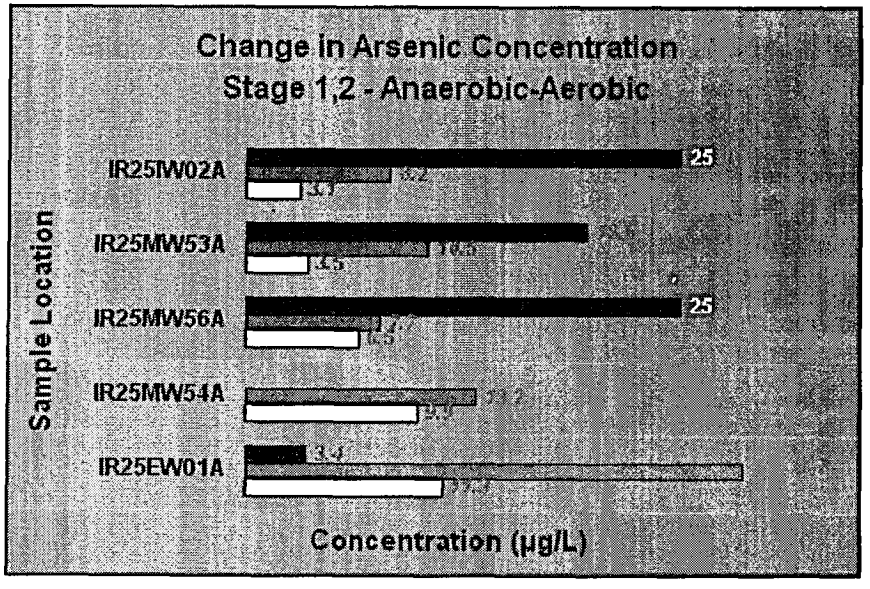


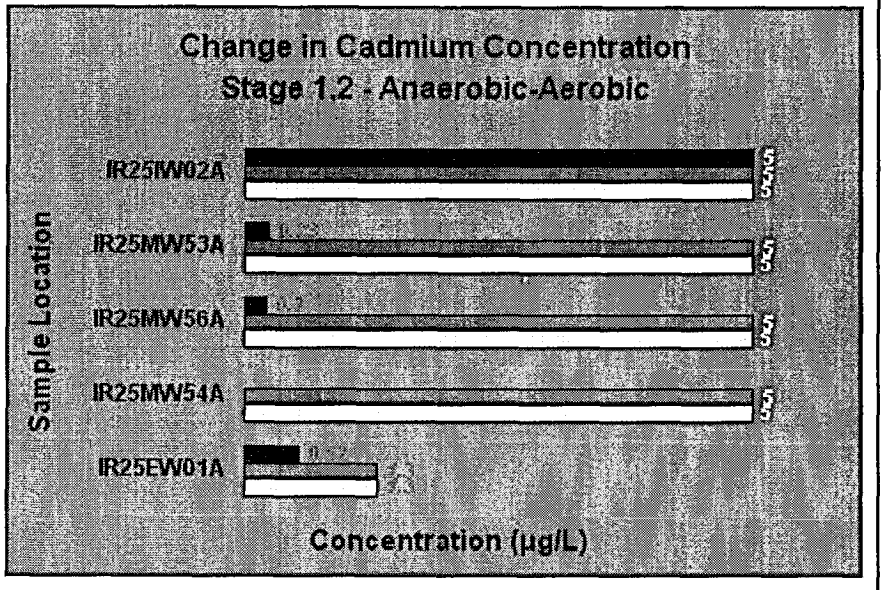
Phenol
2,4-Dimethylphenol
3,4-Methylphenol (m,p-Cresol)
2-Methylphenol(o-Cresol)
Diesel

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F46
Concentration of Phenols and TPH as Diesel in Well IR25IW02A





Legend

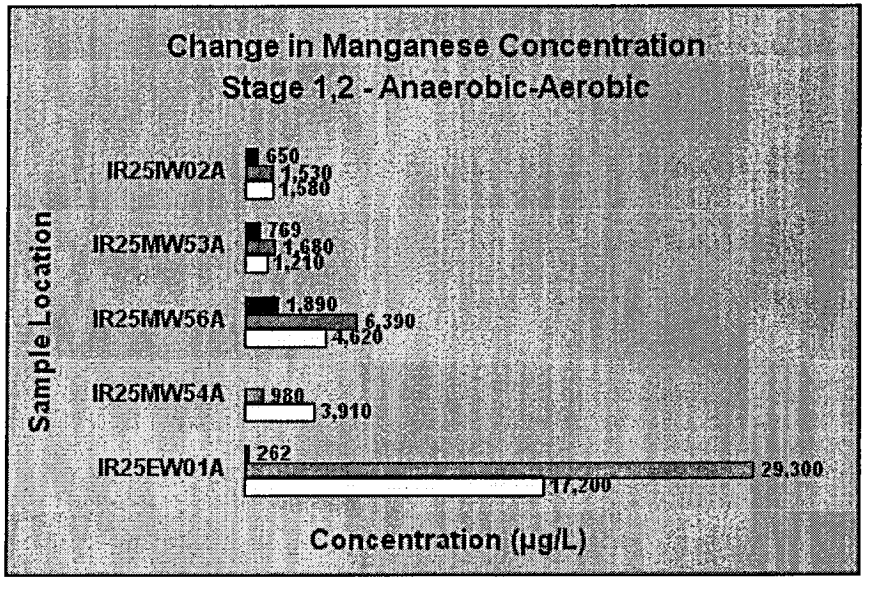
Meaning	Example
ND - Conc = 1/2 Detection Limit	0.5
J value - Estimated Concentration	0.5

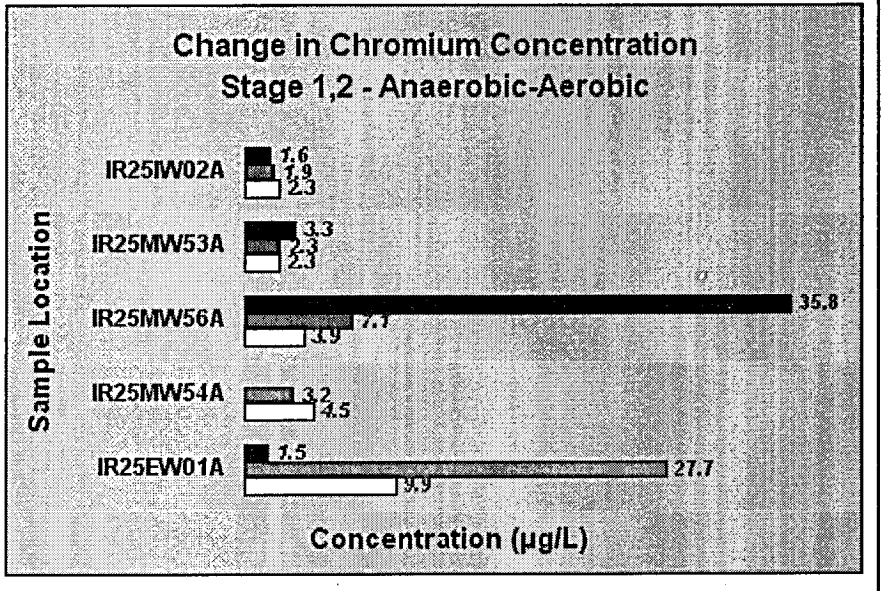
- **Day 0**
- **Day 238**
- **Day 397**

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F47
Arsenic and Cadmium in Groundwater
of Treatment Study Area





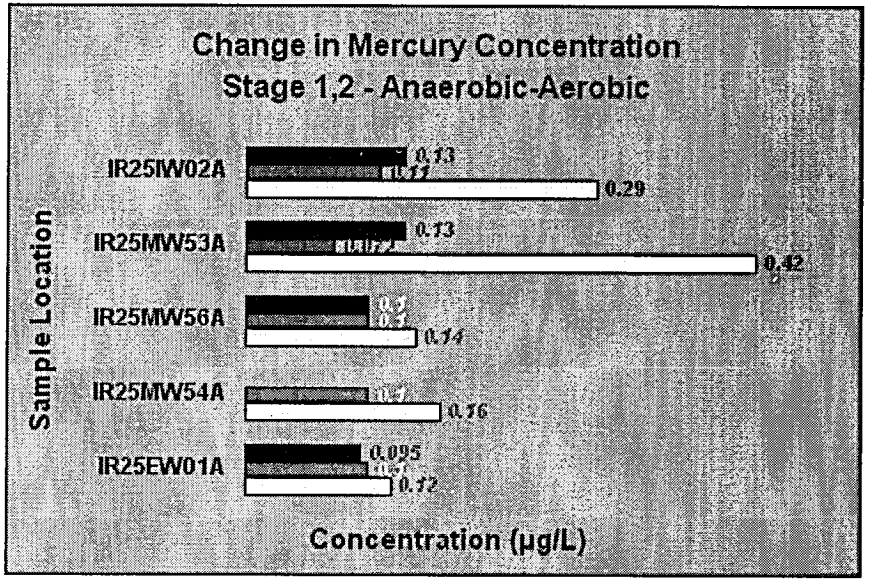
Legend	Meaning	Example
	ND - Conc = 1/2 Detection Limit	0.5
	J value - Estimated Concentration	0.5

- Day 0
- Day 238
- Day 397

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

Shaw® Shaw Environmental, Inc.

Figure F48
Chromium and Manganese in Groundwater of Treatment Study Area



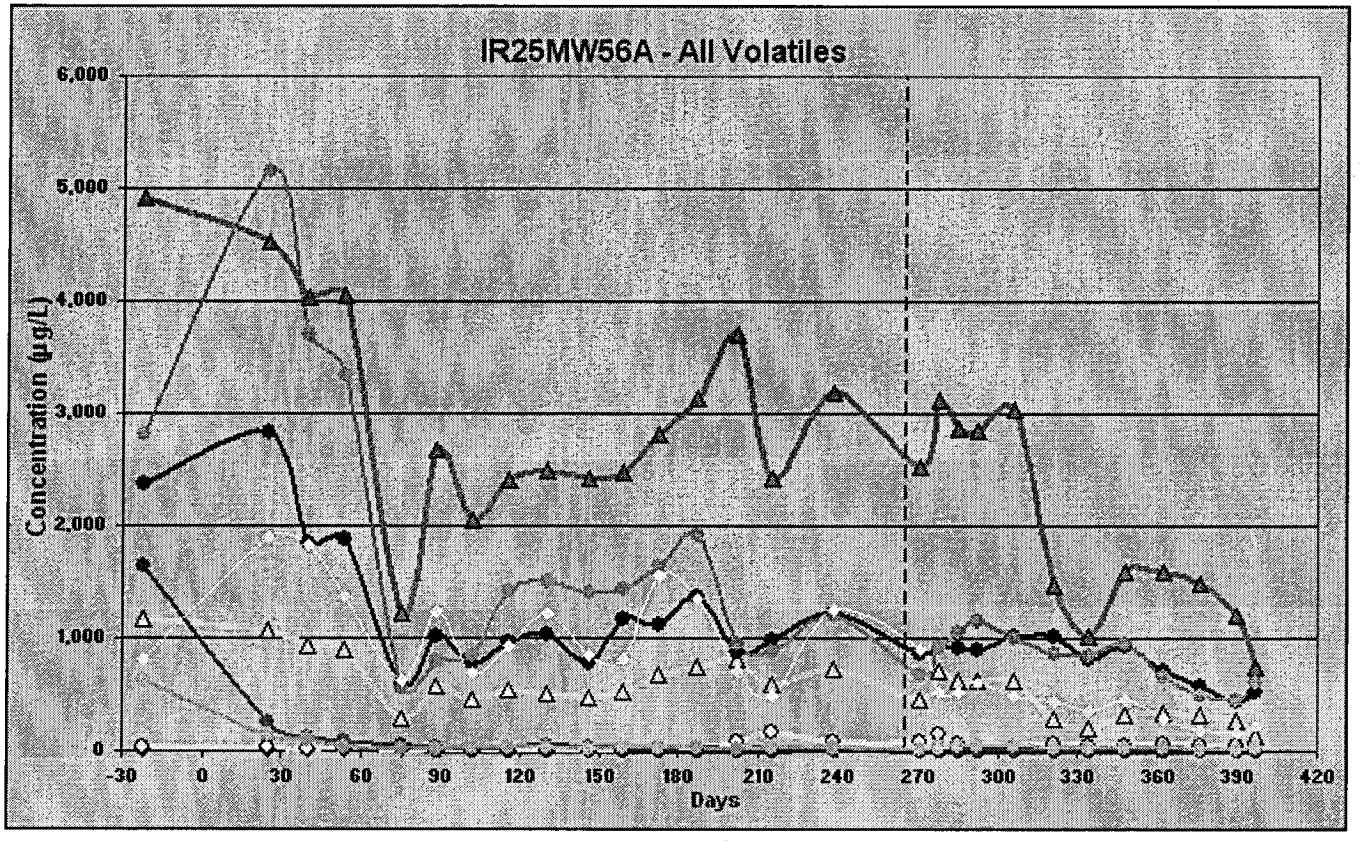
Legend	Meaning	Example
	ND - Conc = 1/2 Detection Limit	0.5
	J value - Estimated Concentration	0.5

- Day 0
- Day 238
- Day 397

Day 0 – Start of re-circulation and lactate injection
Day 238 – End of anaerobic study
Day 266 – Start of aerobic study (oxygen injection)
Day 398 – End of aerobic study

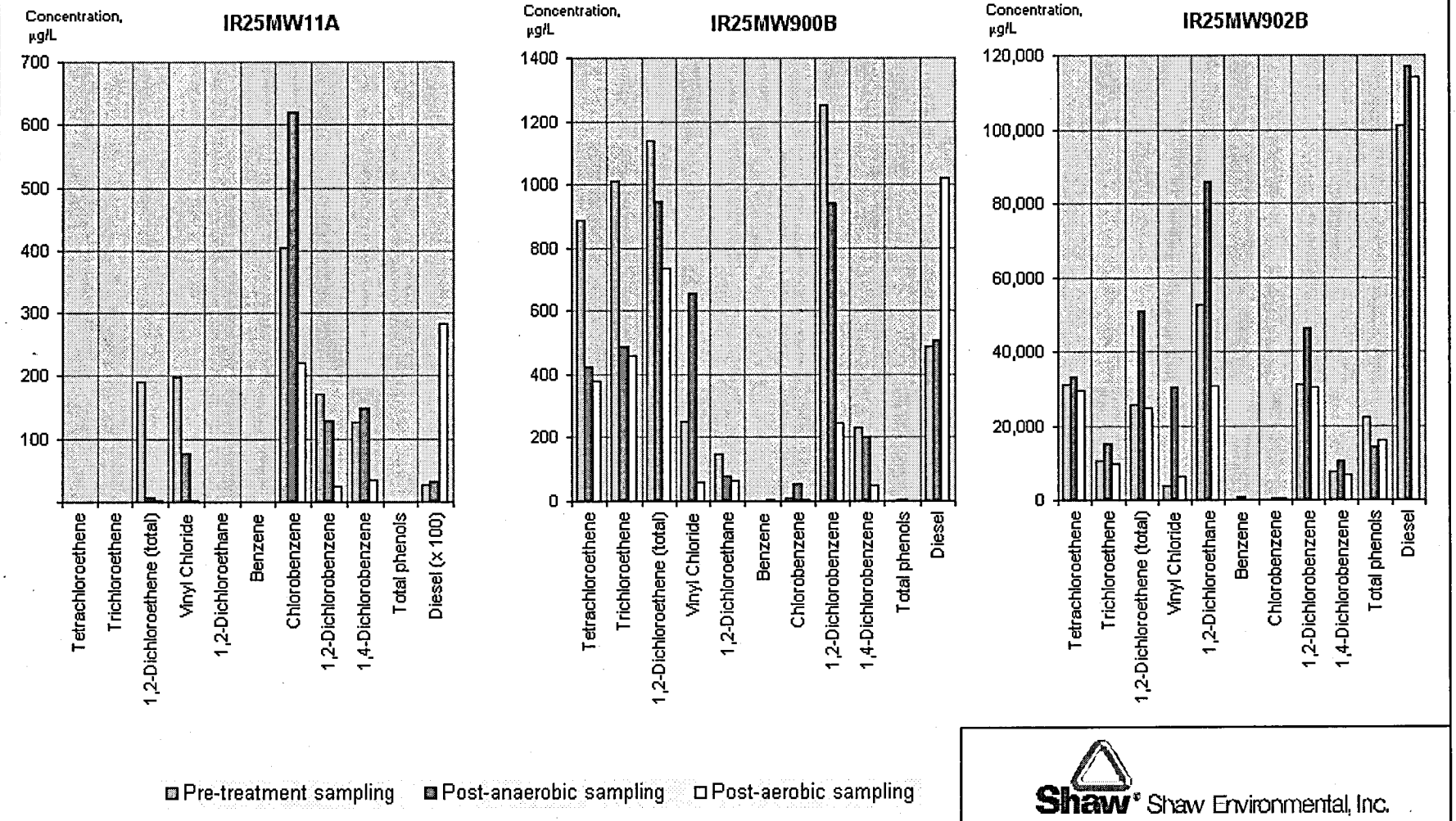
Shaw® Shaw Environmental, Inc.

Figure F49
Mercury in Groundwater of Treatment Study Area



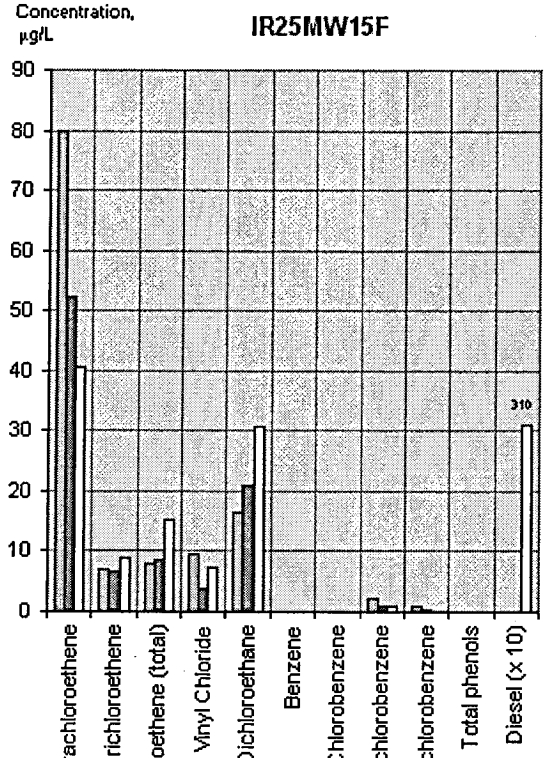
Shaw® Shaw Environmental, Inc.

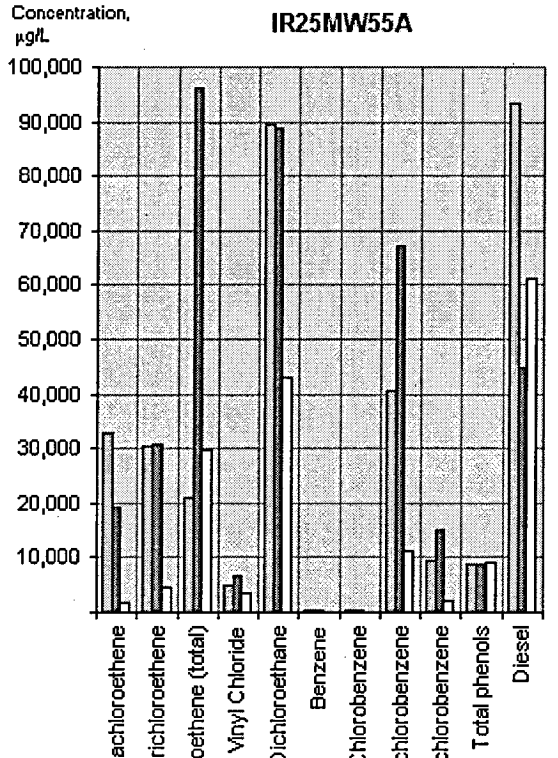
Figure F50
VOC Concentrations in Well IR25MW56A

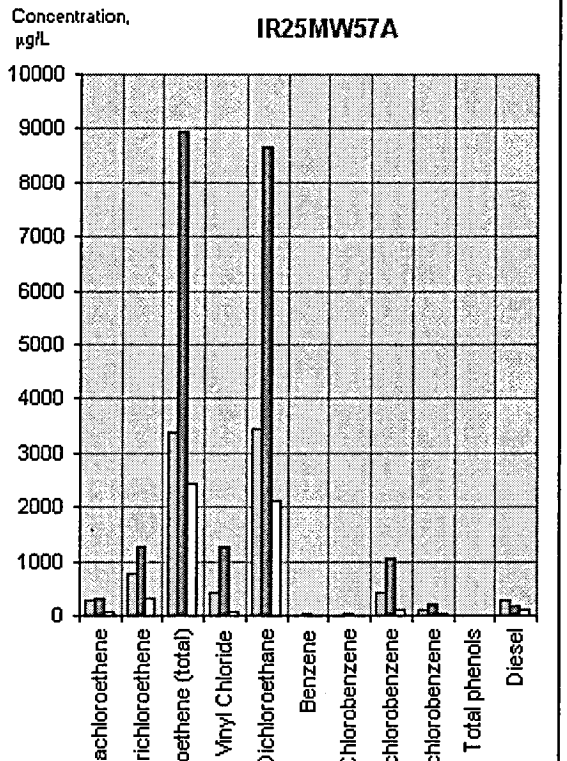


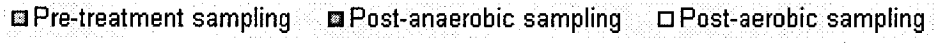
Shaw® Shaw Environmental, Inc.

Figure F51
Results for Outside Wells IR25MW11A, IR25MW900B, and IR25MW902B



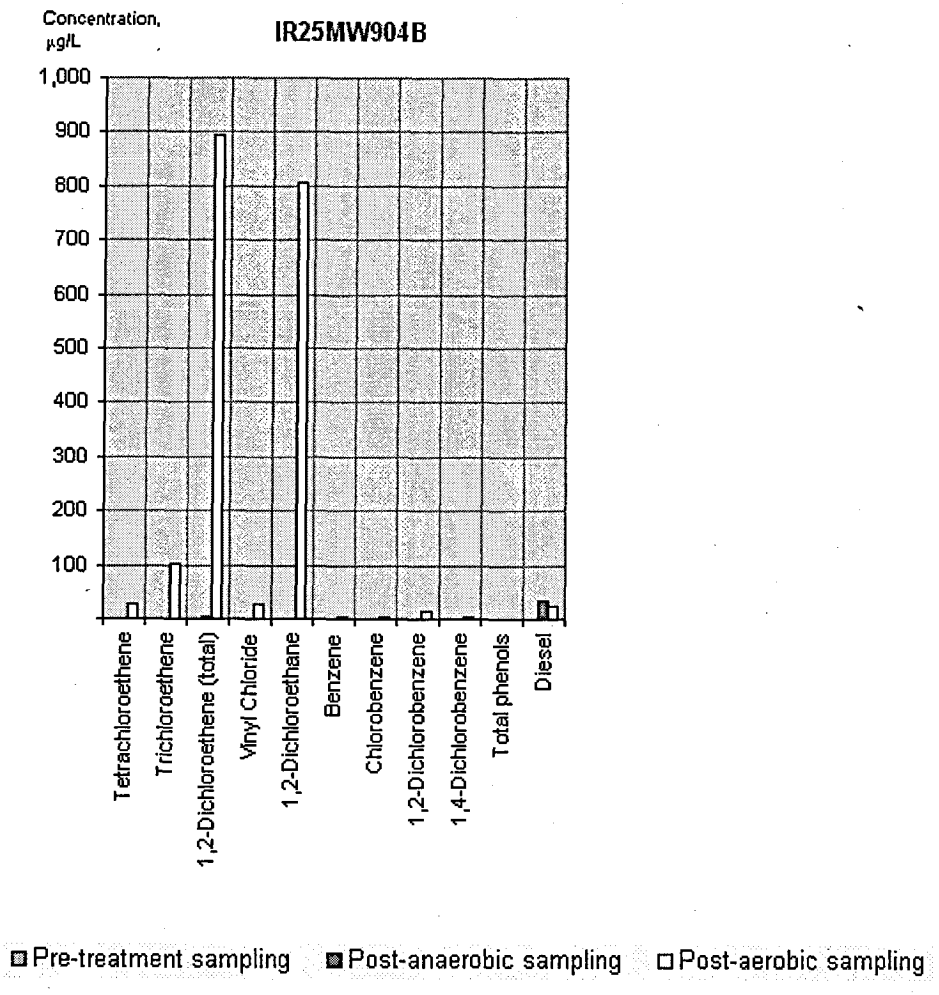






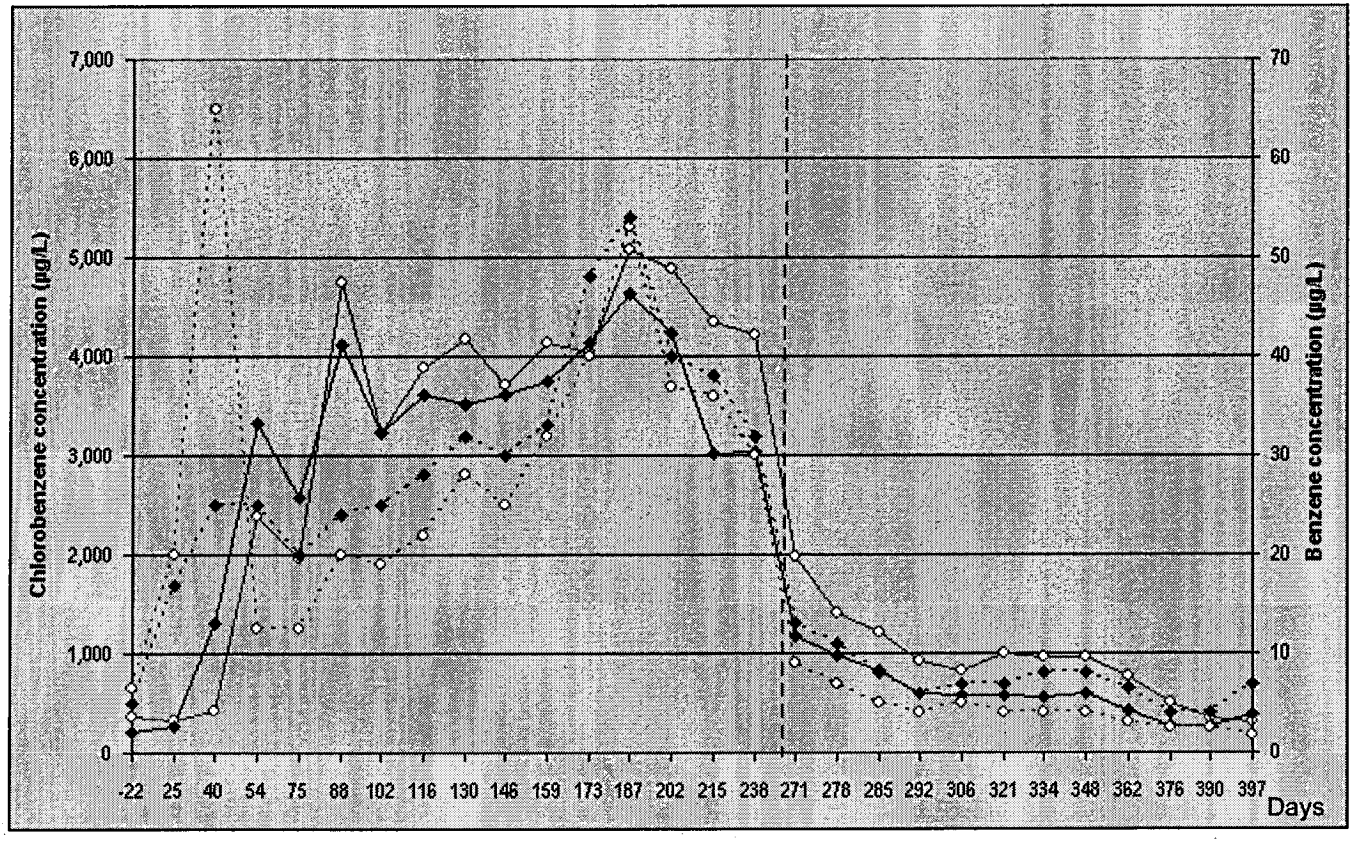
Shaw® Shaw Environmental, Inc.

Figure F52
Results for Outside Wells IR25MW15F, IR25MW55A, and IR25MW57A



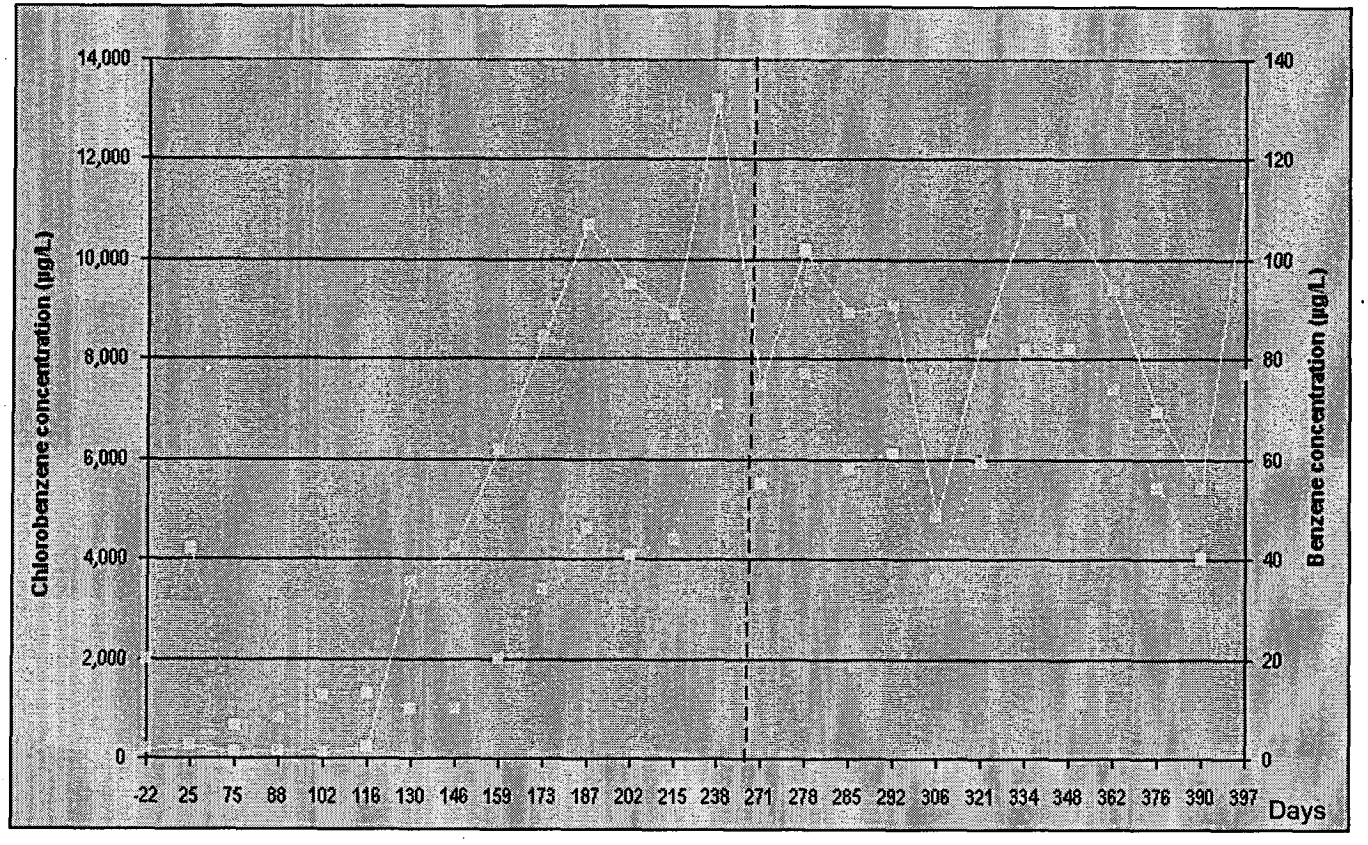
Shaw® Shaw Environmental, Inc.

Figure F53
Results for Outside Well IR25MW904B



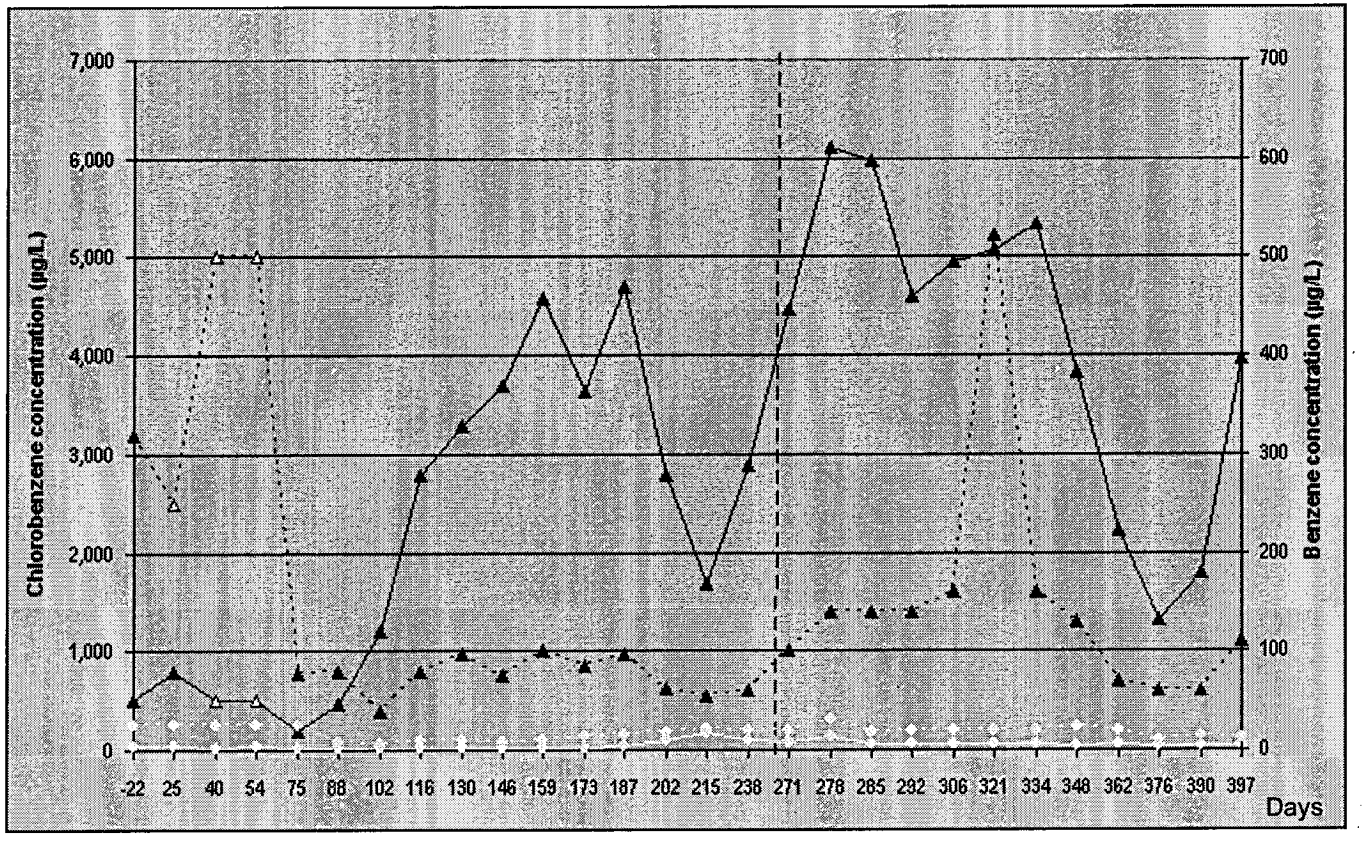
Shaw® Shaw Environmental, Inc.

Figure F54
Benzene-Chlorobenzene comparison for Wells IR25IW02A and IR25MW53A



Shaw® Shaw Environmental, Inc.

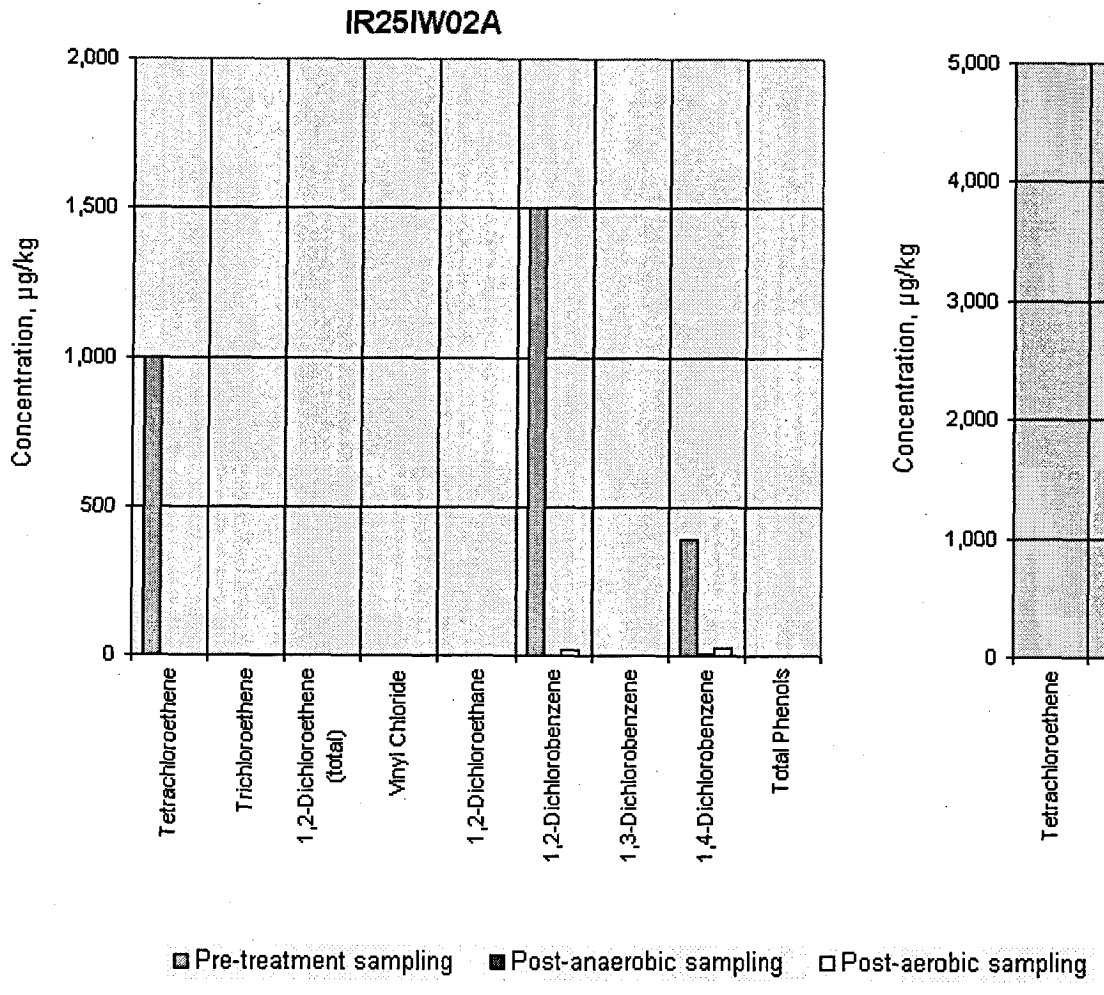
Figure F55
Benzene-Chlorobenzene comparison for Well IR25EW01A

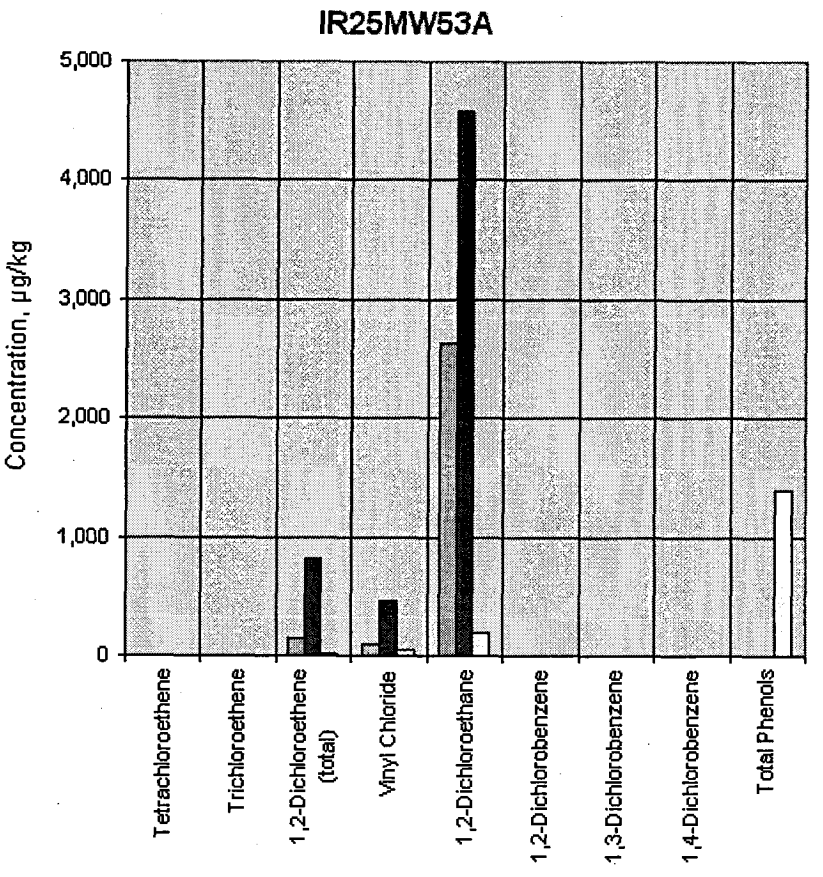


Δ Indicates non-detected value as ½ of the Reporting Limit

Shaw® Shaw Environmental, Inc.

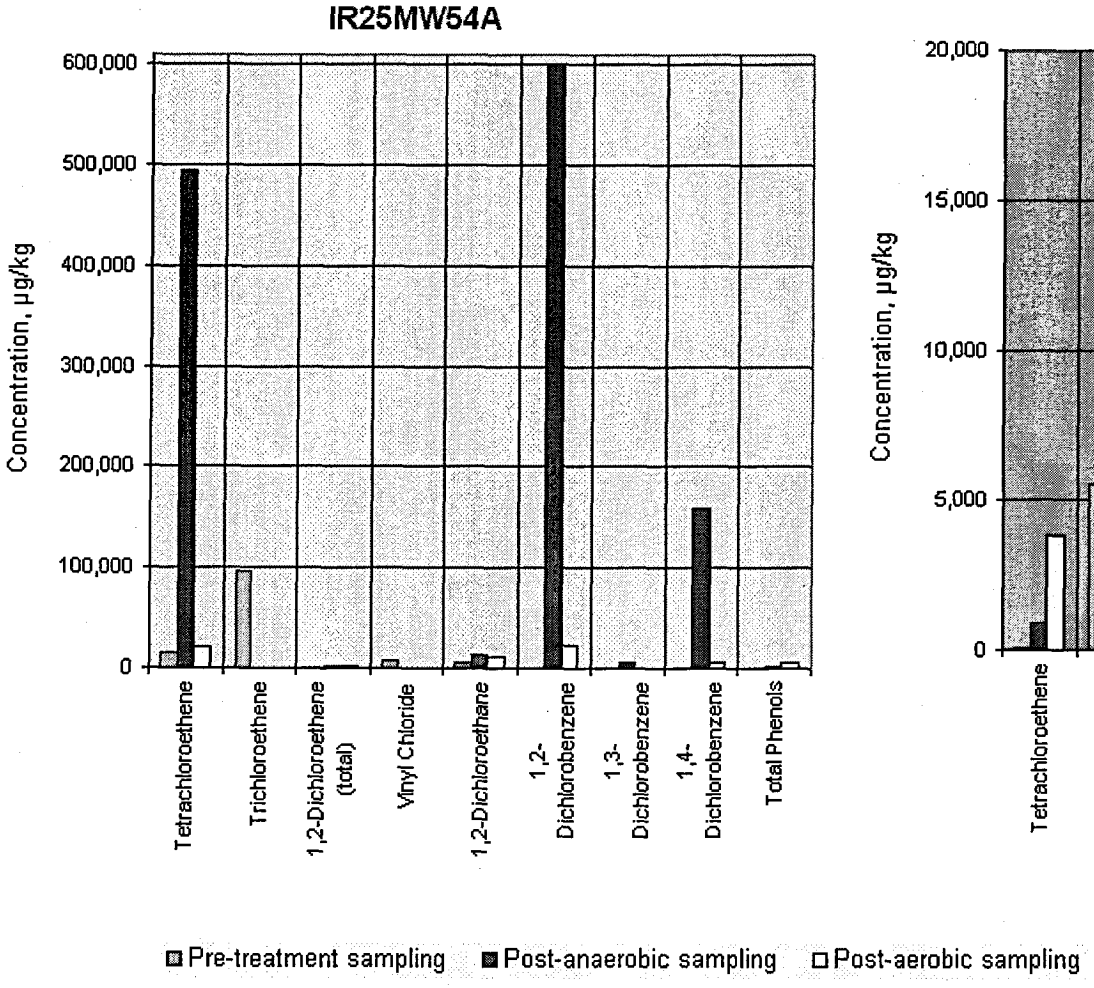
Figure F56
Benzene-Chlorobenzene comparison for Wells IR25MW54A and IR25MW56A

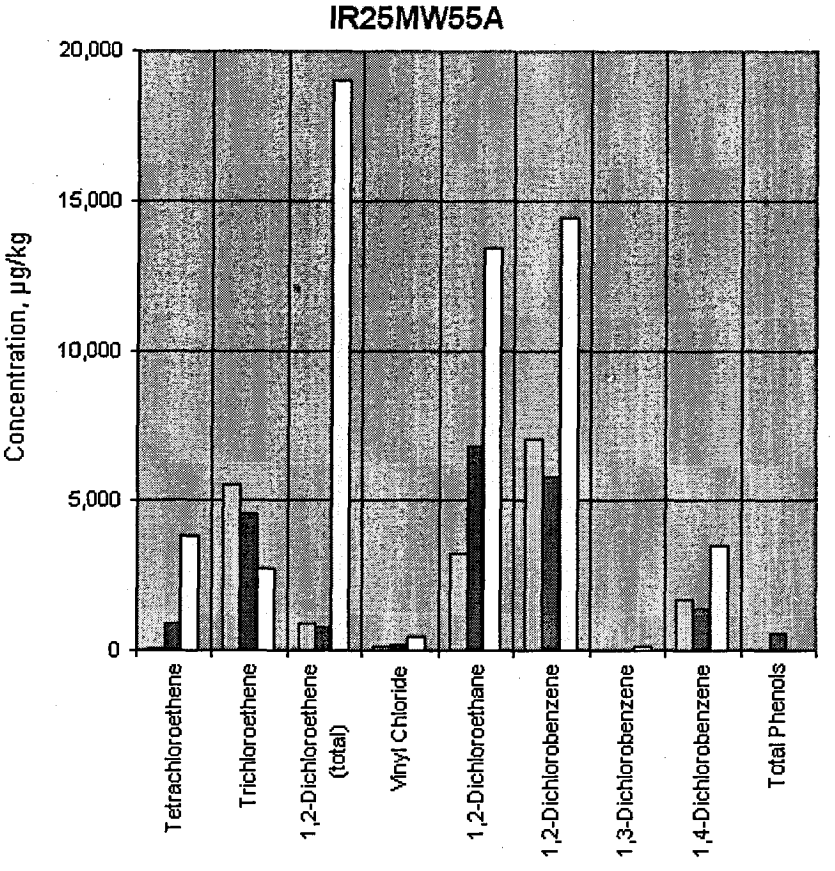




Shaw Environmental, Inc.

Figure F57
Contaminants in Soil at Well IR25IW02A and IR25MW53A Locations





Shaw® Shaw Environmental, Inc.

Figure F58
Contaminants in Soil at Well IR25MW54A and IR25MW55A Locations

Appendix G
Laboratory Analytical Reports

AR_N00217_000936
HUNTERS POINT
SSIC NO. 5090.3.A

APPENDIX G – LABORATORY ANALYTICAL REPORTS

RAW ANALYTICAL DATA IS CONTAINED ON ELECTRONIC MEDIA AND IS TOO VOLUMINOUS TO PRINT.

FOR ADDITIONAL INFORMATION, CONTACT:

DIANE C. SILVA, RECORDS MANAGER
NAVAL FACILITIES ENGINEERING COMMAND, SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132

TELEPHONE: (619) 532-3676
E-MAIL: diane.silva@navy.mil

Appendix H
Data Quality Assessment

Table of Contents

List of Tables i
Acronyms and Abbreviations ii

1.0 Analytical Program ..... ~~1-3~~ 1-1
1.1 Sample Shipment and Storage (Reason Code T) 1-5
1.2 Holding Time (Reason Code H) 1-5
1.3 Laboratory Blank Contamination (Reason Code B) 1-6
1.4 Calibration (Reason Codes C) 1-6
1.5 Laboratory Control Sample and Laboratory Control Sample Duplicate (Reason Code L) 1-8
1.6 Matrix Spike and Matrix Spike Duplicate Samples (Reason Code M) 1-8
1.7 Surrogate Recovery (Reason Code S) 1-9
1.8 Inductively Coupled Plasma Serial Dilution (Reason Code A) 1-9
1.9 Inductively Coupled Plasma Interference Check sample (Reason Code O) 1-9
1.10 Internal Standard Response Check (Reason Code I) 1-9
1.11 Field Quality Control Samples 1-10
1.12 Chemical Data Quality and Usability 1-11
2.0 References 2-1

List of Tables

Table 1 Qualified Data
Table 2 Rejected Analytical Results
Table 3 Relative Percent Difference Between Groundwater Field Duplicate Pairs
Table 4 Relative Percent Difference Between Soil Field Duplicate Pairs

Acronyms and Abbreviations

°C	degree(s) Celsius
As	arsenic
COD	chemical oxygen demand
Cd	cadmium
Cr	chromium
DAQR	Data Quality Assessment Report
DCA	1,2-dichloroethane
DCE	dichloroethene
EMAC	Environmental Multiple Award Contract
EPA	U.S. Environmental Protection Agency
Hg	mercury
HPLC-UV	high Performance Liquid Chromatography using an ultra-violet detector
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
IR	Installation Restoration
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
Mn	manganese
MS	matrix spike
MSD	matrix spike duplicate
Navy	U.S. Department of the Navy
NFESC	Naval Facilities Engineering Services Center
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PQL	practical quantitation limit
QC	quality control
RAC	Remedial Action Contract
RPD	relative percent difference
RSK	R.S. Kerr
SDG	Sample Delivery Group
SVOC	semivolatile organic compound
TCE	trichloroethene
TOC	total organic carbon
TPH-d	total petroleum hydrocarbon as diesel
VOC	volatile organic compound

1.0 Analytical Program

This Data Quality Assessment Report (DQAR) provides a summary of the analytical results for the In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study at Remedial Unit (RU) C5, Building 134, Hunters Point Shipyard San Francisco, California. This work was conducted for the U.S. Department of the Navy (Navy), Southwest Division (SWDIV) Naval Facilities Engineering Command, under Environmental Multi-Award Contract (EMAC) No. N68711-01-D-6011, Contract Task Order (CTO) 004.

A total of 198 groundwater samples, 9 soil samples, 19 groundwater field duplicates, 2 soil field duplicates, 39 trip blanks, and 1 waste water and one soil cuttings samples were collected under CTO 004 at RU C5 in Building 134 from March, 2004 through May, 2005.

The groundwater and soil samples were analyzed for one or more of the following parameters:

- Volatile organic compounds (VOC) by EPA Methods 5035/5030/8260B
- Semi-volatile organic Compounds (SVOC) by EPA Method 8270C
- PCBs by EPA Method 8082
- Dissolved metals (As, Cr, Cd, Mn, Hg) by EPA Method 6010B/6020A/7470A
- Total petroleum hydrocarbons extractable (TPH-d) by EPA Method 8015B
- Nitrate and sulfate by EPA Method 300.0/9056
- Chemical oxygen demand (COD) by EPA Method 410.4
- Sulfide by EPA Method 376.2
- Alkalinity by EPA Method 310.1
- Dissolved gases (methane, ethane and ethene) by R.S. Kerr (RSK) 175 (1994)
- Total organic carbon (TOC) by EPA Method 415.1
- Dihalococcoides by Polymerase Chain Reaction analysis
- Acetate and propionate by High Performance Liquid Chromatography using an ultra-violet detector (HPLC-UV)
- Bromide by Ion Selective Probe and/or EPA Method 300.0/320.1

Groundwater and soil sample results were reviewed and validated in accordance with requirements contained in the following guidance documents:

- *Test Methods for Evaluating Solid Waste, SW-846 Physical/Chemical Methods* EPA, 1996)
- *Methods for Chemical Analysis of Water and Wastes* (EPA, 1983)
- *USEPA National Functional Guidelines for Organic Data Review*, Washington, D.C. (EPA, 1999)
- *USEPA National Functional Guidelines for Inorganic Data Review*, Washington, D.C. (EPA, 2002)
- *U.S. Department of the Navy, Southwest Division, Environmental Work Instruction 3EN.1-Chemical Data Validation (US Navy, 2001a)*
- *Final Sampling and Analysis Plan, In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study at Remedial Unit C5, Building 134, Hunters Point Shipyard San Francisco, California (Shaw, 2004)*

The samples were analyzed by APCL Laboratories Inc., which is a State of California-certified and has successfully completed the Naval Facilities Engineering Service Center's Laboratory Evaluation Program.

The analytical data were reported in 42 sample delivery groups (SDGs) shown below. The Shaw Project Chemist completed a Level III data review of all the SDGs. The findings of the data review and validation process are summarized in this DQAR.

SDG 42211	SDG 42224	SDG 42248	SDG 42660
IR06MW44A-1005	IR25EW01A-1001	IR25IW02A-1000	IR25-INJWATER-1035
IR25MW15F-1012	IR25MW17A-1006	IR25MW11A-1011	IR25IW2A-1027
IR25MW42B-1010	IR25MW37A-1007	IR25MW39A-1013	IR25MW15F-1031
TB1-1022	IR25MW37B-1008	IR25MW39B-1014	IR25MW15F-1032
	IR25MW37B-1023	IR25MW51A-1015	IR25MW53A-1028
	IR25MW38B-1009	IR25MW53A-1003	IR25MW54A-1029
	IR25MW55A-1004	IR25MW54A-1002	IR25MW54A-1030
	IR25MW57A-1021	IR25MW56A-1020	IR25MW56A-1034
	IR25MW904B-1018	IR25MW900B-1016	IR25MW901B-1033
	TB2-1024	IR25MW900B-1025	
		IR25MW902B-1019	
		TB3-1026	

SDG 42686	SDG 42867	SDG 43068	SDG 43242
IR25MW53A-1003	IR25EW01A-1037	IR25IW02A-1043	IR25IW02A-1050
IR25MW53A-1028	IR25IW02A-1036	IR25MW53A-1044	IR25MW53A-1051
IR25MW54A-1029	IR25MW53A-1039	IR25MW53A-1045	IR25MW54A-1052
IR25MW56A-1020	IR25MW54A-1038	IR25MW54A-1046	IR25MW54A-1053
IR25MW56A-1034	IR25MW56A-1040	IR25MW56A-1047	IR25MW56A-1054
IR25MW900B-1016	TB-1041	TB-1048	TB-1055
IR25MW901B-1033			

SDG 43507	SDG 43657	SDG 43839	SDG 44005
IR25EW01A-1057	IR25EW01A-1063	IR25EW01A-1070	IR25EW01A-1076
IR25IW02A-1058	IR25IW02A-1064	IR25IW02A-1071	IR25IW02A-1077
IR25MW53A-1059	IR25MW53A-1065	IR25MW53A-1072	IR25MW53A-1078
IR25MW54A-1060	IR25MW53A-1066	IR25MW54A-1073	IR25MW53A-1079
IR25MW56A-1061	IR25MW54A-1067	IR25MW56A-1074	IR25MW54A-1080
TB-1062	IR25MW56A-1068	TB-1075	IR25MW56A-1081
	TB-1069		TB-1082

SDG 44177	SDG 44402	SDG 44608	SDG 44797
IR25EW01A-1083	IR25EW01A-1089	IR25EW01A-1096	IR25EW01A-1102
IR25IW02A-1084	IR25IW02A-1090	IR25IW02A-1097	IR25IW02A-1103
IR25MW53A-1085	IR25MW53A-1091	IR25MW53A-1098	IR25MW53A-1104
IR25MW54A-1086	IR25MW54A-1092	IR25MW54A-1099	IR25MW54A-1105
IR25MW56A-1087	IR25MW56A-1093	IR25MW56A-1100	IR25MW56A-1106
TB-1088	IR25MW56A-1094	TB-1101	IR25MW56A-1107
	TB-1095		TB-1108

SDG 45000	SDG 45286	SDG 45450	SDG 45664
IR25EW01A-1109	IR25EW01A-1115	IR25EW01A-1122	IR25MW37A-1137
IR25IW02A-1110	IR25IW02A-1116	IR25IW02A-1123	IR25MW37B-1138
IR25MW53A-1111	IR25IW02A-1117	IR25MW53A-1124	IR25MW55A-1134
IR25MW54A-1112	IR25MW53A-1118	IR25MW54A-1125	IR25MW57A-1151
IR25MW56A-1113	IR25MW54A-1119	IR25MW56A-1126	IR25MW904B-1148
TB-1114	IR25MW56A-1120	TB-1127	TB1-1155
	TB-1121		

SDG 45693	SDG 45738	SDG 45762	SDG 45772
IR25MW17A-1136	IR25IW02A-1130	IR25EW01A-1131	IR25IW02A-BH-1263
IR25MW38B-1139	IR25MW11A-1141	IR25MW51A-1145	IR25MW53A-BH-1262
IR25MW39A-1143	IR25MW15F-1142	IR25MW51A-1154	IR25MW54A-BH-1261
IR25MW39B-1144	IR25MW53A-1133	IR25MW54A-1132	IR25MW54A-BH-1265
IR25MW42B-1140	IR25MW900B-1146	IR25MW56A-1150	IR25MW55A-BH-1264
IR25MW44A-1135	IR25MW902B-1149	TB4-1158	
IR25MW44A-1153	IR25MW902B-1152		
TB2-1156	TB3-1157		

SDG 51122	SDG 51222	SDG 51308	SDG 51398
IR25EW01A-1161	IR25EW01A-1167	IR25EW01A-1174	IR25EW01A-1180
IR25IW02A-1162	IR25IW02A-1168	IR25IW02A-1175	IR25IW02A-1181
IR25MW53A-1163	IR25MW53A-1169	IR25MW53A-1176	IR25MW53A-1182
IR25MW54A-1164	IR25MW53A-1170	IR25MW54A-1177	IR25MW54A-1183
IR25MW56A-1165	IR25MW54A-1171	IR25MW56A-1178	IR25MW56A-1184
TB-1166	IR25MW56A-1172	TB-1179	IR25MW56A-1185
	TB-1173		TB-1186

SDG 51592	SDG 51782	SDG 51894	SDG 52096
IR25EW01A-1187	IR25EW01A-1193	IR25EW01A-1200	IR25EW01A-1206
IR25IW02A-1188	IR25IW02A-1194	IR25IW02A-1201	IR25IW02A-1207
IR25MW53A-1189	IR25MW53A-1195	IR25MW53A-1202	IR25MW53A-1208
IR25MW54A-1190	IR25MW53A-1196	IR25MW54A-1203	IR25MW53A-1209
IR25MW56A-1191	IR25MW54A-1197	IR25MW56A-1204	IR25MW54A-1210
TB-1192	IR25MW56A-1198	TB-1205	IR25MW56A-1211
	TB-1199		TB-1212

SDG 52280	SDG 52480	SDG 052677	SDG 52688
IR25EW01A-1213	IR25EW01A-1219	IR25EW01A-1226	IR06MW44A-1237
IR25IW02A-1214	IR25IW02A-1220	IR25IW02A-1227	IR25MW39A-1245
IR25MW53A-1215	IR25MW53A-1221	IR25MW53A-1228	IR25MW42B-1242
IR25MW54A-1216	IR25MW54A-1222	IR25MW54A-1229	IR25MW42B-1255
IR25MW56A-1217	IR25MW54A-1223	IR25MW56A-1230	IR25MW51A-1247
TB-1218	IR25MW56A-1224	TB-1231	TB1-1257
	TB-1225		

SDG 52714	SDG 52742	SDG 52765	SDG 52778
IR25MW11A-1243	IR25MW15F-1244	IR25EW01A-1233	IR25MW38B-1241
IR25MW17A-1238	IR25MW900B-1248	IR25IW02A-1232	IR25MW55A-1236
IR25MW37A-1239	IR25MW900B-1254	IR25MW53A-1235	IR25MW57A-1253
IR25MW37B-1240	IR25MW902B-1251	IR25MW54A-1234	IR25MW904B-1250
IR25MW37B-1256	TB3-1259	IR25MW56A-1252	TB5-1261
IR25MW39B-1246		TB4-1260	
TB2-1258			

SDG 52856	SDG 52887
IR25IW02A-BH-1270	IR25-IDW-SOIL-1281
IR25MW53A-BH-1272	IR25-IDW-WW-1280
IR25MW53A-BH-1274	TB-053105
IR25MW54A-BH-1271	
IR25MW55A-BH-1273	

The following analytical quality control (QC) elements were evaluated and used as the basis for qualifying data:

- Holding time and temperature compliance
- Calibrations
- Method blank contamination
- Field blank contamination
- Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) accuracy and precision
- Matrix spike (MS) and matrix spike duplicate (MSD) accuracy and precision
- Internal standard recovery

- Interference check sample recovery (metals analysis)
- Inductively Coupled Plasma (ICP) serial dilution (EPA Method 6010B only)
- Surrogate recovery
- Sample duplicate precision

The following EPA qualifiers were applied to analytical results based on the review and validation processes:

- *J qualifier* denotes the analyte was positively identified, but the associated numerical value is estimated
- *U qualifier* denotes the analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit
- *UJ qualifier* denotes the associated quantitation limit may be inaccurate or imprecise
- *R qualifier* denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet analytical QC criteria

The following sections discuss the quality of data and the reasons for qualification.

1.1 Sample Shipment and Storage (Reason Code T)

Prior to sample collection, temperature blanks were packaged with all coolers containing environmental samples. Temperature blanks served as a check of the temperature preservation for samples during shipment to the laboratory. During this sampling event, the temperatures of all coolers received by the laboratory were within the acceptable range of 2 degrees Celsius (°C) to 6°C.

1.2 Holding Time (Reason Code H)

Sample holding times were evaluated by comparing the sample collection dates to the sample extraction and analysis dates. All holding time requirements were met, with the exceptions noted below.

Nitrate (EPA Method 300.0)

One sample IR25IW02A-1043 was analyzed for nitrate 4 days past the holding time requirement of 48 hours due to laboratory oversight. The nitrate result for this sample was rejected due to holding time exceedance.

The sample result is presented in Table 2. The rejected nitrate result in one groundwater sample did not have significant affect on the data usability for the purposes of the treatability study.

1.3 Laboratory Blank Contamination (Reason Code B)

A method blank is a matrix equivalent sample used to check reagent or process introduced contamination during the method preparation and analysis. For organic analyses, field sample results were evaluated with respect to the laboratory method blank prepared and analyzed with each analytical batch. For inorganic analytes, initial and continuing calibration blanks were analyzed in addition to the method blanks.

Per EPA requirements (EPA, 1994 and EPA, 1999), if the sample results are less than or equal to 10 times the amount found in any blank for the common laboratory contaminants (methylene chloride, acetone, chloroform and 2-butanone) or 5 times the amount for other compounds, then results are qualified as not detected (U) at their practical quantitation limit (PQL).

The sample results discussed below and summarized in Table 1 were qualified as not detected (U) due to laboratory blank and continuing calibration blank contamination.

Metals (EPA Method 6010B)

Metals results in 51 groundwater and 5 soil samples were qualified as not detected (U) due to laboratory blank and continuing calibration blank contamination. One or more metal (arsenic, barium, cadmium, chromium and mercury) results by EPA Method 6010B/7470A were qualified as not detected (U) due to laboratory blank and continuing calibration blanks contamination.

VOC (EPA 8260B)

Methylene chloride results in 16 groundwater, 5 soil samples, and 5 trip blanks were qualified as not detected (U) due to laboratory blank contamination. 2-Butanone results in 4 groundwater samples and one trip blank were qualified as not detected (U) due to laboratory blank contamination.

PCBs (EPA Method 8082)

Aroclor 1016 results in 16 groundwater and 4 soil samples were qualified as not detected (U) due to laboratory blank contamination.

All of the above noted qualifications due to laboratory blank contamination were minor and did not affect the data usability.

1.4 Calibration (Reason Codes C)

Instrument calibration was performed for each analysis according to the EPA Method requirements. The linear analytical range was established for each method by the analysis of standards prepared at increasing concentrations that cover the expected sample concentrations.

The acceptability of the initial calibration was determined by calculation of a method-specific statistical parameter, such as a percent relative standard deviation or correlation coefficient

Following initial calibration and routinely during sample analysis, the stability of analytical systems was monitored by analysis of standards at concentrations near the mid-point of the linear range. The accuracy of sample results associated with a noncompliant continuing calibration verification may be less than expected, depending on the magnitude of the deviation from method acceptance criteria.

The initial calibration requirements were met for all target analytes.

The sample results qualified for continuing calibration verification (CCV) outliers are discussed below and are summarized in Table 1.

VOC (EPA 8260B)

VOC results in 161 groundwater, 8 soil samples, and 30 trip blanks were qualified as estimated concentrations [J/UJ] due to noncompliant continuing calibration.

The primary VOC of concern for the treatability study at RU C5 included chlorinated ethenes (tetrachloroethene [PCE], trichloroethene [TCE], dichloroethene [DCE] and vinyl chloride), chlorinated ethanes (monochloroethane, 1,2-dichloroethane [DCA]), and chlorobenzenes (monochlorobenzene, 1,2-, 1,3- and 1,4-dichlorobenzene, and 1,2,3- and 1,2,4-trichlorobenzene).

The continuing calibration verification standards were within control limits for all of the None primary VOC with the exception of PCE and 1,2,4-trichlorobenzene, which were out of control limits is a few CCV standards.

SVOC (EPA 8270C)

SVOC results in 67 groundwater samples were qualified as estimated concentrations [J/UJ] due to noncompliant continuing calibration verification standards.

HPLC-UV

Propionic acid results in 4 samples were qualified as estimated concentrations [J/UJ] due to noncompliant continuing calibration verification standards.

The above noted continuing calibration verification standards were outside the EPA specified acceptance criteria; however, all recoveries were within the reasonable range.

The continuing calibration deviations were minor and did not affect the data usability.

1.5 Laboratory Control Sample and Laboratory Control Sample Duplicate (Reason Code L)

The LCS is an aliquot of analyte-free water spiked with all target analytes and is prepared with each extraction batch for organic and inorganic analyses. The recovery of target analytes from the LCS is measurement of method performance in an interference-free sample matrix. Failure of target analyte recovery from the LCS to meet method acceptance criteria may indicate a systematic problem with the preparation and analysis of all samples in the batch. In some cases, a LCS and a laboratory control sample duplicate (LCSD) pair was extracted and analyzed in lieu of a MS and matrix spike duplicate (MSD) to measure precision for analytical batch.

All of the LCS and LCSD recoveries, and relative percent difference (RPD) between LCS/LCSD recoveries met the acceptance criteria, with one exception.

SVOC (EPA 8270C)

The RPD between LCS/LCSD recoveries for phenol and 4-nitrophenol in SDG 45772 were outside the acceptance criteria. As a result, phenol and 4-nitrophenol results in 2 samples were qualified as estimated concentrations [J/UJ] due to noncompliant RPDs.

The RPD deviations were minor and did not affect the data usability.

1.6 Matrix Spike and Matrix Spike Duplicate Samples (Reason Code M)

The MS and MSD samples are a portion of a field sample spiked with all target analytes, and is prepared with each extraction batch for extractable organic and inorganic analytes and with each analytical batch for volatile analytes. The MS/MSD samples are used to evaluate any bias introduced to the method due to matrix interferences, and to measure accuracy and precision for each analytical batch. For inorganic analyses, a field sample duplicate may be prepared in lieu of a MSD) to measure precision for analytical batch.

The sample results qualified for noncompliant MS, MSD, and RPD recoveries are summarized in Table1 and discussed below.

RSK 175

Ethane results in 8 groundwater samples (SDGs 43657 and 44005) were qualified as estimated concentrations (J/UJ) due to noncompliant MS and MSD recoveries. Ethane recoveries were 66 and 68 percent, which were slightly outside the acceptance criteria of 70-105 percent.

Per EPA requirement (EPA, 1994 and EPA, 1999) when recoveries are outside the acceptance criteria, but still within reasonable range (>30 percent for metals and >10 percent for organic analysis), affected results are qualified as estimated values (J/UJ) and data are not rejected.

In all cases discussed above, none of the MS/MSD recoveries were below the rejection criteria. All of the above referenced qualifications due to noncompliant MS/MSD and RPD were considered minor, and data usability was not affected.

1.7 Surrogate Recovery (Reason Code S)

Surrogate standards are organic compounds added to all field and laboratory samples for organic analysis to evaluate matrix effects and method performance on an individual sample basis.

All of the organic surrogate recoveries were within acceptance criteria, with the exceptions noted below.

VOC (8260B)

VOC results in 11 groundwater samples were qualified as estimated concentrations (J/UJ) due to noncompliant surrogate recoveries.

The qualified sample results are summarized in Table 1.

1.8 Inductively Coupled Plasma Serial Dilution (Reason Code A)

The Inductively Coupled Plasma (ICP) serial dilutions are performed at a frequency of 10 percent of all sample analyses for metals by EPA Methods 6010B. The serial dilution result is expected to agree with the undiluted sample result within 10 percent. All of the serial dilution results met the specified criteria, with the exception of chromium in 3 groundwater samples. Chromium results were qualified as estimated concentrations (UJ) due to noncompliant ICP serial dilution recoveries.

The affected sample results are summarized in Table 1.

The qualifications due to ICP serial dilutions outliers were considered minor, and the data usability was not affected.

1.9 Inductively Coupled Plasma Interference Check sample (Reason Code O)

The ICP Interference Check Sample (ICS) verifies the analytical instrument's ability to overcome interferences typical of those found in samples. Laboratory analyzed ICS at the method required frequency. All of the ICS sample results met the criteria.

1.10 Internal Standard Response Check (Reason Code I)

The analysis of internal standards determines the existence and magnitude of instrument drift and physical interferences for EPA Methods 8260B and 8270C. The internal standard response criteria were met for all samples.

1.11 Field Quality Control Samples

Field QC samples were collected to assess the acceptability of sampling techniques, decontamination procedures, and the potential of sample contamination during field sample collection and shipment. The field QC samples consisted of trip blanks and field duplicate samples.

All of the groundwater samples were collected using a peristaltic pump and dedicated sample collection tubing. Therefore, no equipment rinsate samples were collected.

Trip blanks were shipped with all groundwater volatile samples collected. Trip blank results were used to determine whether samples had been contaminated with VOCs during transportation or sample collection. A total of 39 trip blanks were collected during the sampling period.

VOCs were not detected in any of the trip blanks submitted for this project.

Field Duplicate Precision

Field duplicates were analyzed to assess precision of sample collection technique. A total of 19 groundwater duplicate samples and 2 soil duplicate samples were collected corresponding to approximately 9.6 percent of the total number of samples collected for this sampling event. The field duplicate samples were evaluated by calculating the relative percent difference for analytes detected in both the sample and field duplicate.

Pairs of results greater than the PQL were considered acceptable if the relative percent difference (RPD) was less than 35 percent for groundwater samples and 50 percent for soil samples. Field duplicate results are summarized in Table-3 "Relative Percent Difference between Groundwater Field Duplicate Pairs" and Table-4 "Relative Percent Difference between Soil Field Duplicate Pairs".

Field duplicate precision was within control limits for all groundwater and soil sampling for the project, with the exceptions noted below.

Groundwater

- In sample IR25MW37B and field duplicate pair collected on March 24, 2004, the RPD for methylene chloride was 40 percent.
- In sample IR25MW54A and field duplicate pair collected on April 26, 2005, the RPD for 1,4-dichlorobenzene was 65 percent.
- In sample IR25MW42B and field duplicate pair collected on May 11, 2005, the RPD for mercury was 57 percent.

- In sample IR25MW37B and field duplicate pair collected on May 11, 2005, the RPD for mercury was 59 percent.

Soil

- In sample IR25MW54A and field duplicate pair collected on December 10, 2004, the RPDs for manganese, 1,2-dichlorobenzene and 1,4-dichlorobenzene were in the range 58 to 117 percent.
- In sample IR25MW53A and field duplicate pair collected on May 25, 2005, the RPD for chromium was 52 percent.

High RPD values in soil samples could be attributed to non-homogeneous sample matrix.

The data usability is not affected due to RPD values outside the acceptance criteria.

1.12 Chemical Data Quality and Usability

In summary, the QC data are indicative of acceptable analytical method performance. With the exception of the one nitrate result in sample IR25IW02A-1043, the anomalies mentioned above do not invalidate the data for its intended use. The data are valid and usable for project decisions.

2.0 References

U.S. Environmental protection Agency (EPA), 1983. *Methods for Chemical Analysis of Water and Wastes.*

EPA, 1996. *Test Methods for Evaluating Solid Waste, SW-846 Physical/Chemical Methods.*

EPA, 1999. *USEPA National Functional Guidelines for Organic Data Review*, Washington, D.C..

EPA, 2002. *USEPA National Functional Guidelines for Inorganic Data Review*, Washington, D.C..

U.S. Navy, 2001. *U.S. Department of the Navy, Southwest Division, Environmental Work Instruction 3EN.1-Chemical Data Validation.*

Shaw Environmental, Inc., 2004. *Final Sampling and Analysis Plan, In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study at Remedial Unit C5, Building 134, Hunters Point Shipyard San Francisco, California.*

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
GENCHEM	**RSK175**							
043657	IR25EW01A-1063	Ethane	3	0.35	3	ug/L	UJ	M
	IR25IW02A-1064	Ethane	30	3.5	30	ug/L	UJ	M
	IR25MW53A-1065	Ethane	30	3.5	30	ug/L	UJ	M
	IR25MW54A-1067	Ethane	30	3.5	30	ug/L	J	M
044005	IR25EW01A-1076	Ethane	3	0.35	3	ug/L	UJ	M
	IR25IW02A-1077	Ethane	15	1.8	15	ug/L	UJ	M
	IR25MW53A-1078	Ethane	25	0.70	6	ug/L	J	M
	IR25MW54A-1080	Ethane	300	35	300	ug/L	UJ	M
METALS	**SW6010B**							
042211	IR06MW44A-1005	Cadmium	10	0.098	10	ug/L	U	B
		Chromium	50	0.45	10	ug/L	UJ	A
	IR25MW15F-1012	Cadmium	10	0.098	10	ug/L	U	B
		Chromium	50	0.45	10	ug/L	UJ	A
	IR25MW42B-1010	Cadmium	10	0.098	10	ug/L	U	B
		Chromium	50	0.45	10	ug/L	UJ	A
042224	IR25EW01A-1001	Arsenic	50	1.6	50	ug/L	U	B
		Chromium	10	0.45	10	ug/L	U	B
	IR25MW17A-1006	Chromium	10	0.45	10	ug/L	U	B
	IR25MW37A-1007	Arsenic	50	1.6	50	ug/L	U	B
	IR25MW37B-1008	Chromium	10	0.45	10	ug/L	U	B
	IR25MW38B-1009	Arsenic	50	1.6	50	ug/L	U	B
042248	IR25IW02A-1000	Chromium	10	0.45	10	ug/L	U	B
	IR25MW11A-1011	Chromium	10	0.45	10	ug/L	U	B
	IR25MW39A-1013	Chromium	10	0.45	10	ug/L	U	B
	IR25MW39B-1014	Chromium	10	0.45	10	ug/L	U	B
	IR25MW51A-1015	Cadmium	10	0.098	10	ug/L	U	B
		Chromium	10	0.45	10	ug/L	U	B
	IR25MW53A-1003	Cadmium	10	0.098	10	ug/L	U	B
		Chromium	10	0.45	10	ug/L	U	B
	IR25MW56A-1020	Cadmium	10	0.098	10	ug/L	U	B
	IR25MW900B-1016	Chromium	10	0.45	10	ug/L	U	B
	IR25MW900B-1025	Chromium	10	0.45	10	ug/L	U	B
045664	IR25MW37A-1137	Arsenic	50	1.9	50	ug/L	U	B
		Cadmium	10	0.12	10	ug/L	U	B

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045664	IR25MW55A-1134	Arsenic	50	1.9	50	ug/L	U	B
		Cadmium	10	0.12	10	ug/L	U	B
	IR25MW904B-1148	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
045693	IR06MW44A-1135	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
		Mercury	0.2	0.015	0.2	ug/L	U	B
	IR06MW44A-1153	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
	IR25MW17A-1136	Arsenic	50	1.9	50	ug/L	U	B
	IR25MW38B-1139	Mercury	0.2	0.015	0.2	ug/L	U	B
	IR25MW39A-1143	Arsenic	50	1.9	50	ug/L	U	B
	IR25MW39B-1144	Arsenic	50	1.9	50	ug/L	U	B
		Mercury	0.2	0.015	0.2	ug/L	U	B
	IR25MW42B-1140	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
045738	IR25IW02A-1130	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
		Mercury	0.2	0.015	0.2	ug/L	U	B
	IR25MW11A-1141	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
		Mercury	0.2	0.015	0.2	ug/L	U	B
	IR25MW15F-1142	Arsenic	50	1.9	50	ug/L	U	B
		Mercury	0.2	0.015	0.2	ug/L	U	B
	IR25MW53A-1133	Arsenic	50	1.9	50	ug/L	U	B
		Chromium	10	0.88	10	ug/L	U	B
		Mercury	0.2	0.015	0.2	ug/L	U	B
	IR25MW900B-1146	Arsenic	50	1.9	50	ug/L	U	B
	IR25MW902B-1149	Arsenic	50	1.9	50	ug/L	U	B
	IR25MW902B-1152	Arsenic	50	1.9	50	ug/L	U	B
045762	IR25EW01A-1131	Cadmium	10	0.22	10	ug/L	U	B
	IR25MW51A-1145	Arsenic	50	2.2	50	ug/L	U	B
	IR25MW54A-1132	Arsenic	50	2.2	50	ug/L	U	B
	IR25MW56A-1150	Arsenic	50	2.2	50	ug/L	U	B
045772	IR25IW02A-BH-1263	Arsenic	10	0.11	10	mg/kg	U	B
	IR25MW53A-BH-1262	Arsenic	10	0.11	10	mg/kg	U	B
		Mercury	0.2	0.0025	0.2	mg/kg	U	B

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045772	IR25MW54A-BH-1261	Arsenic	10	0.11	10	mg/kg	U	B
		Mercury	0.28	0.0025	0.2	mg/kg	U	B
	IR25MW54A-BH-1265	Arsenic	10	0.11	10	mg/kg	U	B
		Mercury	0.42	0.0025	0.2	mg/kg	U	B
	IR25MW55A-BH-1264	Arsenic	10	0.11	10	mg/kg	U	B
		Chromium	152	0.011	5	mg/kg	J	M
		Mercury	0.2	0.0025	0.2	mg/kg	U	B
052688	IR06MW44A-1237	Cadmium	0.26	0.12	10	ug/L	U	B
052714	IR25MW37B-1256	Cadmium	0.41	0.12	10	ug/L	U	B
	IR25MW39B-1246	Mercury	0.055	0.015	0.2	ug/L	U	B
052742	IR25MW900B-1254	Mercury	0.10	0.015	0.2	ug/L	U	B
	IR25MW902B-1251	Arsenic	3.5	2.3	50	ug/L	U	B
		Mercury	0.050	0.015	0.2	ug/L	U	B
052765	IR25EW01A-1233	Arsenic	11.3	1.6	50	ug/L	U	B
ORGANIC ACID HPLC								
043657	IR25EW01A-1063	Propionic Acid	810	30	200	mg/L	J	C
	IR25IW02A-1064	Propionic Acid	10	1.5	10	mg/L	UJ	C
	IR25MW53A-1065	Propionic Acid	10	1.5	10	mg/L	UJ	C
	IR25MW54A-1067	Propionic Acid	1600	30	200	mg/L	J	C
PCBS	**SW8082**							
045664	IR25MW37A-1137	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW37B-1138	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW904B-1148	Aroclor-1016	1	0.035	0.96	ug/L	U	B
045693	IR06MW44A-1135	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR06MW44A-1153	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW17A-1136	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW38B-1139	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW39A-1143	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW42B-1140	Aroclor-1016	1	0.035	0.96	ug/L	U	B
045738	IR25IW02A-1130	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW11A-1141	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW15F-1142	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW53A-1133	Aroclor-1016	1	0.035	0.96	ug/L	U	B
	IR25MW900B-1146	Aroclor-1016	1	0.035	0.96	ug/L	U	B
045772	IR25IW02A-BH-1263	Aroclor-1016	33	0.93	33	ug/kg	U	B

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045772	IR25MW53A-BH-1262	Aroclor-1016	33	0.93	33	ug/kg	U	B
	IR25MW54A-BH-1261	Aroclor-1016	33	0.93	33	ug/kg	U	B
	IR25MW54A-BH-1265	Aroclor-1016	33	0.93	33	ug/kg	U	B
051122	IR25EW01A-1161	Aroclor-1016	0.2	0.035	0.96	ug/L	U	B
	IR25IW02A-1162	Aroclor-1016	0.2	0.035	0.96	ug/L	U	B
SEMIVOLATILES SW8270C								
042211	IR06MW44A-1005	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Methylphenol	9.6	1.7	9.6	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(Ghi)Perylene	9.6	0.84	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Dibenz(A,H)Anthracene	9.6	0.63	9.6	ug/L	UJ	C
		Di-N-Octyl Phthalate	9.6	0.54	9.6	ug/L	UJ	C
		Indeno(1,2,3-Cd)Pyrene	9.6	0.65	9.6	ug/L	UJ	C
	IR25MW15F-1012	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Methylphenol	9.6	1.7	9.6	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(Ghi)Perylene	9.6	0.84	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Dibenz(A,H)Anthracene	9.6	0.63	9.6	ug/L	UJ	C
		Di-N-Octyl Phthalate	9.6	0.54	9.6	ug/L	UJ	C
		Indeno(1,2,3-Cd)Pyrene	9.6	0.65	9.6	ug/L	UJ	C
	IR25MW42B-1010	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Methylphenol	9.6	1.7	9.6	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(Ghi)Perylene	9.6	0.84	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Dibenz(A,H)Anthracene	9.6	0.63	9.6	ug/L	UJ	C
		Di-N-Octyl Phthalate	9.6	0.54	9.6	ug/L	UJ	C
		Indeno(1,2,3-Cd)Pyrene	9.6	0.65	9.6	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
042224	IR25EW01A-1001	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Chrysene	9.6	0.66	9.6	ug/L	UJ	C
	IR25MW17A-1006	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Chrysene	9.6	0.66	9.6	ug/L	UJ	C
	IR25MW37A-1007	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Chrysene	9.6	0.66	9.6	ug/L	UJ	C
	IR25MW37B-1008	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Chrysene	9.6	0.66	9.6	ug/L	UJ	C
	IR25MW37B-1023	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Chrysene	9.6	0.66	9.6	ug/L	UJ	C
	IR25MW38B-1009	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
042224	IR25MW38B-1009	4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
		Chrysene	9.6	0.66	9.6	ug/L	UJ	C
	IR25MW55A-1004	2-Nitroaniline	4800	290	4800	ug/L	UJ	C
		3-Nitroaniline	4800	240	4800	ug/L	UJ	C
		4-Chloroaniline	1900	240	1900	ug/L	UJ	C
		4-Nitroaniline	4800	200	4800	ug/L	UJ	C
		Benzo(K)Fluoranthene	960	74	960	ug/L	UJ	C
		Benzoic Acid	4800	190	4800	ug/L	UJ	C
	IR25MW57A-1021	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
	IR25MW904B-1018	2-Nitroaniline	48	2.9	48	ug/L	UJ	C
		3-Nitroaniline	48	2.4	48	ug/L	UJ	C
		4-Chloroaniline	19	2.4	19	ug/L	UJ	C
		4-Nitroaniline	48	2.0	48	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	0.74	9.6	ug/L	UJ	C
		Benzoic Acid	48	1.9	48	ug/L	UJ	C
042248	IR25MW902B-1019	Benzo(Ghi)Perylene	9.6	84	960	ug/L	UJ	C
		Dibenz(A,H)Anthracene	9.6	63	960	ug/L	UJ	C
		Indeno(1,2,3-Cd)Pyrene	9.6	65	960	ug/L	UJ	C
045664	IR25MW37A-1137	2,4-Dinitrophenol	48	4.0	48	ug/L	UJ	C
	IR25MW37B-1138	2,4-Dinitrophenol	48	4.0	48	ug/L	UJ	C
	IR25MW57A-1151	2,4-Dinitrophenol	48	4.0	48	ug/L	UJ	C
	IR25MW904B-1148	2,4-Dinitrophenol	48	4.0	48	ug/L	UJ	C
045738	IR25MW11A-1141	2,4,5-Trichlorophenol	48	2.1	48	ug/L	UJ	S
		2,4,6-Trichlorophenol	9.6	2.3	9.6	ug/L	UJ	S
		2,4-Dichlorophenol	9.6	1.8	9.6	ug/L	UJ	S
		2,4-Dimethylphenol	9.6	0.80	9.6	ug/L	UJ	S
		2,4-Dinitrophenol	48	4.0	48	ug/L	UJ	S
		2-Chlorophenol	9.6	1.2	9.6	ug/L	UJ	S
		2-Methylphenol	9.6	0.78	9.6	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045738	IR25MW11A-1141	2-Nitrophenol	9.6	1.2	9.6	ug/L	UJ	S
		3-Methylphenol	9.6	0.75	9.6	ug/L	UJ	S
		4,6-Dinitro-2-Methylphenol	48	6.7	48	ug/L	UJ	S
		4-Chloro-3-Methylphenol	9.6	1.1	9.6	ug/L	UJ	S
		4-Nitrophenol	48	7.1	48	ug/L	UJ	S
		Benzoic Acid	48	0.29	48	ug/L	UJ	S
		Pentachlorophenol	48	15	48	ug/L	UJ	S
	IR25MW15F-1142	2,4,5-Trichlorophenol	48	2.1	48	ug/L	UJ	S
		2,4,6-Trichlorophenol	9.6	2.3	9.6	ug/L	UJ	S
		2,4-Dichlorophenol	9.6	1.8	9.6	ug/L	UJ	S
		2,4-Dimethylphenol	9.6	0.80	9.6	ug/L	UJ	S
		2,4-Dinitrophenol	48	4.0	48	ug/L	UJ	S
		2-Chlorophenol	9.6	1.2	9.6	ug/L	UJ	S
		2-Methylphenol	9.6	0.78	9.6	ug/L	UJ	S
		2-Nitrophenol	9.6	1.2	9.6	ug/L	UJ	S
		3-Methylphenol	9.6	0.75	9.6	ug/L	UJ	S
		4,6-Dinitro-2-Methylphenol	48	6.7	48	ug/L	UJ	S
		4-Chloro-3-Methylphenol	48	1.1	9.6	ug/L	UJ	S
		4-Nitrophenol	48	7.1	48	ug/L	UJ	S
		Benzoic Acid	48	0.29	48	ug/L	UJ	S
		Pentachlorophenol	48	15	48	ug/L	UJ	S
045772	IR25IW02A-BH-1263	4-Nitrophenol	1700	190	1700	ug/kg	UJ	D1
		Phenol	330	25	330	ug/kg	UJ	D1
	IR25MW53A-BH-1262	4-Nitrophenol	17000	1900	17000	ug/kg	UJ	D1
		Phenol	3300	250	3300	ug/kg	UJ	D1
	IR25MW54A-BH-1261	4-Nitrophenol	1700	190	1700	ug/kg	UJ	D1
		Phenol	78	25	330	ug/kg	J	D1
	IR25MW54A-BH-1265	4-Nitrophenol	1700	190	1700	ug/kg	UJ	D1
		Phenol	330	25	330	ug/kg	UJ	D1
	IR25MW55A-BH-1264	4-Nitrophenol	1700	190	1700	ug/kg	UJ	D1
		Phenol	220	25	330	ug/kg	J	D1
051308	IR25EW01A-1174	Bis(2-Ethylhexyl)Phthalate	9.6	1.9	9.6	ug/L	UJ	C
	IR25IW02A-1175	Bis(2-Ethylhexyl)Phthalate	9.6	1.9	9.6	ug/L	UJ	C
	IR25MW53A-1176	Bis(2-Ethylhexyl)Phthalate	9.6	1.9	9.6	ug/L	UJ	C
	IR25MW54A-1177	Bis(2-Ethylhexyl)Phthalate	66	19	95	ug/L	J	C
051592	IR25EW01A-1187	Bis(2-Ethylhexyl)Phthalate	9.6	1.9	9.6	ug/L	J	C
		Hexachlorocyclopentadiene	48	3.9	48	ug/L	J	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
051592	IR25EW01A-1187	Pentachlorophenol	48	12	48	ug/L	J	C
	IR25IW02A-1188	Bis(2-Ethylhexyl)Phthalate	9.6	1.9	9.6	ug/L	J	C
		Hexachlorocyclopentadiene	48	3.9	48	ug/L	J	C
		Pentachlorophenol	48	12	48	ug/L	J	C
	IR25MW53A-1189	Bis(2-Ethylhexyl)Phthalate	9.6	1.9	9.6	ug/L	J	C
		Hexachlorocyclopentadiene	48	3.9	48	ug/L	J	C
		Pentachlorophenol	48	12	48	ug/L	J	C
	IR25MW54A-1190	Bis(2-Ethylhexyl)Phthalate	48	9.5	48	ug/L	J	C
		Hexachlorocyclopentadiene	240	19	240	ug/L	J	C
		Pentachlorophenol	240	62	240	ug/L	J	C
051782	IR25EW01A-1193	Benzoic Acid	48	0.29	48	ug/L	J	C
	IR25IW02A-1194	Benzoic Acid	48	0.29	48	ug/L	J	C
	IR25MW53A-1195	Benzoic Acid	48	0.29	48	ug/L	J	C
	IR25MW53A-1196	Benzoic Acid	48	0.29	48	ug/L	J	C
	IR25MW54A-1197	Benzoic Acid	480	2.9	480	ug/L	J	C
051894	IR25EW01A-1200	Benzoic Acid	48	11	48	ug/L	J	C
	IR25IW02A-1201	Benzoic Acid	48	11	48	ug/L	J	C
	IR25MW53A-1202	Benzoic Acid	48	11	48	ug/L	J	C
	IR25MW54A-1203	Benzoic Acid	480	100	480	ug/L	J	C
052096	IR25EW01A-1206	2,4-Dinitrophenol	48	3.5	48	ug/L	UJ	C
	IR25IW02A-1207	2,4-Dinitrophenol	48	3.5	48	ug/L	UJ	C
	IR25MW53A-1208	2,4-Dinitrophenol	48	3.5	48	ug/L	UJ	C
	IR25MW53A-1209	2,4-Dinitrophenol	48	3.5	48	ug/L	UJ	C
	IR25MW54A-1210	2,4-Dinitrophenol	48	3.5	48	ug/L	UJ	C
052280	IR25EW01A-1213	4-Nitroaniline	48	4.7	48	ug/L	UJ	C
	IR25IW02A-1214	4-Nitroaniline	48	4.7	48	ug/L	UJ	C
	IR25MW53A-1215	4-Nitroaniline	48	4.7	48	ug/L	UJ	C
	IR25MW54A-1216	4-Nitroaniline	480	47	480	ug/L	UJ	C
052677	IR25EW01A-1226	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25IW02A-1227	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW53A-1228	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW54A-1229	Benzo(A)Anthracene	95	15	95	ug/L	UJ	C
		Benzo(K)Fluoranthene	95	12	95	ug/L	UJ	C
052688	IR25MW39A-1245	1,2,4-Trichlorobenzene	9.6	1.3	9.6	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052714	IR25MW11A-1243	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW17A-1238	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW37A-1239	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW37B-1240	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW37B-1256	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
	IR25MW39B-1246	Benzo(A)Anthracene	9.6	1.5	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
052742	IR25MW15F-1244	4-Nitrophenol	48	5.4	48	ug/L	UJ	C
	IR25MW900B-1248	4-Nitrophenol	48	5.4	48	ug/L	UJ	C
	IR25MW900B-1254	4-Nitrophenol	48	5.4	48	ug/L	UJ	C
	IR25MW902B-1251	4-Nitrophenol	480	53	480	ug/L	UJ	C
052765	IR25EW01A-1233	Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
	IR25IW02A-1232	Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
	IR25MW53A-1235	Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
	IR25MW54A-1234	Bis(2-Ethylhexyl)Phthalate	95	17	95	ug/L	UJ	C
	IR25MW56A-1252	Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
052778	IR25MW38B-1241	Benzo(B)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
		Benzo(K)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
		Bis(2-Chloroethyl)Ether	9.6	1.3	9.6	ug/L	UJ	C
		Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
		Butyl Benzyl Phthalate	9.6	1.4	9.6	ug/L	UJ	C
	IR25MW55A-1236	1,2,4-Trichlorobenzene	16	13	95	ug/L	J	S
		1,2-Dichlorobenzene	16700	10	95	ug/L	J	S
		1,3-Dichlorobenzene	140	12	95	ug/L	J	S
		1,4-Dichlorobenzene	3750	13	95	ug/L	J	S
		Benzo(B)Fluoranthene	95	12	95	ug/L	UJ	C
		Bis(2-Chloroethyl)Ether	95	13	95	ug/L	UJ	C
		Bis(2-Ethylhexyl)Phthalate	95	17	95	ug/L	UJ	C
		Butyl Benzyl Phthalate	95	14	95	ug/L	UJ	C
		Hexachlorobutadiene	95	14	95	ug/L	UJ	S
		Naphthalene	70	18	95	ug/L	J	S
	IR25MW57A-1253	1,2,4-Trichlorobenzene	9.6	1.3	9.6	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	IR25MW57A-1253	1,2-Dichlorobenzene	37	1.1	9.6	ug/L	J	S
		1,3-Dichlorobenzene	2	1.2	9.6	ug/L	UJ	S
		1,4-Dichlorobenzene	9	1.3	9.6	ug/L	J	S
		Benzo(B)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
		Bis(2-Chloroethyl)Ether	9.6	1.3	9.6	ug/L	UJ	C
		Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
		Butyl Benzyl Phthalate	9.6	1.4	9.6	ug/L	UJ	C
		Hexachlorobutadiene	9.6	1.4	9.6	ug/L	UJ	S
		Naphthalene	9.6	1.8	9.6	ug/L	UJ	S
	IR25MW904B-1250	1,2,4-Trichlorobenzene	9.6	1.3	9.6	ug/L	UJ	S
		1,2-Dichlorobenzene	16	1.1	9.6	ug/L	J	S
		1,3-Dichlorobenzene	9.6	1.2	9.6	ug/L	J	S
		1,4-Dichlorobenzene	4	1.3	9.6	ug/L	J	S
		Benzo(B)Fluoranthene	9.6	1.2	9.6	ug/L	UJ	C
		Bis(2-Chloroethyl)Ether	9.6	1.3	9.6	ug/L	UJ	C
		Bis(2-Ethylhexyl)Phthalate	9.6	1.7	9.6	ug/L	UJ	C
		Butyl Benzyl Phthalate	9.6	1.4	9.6	ug/L	UJ	C
		Hexachlorobutadiene	9.6	1.4	9.6	ug/L	UJ	S
		Naphthalene	9.6	1.8	9.6	ug/L	UJ	S
VOLATILES	***SW8260B***							
042224	IR25EW01A-1001	Acetone	500	110	500	ug/L	UJ	C
		Methyl Tert-Butyl Ether	25	2.2	25	ug/L	UJ	C
	IR25MW17A-1006	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C
	IR25MW37A-1007	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C
	IR25MW37B-1008	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C
	IR25MW37B-1023	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C
	IR25MW38B-1009	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C
	IR25MW55A-1004	Acetone	250	110	500	ug/L	J	C
		Methyl Tert-Butyl Ether	25	2.2	25	ug/L	UJ	C
	IR25MW57A-1021	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
042224	IR25MW904B-1018	Acetone	20	4.3	20	ug/L	UJ	C
		Methyl Tert-Butyl Ether	1	0.088	1	ug/L	UJ	C
042248	IR25IW02A-1000	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		2-Hexanone	500	3.8	500	ug/L	UJ	C
		Acetone	500	35	500	ug/L	UJ	C
	IR25MW11A-1011	2,2-Dichloropropane	5	0.88	5	ug/L	UJ	C
		2-Hexanone	200	1.5	200	ug/L	UJ	C
		Acetone	200	14	200	ug/L	UJ	C
	IR25MW39A-1013	2,2-Dichloropropane	0.5	0.088	0.5	ug/L	UJ	C
		2-Hexanone	20	0.15	20	ug/L	UJ	C
		Acetone	20	1.4	20	ug/L	UJ	C
	IR25MW39B-1014	2,2-Dichloropropane	0.5	0.088	0.5	ug/L	UJ	C
		2-Hexanone	20	0.15	20	ug/L	UJ	C
		Acetone	20	1.4	20	ug/L	UJ	C
	IR25MW51A-1015	2,2-Dichloropropane	0.5	0.088	0.5	ug/L	UJ	C
		2-Hexanone	20	0.15	20	ug/L	UJ	C
		Acetone	20	1.4	20	ug/L	UJ	C
	IR25MW53A-1003	2,2-Dichloropropane	5	0.88	5	ug/L	UJ	C
		2-Hexanone	200	1.5	200	ug/L	UJ	C
		Acetone	200	14	200	ug/L	UJ	C
	IR25MW54A-1002	2,2-Dichloropropane	500	88	500	ug/L	UJ	C
		2-Hexanone	20000	150	20000	ug/L	UJ	C
		Acetone	20000	1400	20000	ug/L	UJ	C
	IR25MW56A-1020	2,2-Dichloropropane	50	8.8	50	ug/L	UJ	C
		2-Hexanone	2000	15	2000	ug/L	UJ	C
		Acetone	2000	140	2000	ug/L	UJ	C
	IR25MW900B-1016	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		2-Hexanone	500	3.8	500	ug/L	UJ	C
		Acetone	500	35	500	ug/L	UJ	C
	IR25MW900B-1025	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		2-Hexanone	500	3.8	500	ug/L	UJ	C
		Acetone	500	35	500	ug/L	UJ	C
	IR25MW902B-1019	2,2-Dichloropropane	500	88	500	ug/L	UJ	C
		2-Hexanone	20000	150	20000	ug/L	UJ	C
		Acetone	20000	1400	20000	ug/L	UJ	C
	TB3-1026	Acetone	20	1.4	20	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	20	2.7	20	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
042867	IR25EW01A-1037	Acetone	500	12	500	ug/L	UJ	C
	IR25IW02A-1036	Acetone	500	12	500	ug/L	UJ	C
	IR25MW53A-1039	Acetone	200	4.9	200	ug/L	UJ	C
	IR25MW54A-1038	Acetone	20000	490	20000	ug/L	UJ	C
	IR25MW56A-1040	Acetone	2000	49	2000	ug/L	UJ	C
	TB-1041	Acetone	20	0.49	20	ug/L	UJ	C
043068	IR25IW02A-1043	1,2,3-Trichloropropane	130	24	130	ug/L	UJ	C
		Bromomethane	130	22	130	ug/L	UJ	C
	IR25MW53A-1044	1,2,3-Trichloropropane	50	9.4	50	ug/L	UJ	C
		Bromomethane	50	8.8	50	ug/L	UJ	C
	IR25MW54A-1046	1,2,3-Trichloropropane	1000	190	1000	ug/L	UJ	C
		Bromomethane	1000	180	1000	ug/L	UJ	C
	IR25MW56A-1047	1,2,3-Trichloropropane	50	9.4	50	ug/L	UJ	C
		Bromomethane	50	8.8	50	ug/L	UJ	C
	TB-1048	1,2,3-Trichloropropane	0.5	0.094	0.5	ug/L	UJ	C
		Bromomethane	1	0.088	0.5	ug/L	UJ	C
043242	IR25IW02A-1050	2-Butanone	1000	37	1000	ug/L	U	B
		Acetone	1000	70	1000	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	1000	140	1000	ug/L	UJ	C
	IR25MW53A-1051	2-Butanone	2000	74	2000	ug/L	UJ	BC
		Acetone	2000	140	2000	ug/L	UJ	C
		Bromomethane	50	7.0	50	ug/L	UJ	C
	IR25MW54A-1052	2-Butanone	40000	1500	40000	ug/L	UJ	BC
		Acetone	40000	2800	40000	ug/L	UJ	C
		Bromomethane	1000	140	1000	ug/L	UJ	C
	IR25MW54A-1053	2-Butanone	40000	1500	40000	ug/L	UJ	BC
		Acetone	40000	2800	40000	ug/L	UJ	C
		Bromomethane	1000	140	1000	ug/L	UJ	C
	IR25MW56A-1054	2-Butanone	2000	74	2000	ug/L	UJ	C
		Acetone	2000	140	2000	ug/L	UJ	C
		Bromomethane	50	7.0	50	ug/L	UJ	C
	TB-1055	2-Butanone	20	0.74	20	ug/L	U	B
		Acetone	20	1.4	20	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	20	2.7	20	ug/L	UJ	C
043507	IR25EW01A-1057	1,1,2,2-Tetrachloroethane	13	5.3	13	ug/L	UJ	C
		2,2-Dichloropropane	13	4.0	13	ug/L	UJ	C
		2-Butanone	500	45	500	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
043507	IR25EW01A-1057	2-Hexanone	500	28	500	ug/L	UJ	C
		Acetone	500	110	500	ug/L	UJ	C
		Bromomethane	13	10	13	ug/L	UJ	C
		Carbon Tetrachloride	13	2.1	13	ug/L	UJ	C
		Methylene Chloride	58	19	25	ug/L	J	C
	IR25IW02A-1058	1,1,2,2-Tetrachloroethane	25	11	25	ug/L	UJ	C
		2,2-Dichloropropane	25	8.0	25	ug/L	UJ	C
		2-Butanone	1000	90	1000	ug/L	UJ	C
		2-Hexanone	1000	55	1000	ug/L	UJ	C
		Acetone	1000	220	1000	ug/L	UJ	C
		Bromomethane	25	21	25	ug/L	UJ	C
		Carbon Tetrachloride	25	4.1	25	ug/L	UJ	C
		Methylene Chloride	100	37	50	ug/L	J	C
	IR25MW53A-1059	1,1,1-Trichloroethane	13	2.3	13	ug/L	UJ	C
		2,2-Dichloropropane	13	4.0	13	ug/L	UJ	C
		2-Hexanone	500	28	500	ug/L	UJ	C
		Acetone	500	110	500	ug/L	UJ	C
		Bromomethane	13	10	13	ug/L	UJ	C
		Carbon Tetrachloride	13	2.1	13	ug/L	UJ	C
		Methylene Chloride	30	19	25	ug/L	J	C
	IR25MW54A-1060	1,1,1-Trichloroethane	100	18	100	ug/L	UJ	C
		2,2-Dichloropropane	100	32	100	ug/L	UJ	C
		2-Hexanone	4000	220	4000	ug/L	UJ	C
		Acetone	4000	860	4000	ug/L	UJ	C
		Bromomethane	100	82	100	ug/L	UJ	C
		Carbon Tetrachloride	100	16	100	ug/L	UJ	C
		Methylene Chloride	200	150	200	ug/L	J	C
	IR25MW56A-1061	1,1,2,2-Tetrachloroethane	50	21	50	ug/L	UJ	C
		2,2-Dichloropropane	50	16	50	ug/L	UJ	C
		2-Butanone	2000	180	2000	ug/L	UJ	C
		2-Hexanone	2000	110	2000	ug/L	UJ	C
		Acetone	2000	430	2000	ug/L	UJ	C
		Bromomethane	50	41	50	ug/L	UJ	C
		Carbon Tetrachloride	50	8.2	50	ug/L	UJ	C
		Methylene Chloride	200	74	100	ug/L	J	C
	TB-1062	1,1,2,2-Tetrachloroethane	0.5	0.21	0.5	ug/L	UJ	C
		2,2-Dichloropropane	0.5	0.16	0.5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
043507	TB-1062	2-Butanone	20	1.8	20	ug/L	UJ	C
		2-Hexanone	20	1.1	20	ug/L	UJ	C
		Acetone	20	4.3	20	ug/L	UJ	C
		Bromomethane	0.5	0.41	0.5	ug/L	UJ	C
		Carbon Tetrachloride	0.5	0.082	0.5	ug/L	UJ	C
		Methylene Chloride	1	0.74	1	ug/L	UJ	C
043657	TB-1069	2,2-Dichloropropane	0.5	0.16	0.5	ug/L	UJ	C
		Carbon Tetrachloride	0.5	0.082	0.5	ug/L	UJ	C
043839	IR25IW02A-1071	Chloromethane	5	0.48	5	ug/L	UJ	C
		Methylene Chloride	10	0.50	10	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW53A-1072	Chloromethane	5	0.48	5	ug/L	UJ	C
		Methylene Chloride	10	0.50	10	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW54A-1073	2-Butanone	100	3.7	100	ug/L	UJ	C
		Bromomethane	2.5	0.35	2.5	ug/L	UJ	C
		Chloroethane	2.5	0.55	2.5	ug/L	UJ	C
	TB-1075	2-Butanone	20	0.74	20	ug/L	UJ	C
		Bromomethane	0.5	0.070	0.5	ug/L	UJ	C
		Chloroethane	0.5	0.11	0.5	ug/L	UJ	C
044005	IR25EW01A-1076	Methylene Chloride	30	1.3	25	ug/L	J	C
	IR25IW02A-1077	Methylene Chloride	10	0.50	10	ug/L	UJ	C
	IR25MW53A-1078	Methylene Chloride	10	0.50	10	ug/L	UJ	C
	IR25MW53A-1079	Methylene Chloride	10	0.50	10	ug/L	UJ	C
	IR25MW54A-1080	Methylene Chloride	25	1.3	25	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	500	68	500	ug/L	UJ	C
	IR25MW56A-1081	Methylene Chloride	10	0.50	10	ug/L	UJ	C
	TB-1082	Methylene Chloride	1	0.050	1	ug/L	UJ	C
044177	IR25EW01A-1083	2-Butanone	500	9.3	500	ug/L	UJ	C
	IR25IW02A-1084	2-Butanone	200	3.7	200	ug/L	UJ	C
	IR25MW53A-1085	2-Butanone	200	3.7	200	ug/L	UJ	C
	IR25MW54A-1086	2-Butanone	500	9.3	500	ug/L	UJ	C
	IR25MW56A-1087	2-Butanone	200	3.7	200	ug/L	UJ	C
	TB-1088	2-Butanone	20	0.37	20	ug/L	UJ	C
044402	IR25EW01A-1089	1,2,3-Trichlorobenzene	13	3.5	13	ug/L	UJ	C
		1,2,4-Trichlorobenzene	13	4.3	13	ug/L	UJ	C
		Bromoform	13	2.2	13	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
044402	IR25EW01A-1089	Chloromethane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	C
		Naphthalene	36	3.5	13	ug/L	J	C
	IR25IW02A-1090	1,2,3-Trichlorobenzene	5	1.4	5	ug/L	UJ	C
		1,2,4-Trichlorobenzene	5	1.7	5	ug/L	UJ	C
		Bromoform	5	0.87	5	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	17	1.4	5	ug/L	J	C
	IR25MW53A-1091	1,2,3-Trichlorobenzene	5	1.4	5	ug/L	UJ	C
		1,2,4-Trichlorobenzene	5	1.7	5	ug/L	UJ	C
		Bromoform	5	0.87	5	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	13	1.4	5	ug/L	J	C
	IR25MW54A-1092	1,2,3-Trichlorobenzene	13	3.5	13	ug/L	UJ	C
		1,2,4-Trichlorobenzene	13	4.3	13	ug/L	UJ	C
		Bromoform	13	2.2	13	ug/L	UJ	C
		Chloromethane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	C
		Naphthalene	37	3.5	13	ug/L	J	C
	IR25MW56A-1093	1,2,3-Trichlorobenzene	5	1.4	5	ug/L	UJ	C
		1,2,4-Trichlorobenzene	5	1.7	5	ug/L	UJ	C
		Bromoform	5	0.87	5	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	5	1.4	5	ug/L	J	C
	IR25MW56A-1094	1,2,3-Trichlorobenzene	5	1.4	5	ug/L	UJ	C
		1,2,4-Trichlorobenzene	5	1.7	5	ug/L	UJ	C
		Bromoform	5	0.87	5	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	6	1.4	5	ug/L	J	C
	TB-1095	1,2,3-Trichlorobenzene	0.5	0.14	0.5	ug/L	UJ	C
		1,2,4-Trichlorobenzene	0.5	0.17	0.5	ug/L	UJ	C
		Bromoform	0.5	0.087	0.5	ug/L	UJ	C
		Chloromethane	0.5	0.086	0.5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
044402	TB-1095	Dichlorodifluoromethane	0.5	0.065	0.5	ug/L	UJ	C
		Naphthalene	0.5	0.14	0.5	ug/L	UJ	C
044797	IR25EW01A-1102	Methylene Chloride	25	1.3	25	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	500	68	500	ug/L	UJ	C
	IR25IW02A-1103	Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW53A-1104	Acetone	200	14	200	ug/L	UJ	C
		Methylene Chloride	10	0.50	10	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW54A-1105	Acetone	500	35	500	ug/L	UJ	C
		Methylene Chloride	25	1.3	25	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	500	68	500	ug/L	UJ	C
	IR25MW56A-1106	Acetone	200	14	200	ug/L	UJ	C
		Methylene Chloride	10	0.50	10	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW56A-1107	Acetone	200	14	200	ug/L	UJ	C
		Methylene Chloride	10	0.50	10	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	TB-1108	Methylene Chloride	1	0.050	1	ug/L	U	B
		Tert-Butyl Alcohol (TBA)	20	2.7	20	ug/L	UJ	C
045000	IR25EW01A-1109	Bromoform	13	1.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	UJ	C
		Naphthalene	20	1.4	13	ug/L	J	C
		Tert-Butyl Alcohol (TBA)	500	68	500	ug/L	UJ	C
	IR25IW02A-1110	Bromoform	5	0.46	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C
		Naphthalene	5	0.56	5	ug/L	J	C
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW53A-1111	Bromoform	5	0.46	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C
		Naphthalene	5	0.56	5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	IR25MW54A-1112	Bromoform	13	1.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	UJ	C
		Naphthalene	10	1.4	13	ug/L	J	C
		Tert-Butyl Alcohol (TBA)	500	68	500	ug/L	UJ	C
	IR25MW56A-1113	Bromoform	5	0.46	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045000	IR25MW56A-1113	Naphthalene	5	0.56	5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	27	200	ug/L	UJ	C
	TB-1114	Bromoform	0.5	0.046	0.5	ug/L	UJ	C
		Dichlorodifluoromethane	0.5	0.034	0.5	ug/L	UJ	C
		Naphthalene	0.5	0.056	0.5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	20	2.7	20	ug/L	UJ	C
045286	IR25EW01A-1115	1,1,2,2-Tetrachloroethane	13	2.8	13	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	50	9.5	50	ug/L	UJ	C
		2-Butanone	500	9.3	500	ug/L	UJ	C
		2-Hexanone	500	8.8	500	ug/L	UJ	C
		Chloromethane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	500	23	500	ug/L	UJ	C
	IR25IW02A-1116	1,1,2,2-Tetrachloroethane	5	1.1	5	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	20	3.8	20	ug/L	UJ	C
		2-Butanone	200	3.7	200	ug/L	UJ	C
		2-Hexanone	200	3.5	200	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	9.2	200	ug/L	UJ	C
	IR25IW02A-1117	1,1,2,2-Tetrachloroethane	5	1.1	5	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	20	3.8	20	ug/L	UJ	C
		2-Butanone	200	3.7	200	ug/L	UJ	C
		2-Hexanone	200	3.5	200	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	9.2	200	ug/L	UJ	C
	IR25MW53A-1118	1,1,2,2-Tetrachloroethane	5	1.1	5	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	20	3.8	20	ug/L	UJ	C
		2-Butanone	200	3.7	200	ug/L	UJ	C
		2-Hexanone	200	3.5	200	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	9.2	200	ug/L	UJ	C
	IR25MW54A-1119	1,1,2,2-Tetrachloroethane	13	2.8	13	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	50	9.5	50	ug/L	UJ	C
		2-Butanone	500	9.3	500	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045286	IR25MW54A-1119	2-Hexanone	500	8.8	500	ug/L	UJ	C
		Chloromethane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	500	23	500	ug/L	UJ	C
	IR25MW56A-1120	1,1,2,2-Tetrachloroethane	5	1.1	5	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	20	3.8	20	ug/L	UJ	C
		2-Butanone	200	3.7	200	ug/L	UJ	C
		2-Hexanone	200	3.5	200	ug/L	UJ	C
		Chloromethane	5	0.86	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	200	9.2	200	ug/L	UJ	C
	TB-1121	1,1,2,2-Tetrachloroethane	0.5	0.11	0.5	ug/L	UJ	C
		1,2-Dibromo-3-Chloropropane	2	0.38	2	ug/L	UJ	C
		2-Butanone	20	0.37	20	ug/L	UJ	C
		2-Hexanone	20	0.35	20	ug/L	UJ	C
		Chloromethane	0.5	0.086	0.5	ug/L	UJ	C
		Dichlorodifluoromethane	0.5	0.065	0.5	ug/L	UJ	C
		Tert-Butyl Alcohol (TBA)	20	0.92	20	ug/L	UJ	C
045450	IR25EW01A-1122	2-Hexanone	500	3.8	500	ug/L	UJ	C
		Trichlorofluoromethane	13	2.4	13	ug/L	UJ	C
	IR25IW02A-1123	2-Hexanone	200	1.5	200	ug/L	UJ	C
		Trichlorofluoromethane	5	0.94	5	ug/L	UJ	C
	IR25MW53A-1124	2-Hexanone	200	1.5	200	ug/L	UJ	C
		Trichlorofluoromethane	5	0.94	5	ug/L	UJ	C
	IR25MW54A-1125	2-Hexanone	500	3.8	500	ug/L	UJ	C
		Trichlorofluoromethane	13	2.4	13	ug/L	UJ	C
	IR25MW56A-1126	2-Hexanone	200	1.5	200	ug/L	UJ	C
		Trichlorofluoromethane	5	0.94	5	ug/L	UJ	C
	TB-1127	2-Hexanone	20	0.15	20	ug/L	UJ	C
		Trichlorofluoromethane	0.5	0.094	0.5	ug/L	UJ	C
045664	IR25MW37A-1137	Bromoform	0.5	0.087	0.5	ug/L	UJ	C
	IR25MW37B-1138	Bromoform	0.5	0.087	0.5	ug/L	UJ	C
	IR25MW55A-1134	Bromoform	13	2.2	13	ug/L	UJ	C
	IR25MW57A-1151	Bromoform	0.5	0.087	0.5	ug/L	UJ	C
		Methylene Chloride	1	0.081	1	ug/L	U	B
	IR25MW904B-1148	Bromoform	0.5	0.087	0.5	ug/L	UJ	C
	TB1-1155	Bromoform	0.5	0.087	0.5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
045664	TB1-1155	Methylene Chloride	1	0.081	1	ug/L	U	B
045738	IR25IW02A-1130	2,2-Dichloropropane	25	4.4	25	ug/L	UJ	C
		Naphthalene	25	2.8	25	ug/L	UJ	C
	IR25MW11A-1141	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		Naphthalene	13	1.4	13	ug/L	UJ	C
	IR25MW53A-1133	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		Naphthalene	13	1.4	13	ug/L	UJ	C
	IR25MW900B-1146	2,2-Dichloropropane	25	4.4	25	ug/L	UJ	C
		Naphthalene	25	2.8	25	ug/L	UJ	C
	IR25MW902B-1149	2,2-Dichloropropane	25	4.4	25	ug/L	UJ	C
		Naphthalene	25	2.8	25	ug/L	UJ	C
	IR25MW902B-1152	2,2-Dichloropropane	25	4.4	25	ug/L	UJ	C
		Naphthalene	25	2.8	25	ug/L	UJ	C
045762	IR25MW51A-1154	Methylene Chloride	1	0.050	1	ug/L	U	B
	TB4-1158	Methylene Chloride	1	0.081	1	ug/L	UJ	C
045772	IR25IW02A-BH-1263	Acetone	19	12	19	ug/kg	UJ	C
	IR25MW53A-BH-1262	Acetone	15	13	19	ug/kg	J	C
	IR25MW54A-BH-1261	2,2-Dichloropropane	50000	3000	50000	ug/kg	UJ	C
		2-Butanone	200000	28000	200000	ug/kg	UJ	C
		Acetone	200000	37000	200000	ug/kg	UJ	C
		Carbon Tetrachloride	50000	1200	50000	ug/kg	UJ	C
		Chloromethane	100000	2700	100000	ug/kg	UJ	C
		Tert-Butyl Alcohol (TBA)	200000	28000	200000	ug/kg	UJ	C
	IR25MW54A-BH-1265	2,2-Dichloropropane	50000	3000	50000	ug/kg	UJ	C
		2-Butanone	200000	28000	200000	ug/kg	UJ	C
		Acetone	200000	37000	200000	ug/kg	UJ	C
		Carbon Tetrachloride	50000	1200	50000	ug/kg	UJ	C
		Chloromethane	100000	2700	100000	ug/kg	UJ	C
		Tert-Butyl Alcohol (TBA)	200000	28000	200000	ug/kg	UJ	C
	IR25MW55A-BH-1264	2,2-Dichloropropane	500	30	500	ug/kg	UJ	C
		2-Butanone	2000	280	2000	ug/kg	UJ	C
		Acetone	2000	370	2000	ug/kg	UJ	C
		Carbon Tetrachloride	500	12	500	ug/kg	UJ	C
		Chloromethane	1000	27	1000	ug/kg	U	C
		Tert-Butyl Alcohol (TBA)	2000	280	2000	ug/kg	UJ	C
051122	TB-1166	Methylene Chloride	2	0.081	1	ug/L	U	B
051222	IR25EW01A-1167	Acetone	500	12	500	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
051222	IR25EW01A-1167	Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	C
		Naphthalene	41	3.5	13	ug/L	J	C
	IR25IW02A-1168	Acetone	200	4.9	200	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	5	1.4	5	ug/L	UJ	C
	IR25MW53A-1169	Acetone	200	4.9	200	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	5	1.4	5	ug/L	UJ	C
	IR25MW53A-1170	Acetone	200	4.9	200	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	5	1.4	5	ug/L	UJ	C
	IR25MW54A-1171	Acetone	500	12	500	ug/L	UJ	C
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	C
		Naphthalene	41	3.5	13	ug/L	J	C
	IR25MW56A-1172	Acetone	200	4.9	200	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.65	5	ug/L	UJ	C
		Naphthalene	5	1.4	5	ug/L	UJ	C
	TB-1173	Acetone	20	0.49	20	ug/L	UJ	C
		Dichlorodifluoromethane	0.5	0.065	0.5	ug/L	UJ	C
		Naphthalene	0.5	0.14	0.5	ug/L	UJ	C
051308	IR25EW01A-1174	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		2-Hexanone	500	3.8	500	ug/L	UJ	C
		Acetone	440	35	500	ug/L	J	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	UJ	C
	IR25IW02A-1175	2,2-Dichloropropane	5	0.88	5	ug/L	UJ	C
		2-Hexanone	200	1.5	200	ug/L	UJ	C
		Acetone	200	14	200	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C
	IR25MW53A-1176	2,2-Dichloropropane	2.5	0.44	2.5	ug/L	UJ	C
		2-Hexanone	100	0.75	100	ug/L	UJ	C
		Acetone	100	7.0	100	ug/L	UJ	C
		Dichlorodifluoromethane	2.5	0.17	2.5	ug/L	UJ	C
	IR25MW54A-1177	2,2-Dichloropropane	25	4.4	25	ug/L	UJ	C
		2-Hexanone	1000	7.5	1000	ug/L	UJ	C
		Acetone	1000	70	1000	ug/L	UJ	C
		Dichlorodifluoromethane	25	1.7	25	ug/L	UJ	C
	IR25MW56A-1178	2,2-Dichloropropane	5	0.88	5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
051308	IR25MW56A-1178	2-Hexanone	200	1.5	200	ug/L	UJ	C
		Acetone	200	14	200	ug/L	UJ	C
		Bromoform	5	0.46	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C
	TB-1179	2,2-Dichloropropane	0.5	0.088	0.5	ug/L	UJ	C
		2-Hexanone	20	0.15	20	ug/L	UJ	C
		Acetone	20	1.4	20	ug/L	UJ	C
		Bromoform	0.5	0.046	0.5	ug/L	UJ	C
		Dichlorodifluoromethane	0.5	0.034	0.5	ug/L	UJ	C
051398	IR25EW01A-1180	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	UJ	C
	IR25IW02A-1181	2,2-Dichloropropane	5	0.88	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C
	IR25MW53A-1182	2,2-Dichloropropane	5	0.88	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	UJ	C
	IR25MW54A-1183	2,2-Dichloropropane	25	4.4	25	ug/L	UJ	C
		Dichlorodifluoromethane	25	1.7	25	ug/L	UJ	C
	IR25MW56A-1184	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	UJ	C
	IR25MW56A-1185	2,2-Dichloropropane	13	2.2	13	ug/L	UJ	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	UJ	C
	TB-1186	2,2-Dichloropropane	0.5	0.088	0.5	ug/L	UJ	C
		Dichlorodifluoromethane	0.5	0.034	0.5	ug/L	UJ	C
051592	IR25EW01A-1187	2-Butanone	500	19	500	ug/L	J	C
		2-Hexanone	500	3.8	500	ug/L	J	C
		Acetone	500	35	500	ug/L	J	C
		Bromomethane	13	1.8	13	ug/L	J	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	J	C
	IR25IW02A-1188	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Acetone	200	14	200	ug/L	J	C
		Bromomethane	5	0.70	5	ug/L	J	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	J	C
	IR25MW53A-1189	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Acetone	200	14	200	ug/L	J	C
		Bromomethane	5	0.70	5	ug/L	J	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
051592	IR25MW53A-1189	Dichlorodifluoromethane	5	0.34	5	ug/L	J	C
	IR25MW54A-1190	2-Butanone	1000	37	1000	ug/L	J	C
		2-Hexanone	1000	7.5	1000	ug/L	J	C
		Acetone	1000	70	1000	ug/L	J	C
		Bromobenzene	25	3.1	25	ug/L	J	C
		Bromomethane	25	3.5	25	ug/L	J	C
		Dichlorodifluoromethane	25	1.7	25	ug/L	J	C
	IR25MW56A-1191	2-Butanone	500	19	500	ug/L	J	C
		2-Hexanone	500	3.8	500	ug/L	J	C
		Acetone	500	35	500	ug/L	J	C
		Bromomethane	13	1.8	13	ug/L	J	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	J	C
	TB-1192	2-Butanone	20	0.74	20	ug/L	J	C
		2-Hexanone	20	0.15	20	ug/L	J	C
		Acetone	20	1.4	20	ug/L	J	C
		Bromomethane	0.5	0.070	0.5	ug/L	J	C
		Dichlorodifluoromethane	0.5	0.034	0.5	ug/L	J	C
051782	IR25EW01A-1193	2-Butanone	500	19	500	ug/L	J	C
		2-Hexanone	500	3.8	500	ug/L	J	C
		Acetone	500	35	500	ug/L	J	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	J	C
		Methylene Chloride	25	1.3	25	ug/L	J	C
	IR25IW02A-1194	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Acetone	200	14	200	ug/L	J	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	J	C
		Methylene Chloride	10	0.50	10	ug/L	J	C
	IR25MW53A-1195	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Acetone	200	14	200	ug/L	J	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	J	C
		Methylene Chloride	10	0.50	10	ug/L	J	C
	IR25MW53A-1196	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Acetone	200	14	200	ug/L	J	C
		Dichlorodifluoromethane	5	0.34	5	ug/L	J	C
		Methylene Chloride	10	0.50	10	ug/L	J	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
051782	IR25MW54A-1197	2-Butanone	1000	37	1000	ug/L	J	C
		2-Hexanone	1000	7.5	1000	ug/L	J	C
		Acetone	520	70	1000	ug/L	J	C
		Dichlorodifluoromethane	25	1.7	25	ug/L	J	C
		Methylene Chloride	50	2.5	50	ug/L	J	C
	IR25MW56A-1198	2-Butanone	500	19	500	ug/L	J	C
		2-Hexanone	500	3.8	500	ug/L	J	C
		Acetone	130	35	500	ug/L	J	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	J	C
		Methylene Chloride	25	1.3	25	ug/L	J	C
	TB-1199	Acetone	20	1.4	20	ug/L	J	C
		Methylene Chloride	1	0.050	1	ug/L	J	C
051894	IR25EW01A-1200	2-Butanone	500	19	500	ug/L	J	C
		2-Hexanone	500	3.8	500	ug/L	J	C
		Chloromethane	13	1.2	13	ug/L	J	C
	IR25IW02A-1201	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Chloromethane	5	0.48	5	ug/L	J	C
	IR25MW53A-1202	2-Butanone	200	7.4	200	ug/L	J	C
		2-Hexanone	200	1.5	200	ug/L	J	C
		Chloromethane	5	0.48	5	ug/L	J	C
	IR25MW54A-1203	2-Butanone	1000	37	1000	ug/L	J	C
		2-Hexanone	1000	7.5	1000	ug/L	J	C
		Chloromethane	25	2.4	25	ug/L	J	C
	IR25MW56A-1204	Bromomethane	13	1.8	13	ug/L	J	C
		Chloromethane	13	1.2	13	ug/L	J	C
		Dichlorodifluoromethane	13	0.85	13	ug/L	J	C
	TB-1205	Chloromethane	0.5	0.048	0.5	ug/L	J	C
052096	IR25EW01A-1206	Methyl Isobutyl Ketone	500	1.2	500	ug/L	UJ	C
	IR25IW02A-1207	Methyl Isobutyl Ketone	200	0.47	200	ug/L	UJ	C
	IR25MW53A-1208	Methyl Isobutyl Ketone	200	0.47	200	ug/L	UJ	C
	IR25MW53A-1209	Methyl Isobutyl Ketone	200	0.47	200	ug/L	UJ	C
	IR25MW54A-1210	Methyl Isobutyl Ketone	500	1.2	500	ug/L	UJ	C
	IR25MW56A-1211	Acetone	200	7.8	200	ug/L	UJ	C
		Bromoform	5	0.77	5	ug/L	UJ	C
		Dichlorodifluoromethane	5	1.0	5	ug/L	UJ	C
		Trichlorofluoromethane	5	0.51	5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052096	TB-1212	Acetone	20	0.78	20	ug/L	UJ	C
		Bromoform	0.5	0.077	0.5	ug/L	UJ	C
		Dichlorodifluoromethane	0.5	0.10	0.5	ug/L	UJ	C
		Trichlorofluoromethane	0.5	0.051	0.5	ug/L	UJ	C
052480	IR25EW01A-1219	1,2,3-Trichloropropane	13	6.5	13	ug/L	UJ	C
		2-Butanone	500	13	500	ug/L	UJ	C
		Methyl Isobutyl Ketone	500	1.6	500	ug/L	UJ	C
	IR25IW02A-1220	1,2,3-Trichloropropane	5	2.6	5	ug/L	UJ	C
		2,2-Dichloropropane	5	0.54	5	ug/L	UJ	C
		Methyl Isobutyl Ketone	200	0.65	200	ug/L	UJ	C
	IR25MW53A-1221	1,2,3-Trichloropropane	5	2.6	5	ug/L	UJ	C
		2,2-Dichloropropane	5	0.54	5	ug/L	UJ	C
		Methyl Isobutyl Ketone	200	0.65	200	ug/L	UJ	C
	IR25MW54A-1222	1,2,3-Trichloropropane	25	13	25	ug/L	UJ	C
		2,2-Dichloropropane	25	2.7	25	ug/L	UJ	C
		Methyl Isobutyl Ketone	1000	3.3	1000	ug/L	UJ	C
	IR25MW54A-1223	1,2,3-Trichloropropane	25	13	25	ug/L	UJ	C
		2,2-Dichloropropane	25	2.7	25	ug/L	UJ	C
		Methyl Isobutyl Ketone	1000	3.3	1000	ug/L	UJ	C
	IR25MW56A-1224	1,2,3-Trichloropropane	13	6.5	13	ug/L	UJ	C
		2,2-Dichloropropane	13	1.4	13	ug/L	UJ	C
		Methyl Isobutyl Ketone	500	1.6	500	ug/L	UJ	C
	TB-1225	1,2,3-Trichloropropane	0.5	0.26	0.5	ug/L	UJ	C
		2,2-Dichloropropane	0.5	0.054	0.5	ug/L	UJ	C
		Methyl Isobutyl Ketone	20	0.065	20	ug/L	UJ	C
052677	IR25EW01A-1226	Tetrachloroethene	1.7	1.7	1.7	ug/L	UJ	C
	IR25IW02A-1227	Tetrachloroethene	0.66	0.66	0.66	ug/L	UJ	C
	IR25MW53A-1228	Tetrachloroethene	0.66	0.66	0.66	ug/L	UJ	C
	IR25MW54A-1229	Tetrachloroethene	863	3.3	3.3	ug/L	J	C
	IR25MW56A-1230	Tetrachloroethene	14	1.7	1.7	ug/L	J	C
	TB-1231	Tetrachloroethene	0.066	0.066	0.066	ug/L	UJ	C
052688	IR06MW44A-1237	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.7	0.094	1	ug/L	U	B
	IR25MW39A-1245	2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.5	0.094	1	ug/L	U	B
	IR25MW42B-1242	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052688	IR25MW42B-1242	2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.4	0.094	1	ug/L	U	B
	IR25MW42B-1255	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.5	0.094	1	ug/L	U	B
	IR25MW51A-1247	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.4	0.094	1	ug/L	U	B
	TB1-1257	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.6	0.094	1	ug/L	U	B
052714	IR25MW11A-1243	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.6	0.094	1	ug/L	U	B
	IR25MW37B-1240	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	1	0.094	1	ug/L	U	B
	IR25MW37B-1256	1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		Methylene Chloride	0.9	0.094	1	ug/L	U	B
	IR25MW39B-1246	2,2-Dichloropropane	0.5	0.054	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		2-Hexanone	20	0.20	20	ug/L	UJ	C
		Acetone	20	0.58	20	ug/L	UJ	C
		Methyl Isobutyl Ketone	20	0.065	20	ug/L	UJ	C
		Methylene Chloride	0.9	0.094	1	ug/L	J	C
	TB2-1258	2,2-Dichloropropane	0.5	0.054	0.5	ug/L	UJ	C
		2-Butanone	20	0.51	20	ug/L	UJ	C
		2-Hexanone	20	0.20	20	ug/L	UJ	C
		Acetone	20	0.58	20	ug/L	UJ	C
		Methylene Chloride	1	0.094	1	ug/L	UJ	BC
052742	IR25MW15F-1244	2-Butanone	20	0.51	20	ug/L	UJ	C
	IR25MW900B-1248	2-Butanone	20	0.51	20	ug/L	UJ	C
	IR25MW900B-1254	2-Butanone	20	0.51	20	ug/L	UJ	C
	IR25MW902B-1251	2-Butanone	500	13	500	ug/L	UJ	C
	TB3-1259	2-Butanone	20	0.51	20	ug/L	UJ	C
052765	IR25EW01A-1233	1,2,4-Trimethylbenzene	7.6	0.22	2.5	ug/L	J	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052765	IR25EW01A-1233	1,2-Dichlorobenzene	54	0.13	2.5	ug/L	J	S
		1,2-Dichloroethane	4	0.32	2.5	ug/L	J	S
		1,3,5-Trimethylbenzene	2	0.19	2.5	ug/L	J	S
		1,3-Dichlorobenzene	6.1	0.18	2.5	ug/L	J	S
		1,4-Dichlorobenzene	223	0.17	2.5	ug/L	J	S
		2-Butanone	100	2.6	100	ug/L	UJ	C
		Benzene	77	0.27	2.5	ug/L	J	S
		Chlorobenzene	11500	6.0	130	ug/L	J	S
		Cis-1,2-Dichloroethene	1.9	0.28	0.28	ug/L	J	S
		Naphthalene	30	0.65	2.5	ug/L	J	S
		O-Xylene	5	0.55	2.5	ug/L	J	S
		Tetrachloroethene	3.7	0.33	0.33	ug/L	J	S
		Toluene	5.5	0.20	2.5	ug/L	J	S
		Trans-1,2-Dichloroethene	13.2	0.34	0.34	ug/L	J	S
	IR25IW02A-1232	2-Butanone	20	0.51	20	ug/L	UJ	C
	IR25MW53A-1235	2-Butanone	20	0.51	20	ug/L	UJ	C
	IR25MW54A-1234	1,1,1,2-Tetrachloroethane	13	1.1	13	ug/L	UJ	S
		1,1,1-Trichloroethane	13	0.90	13	ug/L	UJ	S
		1,1,2,2-Tetrachloroethane	13	3.0	13	ug/L	UJ	S
		1,1,2-Trichloroethane	13	0.63	13	ug/L	UJ	S
		1,1-Dichloroethane	13	0.78	13	ug/L	UJ	S
		1,1-Dichloroethene	11	0.90	0.9	ug/L	J	S
		1,1-Dichloropropene	13	1.9	13	ug/L	UJ	S
		1,2,3-Trichlorobenzene	13	4.3	13	ug/L	UJ	S
		1,2,3-Trichloropropane	13	6.5	13	ug/L	UJ	S
		1,2,4-Trichlorobenzene	11	2.0	13	ug/L	J	S
		1,2,4-Trimethylbenzene	12	1.1	13	ug/L	J	S
		1,2-Dibromo-3-Chloropropane	50	6.3	50	ug/L	UJ	S
		1,2-Dibromoethane	25	2.4	25	ug/L	UJ	S
		1,2-Dichlorobenzene	9040	25	500	ug/L	J	S
		1,2-Dichloroethane	22300	63	500	ug/L	J	S
		1,2-Dichloropropane	62	1.7	13	ug/L	J	S
		1,3,5-Trimethylbenzene	13	0.95	13	ug/L	UJ	S
		1,3-Dichlorobenzene	67	0.88	13	ug/L	J	S
		1,3-Dichloropropane	13	1.2	13	ug/L	UJ	S
		1,4-Dichlorobenzene	2120	34	500	ug/L	J	S
		2,2-Dichloropropane	13	1.4	13	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052765	IR25MW54A-1234	2-Butanone	500	13	500	ug/L	UJ	CS
		2-Chlorotoluene	13	1.7	13	ug/L	UJ	S
		2-Hexanone	500	5.0	500	ug/L	UJ	S
		4-Chlorotoluene	13	1.7	13	ug/L	UJ	S
		Acetone	500	15	500	ug/L	UJ	S
		Benzene	110	1.4	13	ug/L	J	S
		Bromobenzene	13	2.1	13	ug/L	UJ	S
		Bromochloromethane	25	2.4	25	ug/L	UJ	S
		Bromodichloromethane	13	1.1	13	ug/L	UJ	S
		Bromoform	13	2.3	13	ug/L	UJ	S
		Bromomethane	13	4.8	13	ug/L	UJ	S
		Carbon Tetrachloride	13	1.8	13	ug/L	UJ	S
		Chlorobenzene	3970	24	500	ug/L	J	S
		Chloroethane	13	4.0	13	ug/L	UJ	S
		Chloroform	13	1.0	13	ug/L	UJ	S
		Chloromethane	13	1.5	13	ug/L	UJ	S
		Cis-1,2-Dichloroethene	19700	56	56	ug/L	J	S
		Dibromochloromethane	13	1.2	13	ug/L	UJ	S
		Dibromomethane	13	3.8	13	ug/L	UJ	S
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	S
		Ethylbenzene	13	3.0	13	ug/L	UJ	S
		Hexachlorobutadiene	25	3.0	25	ug/L	UJ	S
		Isopropylbenzene	13	1.2	13	ug/L	UJ	S
		M,P-Xylenes	16	4.3	25	ug/L	J	S
		Methyl Isobutyl Ketone	500	1.6	500	ug/L	UJ	S
		Methyl Tert-Butyl Ether	25	0.70	25	ug/L	UJ	S
		Methylene Chloride	51	2.4	25	ug/L	J	S
		Naphthalene	59	3.3	13	ug/L	J	S
		N-Butylbenzene	13	3.5	13	ug/L	UJ	S
		N-Propylbenzene	13	2.1	13	ug/L	UJ	S
		O-Xylene	11	2.8	13	ug/L	J	S
		P-Isopropyltoluene	13	0.88	13	ug/L	UJ	S
		Sec-Butylbenzene	13	0.88	13	ug/L	UJ	S
		Styrene	13	2.4	13	ug/L	UJ	S
		Tert-Butyl Alcohol (TBA)	500	190	500	ug/L	UJ	S
		Tert-Butylbenzene	13	1.5	13	ug/L	UJ	S
		Tetrachloroethene	5220	66	66	ug/L	J	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052765	IR25MW54A-1234	Toluene	20	1.0	13	ug/L	J	S
		Trans-1,2-Dichloroethene	97	1.7	1.7	ug/L	J	S
		Trichloroethene	807	2.0	2	ug/L	J	S
		Trichlorofluoromethane	13	1.4	13	ug/L	UJ	S
		Vinyl Chloride	5130	57	57	ug/L	J	S
	IR25MW56A-1252	1,1,1,2-Tetrachloroethane	2.5	0.22	2.5	ug/L	UJ	S
		1,1,1-Trichloroethane	2.5	0.18	2.5	ug/L	UJ	S
		1,1,2,2-Tetrachloroethane	2.5	0.60	2.5	ug/L	UJ	S
		1,1,2-Trichloroethane	2.5	0.13	2.5	ug/L	UJ	S
		1,1-Dichloroethane	2.5	0.16	2.5	ug/L	UJ	S
		1,1-Dichloroethene	0.18	0.18	0.18	ug/L	UJ	S
		1,1-Dichloropropene	2.5	0.38	2.5	ug/L	UJ	S
		1,2,3-Trichlorobenzene	2.5	0.85	2.5	ug/L	UJ	S
		1,2,3-Trichloropropane	2.5	1.3	2.5	ug/L	UJ	S
		1,2,4-Trichlorobenzene	2	0.40	2.5	ug/L	UJ	S
		1,2,4-Trimethylbenzene	2.5	0.22	2.5	ug/L	UJ	S
		1,2-Dibromo-3-Chloropropane	10	1.3	10	ug/L	UJ	S
		1,2-Dibromoethane	5	0.47	5	ug/L	UJ	S
		1,2-Dichlorobenzene	749	0.63	13	ug/L	J	S
		1,2-Dichloroethane	530	1.6	13	ug/L	J	S
		1,2-Dichloropropane	3	0.34	2.5	ug/L	J	S
		1,3,5-Trimethylbenzene	2.5	0.19	2.5	ug/L	UJ	S
		1,3-Dichlorobenzene	10	0.18	2.5	ug/L	J	S
		1,3-Dichloropropane	2.5	0.25	2.5	ug/L	UJ	S
		1,4-Dichlorobenzene	134	0.17	2.5	ug/L	J	S
		2,2-Dichloropropane	2.5	0.27	2.5	ug/L	UJ	S
		2-Butanone	100	2.6	100	ug/L	UJ	CS
		2-Chlorotoluene	2.5	0.33	2.5	ug/L	UJ	S
		2-Hexanone	100	1.0	100	ug/L	UJ	S
		4-Chlorotoluene	2.5	0.34	2.5	ug/L	UJ	S
		Acetone	100	2.9	100	ug/L	UJ	S
		Benzene	12	0.27	2.5	ug/L	J	S
		Bromobenzene	2.5	0.42	2.5	ug/L	UJ	S
		Bromochloromethane	5	0.49	5	ug/L	UJ	S
		Bromodichloromethane	2.5	0.21	2.5	ug/L	UJ	S
		Bromoform	2.5	0.46	2.5	ug/L	UJ	S
		Bromomethane	2.5	0.95	2.5	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052765	IR25MW56A-1252	Carbon Tetrachloride	2.5	0.35	2.5	ug/L	UJ	S
		Chlorobenzene	36	0.12	2.5	ug/L	J	S
		Chloroethane	2.5	0.80	2.5	ug/L	UJ	S
		Chloroform	2.5	0.20	2.5	ug/L	UJ	S
		Chloromethane	2.5	0.31	2.5	ug/L	UJ	S
		Cis-1,2-Dichloroethene	586	1.4	1.4	ug/L	J	S
		Dibromochloromethane	2.5	0.24	2.5	ug/L	UJ	S
		Dibromomethane	2.5	0.75	2.5	ug/L	UJ	S
		Dichlorodifluoromethane	2.5	0.33	2.5	ug/L	UJ	S
		Ethylbenzene	2.5	0.60	2.5	ug/L	UJ	S
		Hexachlorobutadiene	5	0.60	5	ug/L	UJ	S
		Isopropylbenzene	2.5	0.25	2.5	ug/L	UJ	S
		M,P-Xylenes	5	0.85	5	ug/L	UJ	S
		Methyl Isobutyl Ketone	100	0.33	100	ug/L	UJ	S
		Methyl Tert-Butyl Ether	5	0.14	5	ug/L	UJ	S
		Methylene Chloride	4	0.47	5	ug/L	J	S
		Naphthalene	2.5	0.65	2.5	ug/L	UJ	S
		N-Butylbenzene	2.5	0.70	2.5	ug/L	UJ	S
		N-Propylbenzene	2.5	0.42	2.5	ug/L	UJ	S
		O-Xylene	2.5	0.55	2.5	ug/L	UJ	S
		P-Isopropyltoluene	2.5	0.18	2.5	ug/L	UJ	S
		Sec-Butylbenzene	2.5	0.18	2.5	ug/L	UJ	S
		Styrene	2.5	0.49	2.5	ug/L	UJ	S
		Tert-Butyl Alcohol (TBA)	100	38	100	ug/L	UJ	S
		Tert-Butylbenzene	2.5	0.30	2.5	ug/L	UJ	S
		Tetrachloroethene	22.9	0.33	0.33	ug/L	J	S
		Toluene	1	0.20	2.5	ug/L	J	S
		Trans-1,2-Dichloroethene	25.9	0.34	0.34	ug/L	J	S
		Trichloroethene	27.1	0.40	0.4	ug/L	J	S
		Trichlorofluoromethane	2.5	0.29	2.5	ug/L	UJ	S
		Vinyl Chloride	212	0.29	0.29	ug/L	J	S
	TB4-1260	2-Butanone	20	0.51	20	ug/L	UJ	C
052778	IR25MW38B-1241	Dichlorodifluoromethane	0.5	0.065	0.5	ug/L	UJ	C
	IR25MW55A-1236	1,1,1,2-Tetrachloroethane	13	1.1	13	ug/L	UJ	S
		1,1,1-Trichloroethane	13	0.90	13	ug/L	UJ	S
		1,1,2,2-Tetrachloroethane	13	3.0	13	ug/L	UJ	S
		1,1,2-Trichloroethane	13	0.63	13	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	IR25MW55A-1236	1,1-Dichloroethane	13	0.78	13	ug/L	UJ	S
		1,1-Dichloroethene	19.3	0.90	0.9	ug/L	J	S
		1,1-Dichloropropene	13	1.9	13	ug/L	UJ	S
		1,2,3-Trichlorobenzene	13	4.3	13	ug/L	UJ	S
		1,2,3-Trichloropropane	13	6.5	13	ug/L	UJ	S
		1,2,4-Trichlorobenzene	13	2.0	13	ug/L	J	S
		1,2,4-Trimethylbenzene	8	1.1	13	ug/L	J	S
		1,2-Dibromo-3-Chloropropane	50	6.3	50	ug/L	UJ	S
		1,2-Dibromoethane	25	2.4	25	ug/L	UJ	S
		1,2-Dichlorobenzene	11100	25	500	ug/L	J	S
		1,2-Dichloroethane	43000	63	500	ug/L	J	S
		1,2-Dichloropropane	130	1.7	13	ug/L	J	S
		1,3,5-Trimethylbenzene	13	0.95	13	ug/L	UJ	S
		1,3-Dichlorobenzene	76	0.88	13	ug/L	J	S
		1,3-Dichloropropane	13	1.2	13	ug/L	UJ	S
		1,4-Dichlorobenzene	2250	34	500	ug/L	J	S
		2,2-Dichloropropane	13	1.4	13	ug/L	UJ	S
		2-Butanone	500	13	500	ug/L	UJ	CS
		2-Chlorotoluene	13	1.7	13	ug/L	UJ	S
		2-Hexanone	500	5.0	500	ug/L	UJ	S
		4-Chlorotoluene	13	1.7	13	ug/L	UJ	S
		Acetone	48	15	500	ug/L	J	S
		Benzene	150	1.4	13	ug/L	J	S
		Bromobenzene	13	2.1	13	ug/L	UJ	S
		Bromochloromethane	25	2.4	25	ug/L	UJ	S
		Bromodichloromethane	13	1.1	13	ug/L	UJ	S
		Bromoform	13	2.3	13	ug/L	UJ	S
		Bromomethane	13	4.8	13	ug/L	UJ	S
		Carbon Tetrachloride	13	1.8	13	ug/L	UJ	S
		Chlorobenzene	110	0.60	13	ug/L	J	S
		Chloroethane	13	4.0	13	ug/L	UJ	S
		Chloroform	13	1.0	13	ug/L	UJ	S
		Chloromethane	13	1.5	13	ug/L	UJ	S
		Cis-1,2-Dichloroethene	28900	56	56	ug/L	J	S
		Dibromochloromethane	13	1.2	13	ug/L	UJ	S
		Dibromomethane	13	3.8	13	ug/L	UJ	S
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	IR25MW55A-1236	Ethylbenzene	13	3.0	13	ug/L	UJ	S
		Hexachlorobutadiene	25	3.0	25	ug/L	UJ	S
		Isopropylbenzene	13	1.2	13	ug/L	UJ	S
		M,P-Xylenes	14	4.3	25	ug/L	J	S
		Methyl Isobutyl Ketone	8	1.6	500	ug/L	J	S
		Methyl Tert-Butyl Ether	25	0.70	25	ug/L	UJ	S
		Methylene Chloride	480	2.4	25	ug/L	J	S
		Naphthalene	32	3.3	13	ug/L	J	S
		N-Butylbenzene	13	3.5	13	ug/L	UJ	S
		N-Propylbenzene	13	2.1	13	ug/L	UJ	S
		O-Xylene	10	2.8	13	ug/L	J	S
		P-Isopropyltoluene	13	0.88	13	ug/L	UJ	S
		Sec-Butylbenzene	13	0.88	13	ug/L	UJ	S
		Styrene	13	2.4	13	ug/L	UJ	S
		Tert-Butyl Alcohol (TBA)	500	190	500	ug/L	UJ	S
		Tert-Butylbenzene	13	1.5	13	ug/L	UJ	S
		Tetrachloroethene	1810	66	66	ug/L	J	S
		Toluene	53	1.0	13	ug/L	J	S
		Trans-1,2-Dichloroethene	670	1.7	1.7	ug/L	J	S
		Trichloroethene	4470	80	80	ug/L	J	S
		Trichlorofluoromethane	13	1.4	13	ug/L	UJ	S
		Vinyl Chloride	3580	57	57	ug/L	J	S
	IR25MW57A-1253	1,1,1,2-Tetrachloroethane	13	1.1	13	ug/L	UJ	S
		1,1,1-Trichloroethane	13	0.90	13	ug/L	UJ	S
		1,1,2,2-Tetrachloroethane	13	3.0	13	ug/L	UJ	S
		1,1,2-Trichloroethane	13	0.63	13	ug/L	UJ	S
		1,1-Dichloroethane	13	0.78	13	ug/L	UJ	S
		1,1-Dichloroethene	0.9	0.90	0.9	ug/L	UJ	S
		1,1-Dichloropropene	13	1.9	13	ug/L	UJ	S
		1,2,3-Trichlorobenzene	13	4.3	13	ug/L	UJ	S
		1,2,3-Trichloropropane	13	6.5	13	ug/L	UJ	S
		1,2,4-Trichlorobenzene	13	2.0	13	ug/L	UJ	S
		1,2,4-Trimethylbenzene	13	1.1	13	ug/L	UJ	S
		1,2-Dibromo-3-Chloropropane	50	6.3	50	ug/L	UJ	S
		1,2-Dibromoethane	25	2.4	25	ug/L	UJ	S
		1,2-Dichlorobenzene	100	0.63	13	ug/L	J	S
		1,2-Dichloroethane	2120	6.3	50	ug/L	J	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	IR25MW57A-1253	1,2-Dichloropropane	13	1.7	13	ug/L	UJ	S
		1,3,5-Trimethylbenzene	13	0.95	13	ug/L	UJ	S
		1,3-Dichlorobenzene	13	0.88	13	ug/L	UJ	S
		1,3-Dichloropropane	13	1.2	13	ug/L	UJ	S
		1,4-Dichlorobenzene	20	0.85	13	ug/L	J	S
		2,2-Dichloropropane	13	1.4	13	ug/L	UJ	S
		2-Butanone	500	13	500	ug/L	UJ	CS
		2-Chlorotoluene	13	1.7	13	ug/L	UJ	S
		2-Hexanone	500	5.0	500	ug/L	UJ	S
		4-Chlorotoluene	13	1.7	13	ug/L	UJ	S
		Acetone	500	15	500	ug/L	UJ	S
		Benzene	11	1.4	13	ug/L	J	S
		Bromobenzene	13	2.1	13	ug/L	UJ	S
		Bromochloromethane	25	2.4	25	ug/L	UJ	S
		Bromodichloromethane	13	1.1	13	ug/L	UJ	S
		Bromoform	13	2.3	13	ug/L	UJ	S
		Bromomethane	13	4.8	13	ug/L	UJ	S
		Carbon Tetrachloride	13	1.8	13	ug/L	UJ	S
		Chlorobenzene	13	0.60	13	ug/L	UJ	S
		Chloroethane	13	4.0	13	ug/L	UJ	S
		Chloroform	13	1.0	13	ug/L	UJ	S
		Chloromethane	13	1.5	13	ug/L	UJ	S
		Cis-1,2-Dichloroethene	2280	5.6	5.6	ug/L	J	S
		Dibromochloromethane	13	1.2	13	ug/L	UJ	S
		Dibromomethane	13	3.8	13	ug/L	UJ	S
		Dichlorodifluoromethane	13	1.6	13	ug/L	UJ	S
		Ethylbenzene	13	3.0	13	ug/L	UJ	S
		Hexachlorobutadiene	25	3.0	25	ug/L	UJ	S
		Isopropylbenzene	13	1.2	13	ug/L	UJ	S
		M,P-Xylenes	25	4.3	25	ug/L	UJ	S
		Methyl Isobutyl Ketone	500	1.6	500	ug/L	UJ	S
		Methyl Tert-Butyl Ether	25	0.70	25	ug/L	UJ	S
		Methylene Chloride	11	2.4	25	ug/L	J	S
		Naphthalene	13	3.3	13	ug/L	UJ	S
		N-Butylbenzene	13	3.5	13	ug/L	UJ	S
		N-Propylbenzene	13	2.1	13	ug/L	UJ	S
		O-Xylene	13	2.8	13	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	IR25MW57A-1253	P-Isopropyltoluene	13	0.88	13	ug/L	UJ	S
		Sec-Butylbenzene	13	0.88	13	ug/L	UJ	S
		Styrene	13	2.4	13	ug/L	UJ	S
		Tert-Butyl Alcohol (TBA)	500	190	500	ug/L	UJ	S
		Tert-Butylbenzene	13	1.5	13	ug/L	UJ	S
		Tetrachloroethene	82	1.7	1.7	ug/L	J	S
		Toluene	13	1.0	13	ug/L	UJ	S
		Trans-1,2-Dichloroethene	135	1.7	1.7	ug/L	J	S
		Trichloroethene	316	2.0	2	ug/L	J	S
		Trichlorofluoromethane	13	1.4	13	ug/L	UJ	S
		Vinyl Chloride	80	1.4	1.4	ug/L	J	S
	IR25MW904B-1250	1,1,1,2-Tetrachloroethane	0.5	0.044	0.5	ug/L	UJ	S
		1,1,1-Trichloroethane	0.5	0.036	0.5	ug/L	UJ	S
		1,1,2,2-Tetrachloroethane	0.5	0.12	0.5	ug/L	UJ	S
		1,1,2-Trichloroethane	0.5	0.025	0.5	ug/L	UJ	S
		1,1-Dichloroethane	0.5	0.031	0.5	ug/L	UJ	S
		1,1-Dichloroethene	1.06	0.036	0.036	ug/L	J	S
		1,1-Dichloropropene	0.5	0.076	0.5	ug/L	UJ	S
		1,2,3-Trichlorobenzene	0.5	0.17	0.5	ug/L	UJ	S
		1,2,3-Trichloropropane	0.5	0.26	0.5	ug/L	UJ	S
		1,2,4-Trichlorobenzene	0.5	0.079	0.5	ug/L	UJ	S
		1,2,4-Trimethylbenzene	0.5	0.044	0.5	ug/L	UJ	S
		1,2-Dibromo-3-Chloropropane	2	0.25	2	ug/L	UJ	S
		1,2-Dibromoethane	1	0.094	1	ug/L	UJ	S
		1,2-Dichlorobenzene	14.3	0.025	0.5	ug/L	J	S
		1,2-Dichloroethane	807	1.6	13	ug/L	J	S
		1,2-Dichloropropane	1.9	0.067	0.5	ug/L	J	S
		1,3,5-Trimethylbenzene	0.5	0.038	0.5	ug/L	UJ	S
		1,3-Dichlorobenzene	0.5	0.035	0.5	ug/L	J	S
		1,3-Dichloropropane	0.5	0.049	0.5	ug/L	UJ	S
		1,4-Dichlorobenzene	3.2	0.034	0.5	ug/L	J	S
		2,2-Dichloropropane	0.5	0.054	0.5	ug/L	UJ	S
		2-Butanone	20	0.51	20	ug/L	UJ	CS
		2-Chlorotoluene	0.5	0.066	0.5	ug/L	UJ	S
		2-Hexanone	20	0.20	20	ug/L	UJ	S
		4-Chlorotoluene	0.5	0.068	0.5	ug/L	UJ	S
		Acetone	20	0.58	20	ug/L	UJ	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	IR25MW904B-1250	Benzene	3.3	0.054	0.5	ug/L	J	S
		Bromobenzene	0.5	0.083	0.5	ug/L	UJ	S
		Bromochloromethane	1	0.097	1	ug/L	UJ	S
		Bromodichloromethane	0.5	0.042	0.5	ug/L	UJ	S
		Bromoform	0.5	0.092	0.5	ug/L	UJ	S
		Bromomethane	0.5	0.19	0.5	ug/L	UJ	S
		Carbon Tetrachloride	0.5	0.070	0.5	ug/L	UJ	S
		Chlorobenzene	1.8	0.024	0.5	ug/L	J	S
		Chloroethane	0.5	0.16	0.5	ug/L	UJ	S
		Chloroform	0.5	0.040	0.5	ug/L	UJ	S
		Chloromethane	0.5	0.061	0.5	ug/L	UJ	S
		Cis-1,2-Dichloroethene	845	1.4	1.4	ug/L	J	S
		Dibromochloromethane	0.5	0.047	0.5	ug/L	UJ	S
		Dibromomethane	0.5	0.15	0.5	ug/L	UJ	S
		Dichlorodifluoromethane	0.5	0.065	0.5	ug/L	UJ	S
		Ethylbenzene	0.5	0.12	0.5	ug/L	UJ	S
		Hexachlorobutadiene	1	0.12	1	ug/L	UJ	S
		Isopropylbenzene	0.5	0.049	0.5	ug/L	UJ	S
		M,P-Xylenes	1	0.17	1	ug/L	UJ	S
		Methyl Isobutyl Ketone	20	0.065	20	ug/L	UJ	S
		Methyl Tert-Butyl Ether	1	0.028	1	ug/L	UJ	S
		Methylene Chloride	1	0.094	1	ug/L	UJ	S
		Naphthalene	0.5	0.13	0.5	ug/L	UJ	S
		N-Butylbenzene	0.5	0.14	0.5	ug/L	UJ	S
		N-Propylbenzene	0.5	0.083	0.5	ug/L	UJ	S
		O-Xylene	0.5	0.11	0.5	ug/L	UJ	S
		P-Isopropyltoluene	0.5	0.035	0.5	ug/L	UJ	S
		Sec-Butylbenzene	0.5	0.035	0.5	ug/L	UJ	S
		Styrene	0.5	0.097	0.5	ug/L	UJ	S
		Tert-Butyl Alcohol (TBA)	20	7.5	20	ug/L	UJ	S
		Tert-Butylbenzene	0.5	0.059	0.5	ug/L	UJ	S
		Tetrachloroethene	29.7	0.066	0.066	ug/L	J	S
		Toluene	0.5	0.040	0.5	ug/L	UJ	S
		Trans-1,2-Dichloroethene	48.5	0.067	0.067	ug/L	J	S
		Trichloroethene	103	0.080	0.08	ug/L	J	S
		Trichlorofluoromethane	0.5	0.057	0.5	ug/L	UJ	S
		Vinyl Chloride	27.3	0.057	0.057	ug/L	J	S

Table 1
Qualified Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Parameter	Result	MDL	RL	Units	Qualifier	Reason Code
052778	TB5-1261	Dichlorodifluoromethane	0.5	0.065	0.5	ug/L	UJ	C
052856	IR25IW02A-BH-1270	Acetone	21	2.7	21	ug/kg	UJ	C
		Methylene Chloride	3	0.84	5.2	ug/kg	U	B
	IR25MW53A-BH-1272	Acetone	25	4.3	33	ug/kg	UJ	C
		Methylene Chloride	4	1.3	8.3	ug/kg	U	B
	IR25MW53A-BH-1274	Acetone	17	3.4	26	ug/kg	UJ	C
		Methylene Chloride	3	1.0	6.5	ug/kg	U	B
	IR25MW54A-BH-1271	Methylene Chloride	160	93	580	ug/kg	U	B
	IR25MW55A-BH-1273	Methylene Chloride	310	98	610	ug/kg	U	B

General:
ND - Non Detect
MDL - Method Detection Limit
RL - Practical Quantitation Limit
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
mg/L - milligrams per liter
µg/L - micrograms per liter

Reason Codes:
A - ICP Serial Dilution
B - Laboratory Blank Contamination
C - The continuing calibration statistic outside acceptance criteria
D1 - RPD between LCS/LCSD results control limit
H - Holding time violation
M - Compound recovered outside the matrix spike/spike duplicate acceptance criteria
S - Surrogate recovery outside control limit

Qualifiers:
J - Estimated value.
U - Not detected at or above the specified reporting limit.
UJ - Not detected at or above the specified reporting limit. The reporting limit is an estimate.

Table 2
Rejected Data
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Sample ID	Lab Method	Date Sampled	Compound	Result	Qualfier	Reason	Units	MDL
43068	IR25IW02A-1043	E300.0	05/24/04	Nitrate As N	0.8	R	H	mg/L	0.14

Reason Codes:
H - Holding time violation

General:
mg/L - milligrams per liter

Qualifiers:
R - Results are unusable due to deficiencies in the ability to analyze the sample and meet analytical QC criteria

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
METALS									
042224	IR25MW37B	3/24/2004	Cadmium	IR25MW37B-1008	0.3 B	IR25MW37B-1023	0.2 B	ug/L	NC
	IR25MW37B	3/24/2004	Mercury	IR25MW37B-1008	0.077 B	IR25MW37B-1023	0.11 B	ug/L	NC
042248	IR25MW900B	3/25/2004	Arsenic	IR25MW900B-1016	15.7 B	IR25MW900B-1025	50 U	ug/L	NC
	IR25MW900B	3/25/2004	Manganese	IR25MW900B-1016	4700	IR25MW900B-1025	4720	ug/L	0
	IR25MW900B	3/25/2004	Mercury	IR25MW900B-1016	0.027 B	IR25MW900B-1025	0.033 B	ug/L	NC
045693	IR06MW44A	12/7/2004	Manganese	IR06MW44A-1135	290	IR06MW44A-1153	272	ug/L	6
	IR06MW44A	12/7/2004	Mercury	IR06MW44A-1135	0.2 U	IR06MW44A-1153	0.97	ug/L	NC
045738	IR25MW902B	12/6/2004	Chromium	IR25MW902B-1149	6.2 B	IR25MW902B-1152	6.4 B	ug/L	NC
	IR25MW902B	12/6/2004	Manganese	IR25MW902B-1149	8420	IR25MW902B-1152	8120	ug/L	4
045762	IR25MW51A	12/6/2004	Chromium	IR25MW51A-1145	3.1 B	IR25MW51A-1154	3.5 B	ug/L	NC
	IR25MW51A	12/6/2004	Manganese	IR25MW51A-1145	1380	IR25MW51A-1154	1380	ug/L	0
052688	IR25MW42B	5/11/2005	Chromium	IR25MW42B-1242	4.1 B	IR25MW42B-1255	4 B	ug/L	NC
	IR25MW42B	5/11/2005	Manganese	IR25MW42B-1242	1930	IR25MW42B-1255	1830	ug/L	5
	IR25MW42B	5/11/2005	Mercury	IR25MW42B-1242	0.56	IR25MW42B-1255	0.31	ug/L	57
052714	IR25MW37B	5/11/2005	Chromium	IR25MW37B-1240	1 B	IR25MW37B-1256	1.5 B	ug/L	NC
	IR25MW37B	5/11/2005	Manganese	IR25MW37B-1240	0.6 B	IR25MW37B-1256	2.8 B	ug/L	NC
	IR25MW37B	5/11/2005	Mercury	IR25MW37B-1240	0.76	IR25MW37B-1256	1.4	ug/L	59
052742	IR25MW900B	5/11/2005	Chromium	IR25MW900B-1248	5.2 B	IR25MW900B-1254	5 B	ug/L	NC
	IR25MW900B	5/11/2005	Manganese	IR25MW900B-1248	4430	IR25MW900B-1254	4360	ug/L	2
	IR25MW900B	5/11/2005	Mercury	IR25MW900B-1248	0.26	IR25MW900B-1254	0.1 U	ug/L	NC
PCBS									
042224	IR25MW37B	3/24/2004	Aroclor-1260	IR25MW37B-1008	0.02 J	IR25MW37B-1023	0.02 J	ug/L	NC
043068	IR25MW53A	5/24/2004	Aroclor-1260	IR25MW53A-1044	0.06 J	IR25MW53A-1045	0.07 J	ug/L	NC
045693	IR06MW44A	12/7/2004	Aroclor-1260	IR06MW44A-1135	0.5 J	IR06MW44A-1153	0.5 J	ug/L	NC
045738	IR25MW902B	12/6/2004	Aroclor-1260	IR25MW902B-1149	0.02 J	IR25MW902B-1152	0.96 U	ug/L	NC
045762	IR25MW51A	12/6/2004	Aroclor-1016	IR25MW51A-1145	0.07 J	IR25MW51A-1154	0.1 J	ug/L	NC
	IR25MW51A	12/6/2004	Aroclor-1260	IR25MW51A-1145	0.96 U	IR25MW51A-1154	0.02 J	ug/L	NC
SEMIVOLATILES									
042224	IR25MW37B	3/24/2004	1,2-Dichlorobenzene	IR25MW37B-1008	9.6 U	IR25MW37B-1023	7 J	ug/L	NC
	IR25MW37B	3/24/2004	1,4-Dichlorobenzene	IR25MW37B-1008	9.6 U	IR25MW37B-1023	2 J	ug/L	NC

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
042224	IR25MW37B	3/24/2004	Butyl Benzyl Phthalate	IR25MW37B-1008	9.6 U	IR25MW37B-1023	4 J	ug/L	NC
042248	IR25MW900B	3/25/2004	1,2,4-Trichlorobenzene	IR25MW900B-1016	2 J	IR25MW900B-1025	2 J	ug/L	NC
	IR25MW900B	3/25/2004	1,2-Dichlorobenzene	IR25MW900B-1016	684	IR25MW900B-1025	685	ug/L	0
	IR25MW900B	3/25/2004	1,3-Dichlorobenzene	IR25MW900B-1016	8 J	IR25MW900B-1025	10 J	ug/L	NC
	IR25MW900B	3/25/2004	1,4-Dichlorobenzene	IR25MW900B-1016	91 J	IR25MW900B-1025	95 J	ug/L	NC
	IR25MW900B	3/25/2004	Acenaphthene	IR25MW900B-1016	0.6 J	IR25MW900B-1025	9.6 U	ug/L	NC
	IR25MW900B	3/25/2004	Naphthalene	IR25MW900B-1016	2 J	IR25MW900B-1025	2 J	ug/L	NC
045738	IR25MW902B	12/6/2004	1,2,4-Trichlorobenzene	IR25MW902B-1149	36 J	IR25MW902B-1152	33 J	ug/L	NC
	IR25MW902B	12/6/2004	1,2-Dichlorobenzene	IR25MW902B-1149	15200	IR25MW902B-1152	20500	ug/L	30
	IR25MW902B	12/6/2004	1,4-Dichlorobenzene	IR25MW902B-1149	3390	IR25MW902B-1152	4180	ug/L	21
	IR25MW902B	12/6/2004	2,4-Dimethylphenol	IR25MW902B-1149	7990	IR25MW902B-1152	8560	ug/L	7
	IR25MW902B	12/6/2004	2-Methylnaphthalene	IR25MW902B-1149	66 J	IR25MW902B-1152	65 J	ug/L	NC
	IR25MW902B	12/6/2004	4-Methylphenol	IR25MW902B-1149	3790	IR25MW902B-1152	5320	ug/L	34
	IR25MW902B	12/6/2004	Dibenzofuran	IR25MW902B-1149	9 J	IR25MW902B-1152	11 J	ug/L	NC
	IR25MW902B	12/6/2004	Naphthalene	IR25MW902B-1149	99 J	IR25MW902B-1152	96 J	ug/L	NC
	IR25MW902B	12/6/2004	Phenol	IR25MW902B-1149	930	IR25MW902B-1152	770 J	ug/L	NC
045762	IR25MW51A	12/6/2004	1,2-Dichlorobenzene	IR25MW51A-1145	1 J	IR25MW51A-1154	9.6 U	ug/L	NC
	IR25MW51A	12/6/2004	Di-N-Butyl Phthalate	IR25MW51A-1145	9.6 U	IR25MW51A-1154	1 J	ug/L	NC
051222	IR25MW53A	1/18/2005	1,2-Dichlorobenzene	IR25MW53A-1169	58	IR25MW53A-1170	68	ug/L	16
	IR25MW53A	1/18/2005	1,4-Dichlorobenzene	IR25MW53A-1169	27	IR25MW53A-1170	30	ug/L	11
	IR25MW53A	1/18/2005	2,4-Dimethylphenol	IR25MW53A-1169	6 J	IR25MW53A-1170	6 J	ug/L	NC
	IR25MW53A	1/18/2005	2-Chlorophenol	IR25MW53A-1169	1 J	IR25MW53A-1170	2 J	ug/L	NC
	IR25MW53A	1/18/2005	Naphthalene	IR25MW53A-1169	2 J	IR25MW53A-1170	2 J	ug/L	NC
051782	IR25MW53A	3/1/2005	1,2-Dichlorobenzene	IR25MW53A-1195	51	IR25MW53A-1196	50	ug/L	2
	IR25MW53A	3/1/2005	1,4-Dichlorobenzene	IR25MW53A-1195	33	IR25MW53A-1196	33	ug/L	0
	IR25MW53A	3/1/2005	Acenaphthene	IR25MW53A-1195	3 J	IR25MW53A-1196	3 J	ug/L	NC
	IR25MW53A	3/1/2005	Benzoic Acid	IR25MW53A-1195	48 J	IR25MW53A-1196	48 J	ug/L	0
	IR25MW53A	3/1/2005	Di-N-Butyl Phthalate	IR25MW53A-1195	4 J	IR25MW53A-1196	9.6 U	ug/L	NC
052096	IR25MW53A	3/29/2005	1,2-Dichlorobenzene	IR25MW53A-1208	62	IR25MW53A-1209	59	ug/L	5
	IR25MW53A	3/29/2005	1,3-Dichlorobenzene	IR25MW53A-1208	2 J	IR25MW53A-1209	2 J	ug/L	NC
	IR25MW53A	3/29/2005	1,4-Dichlorobenzene	IR25MW53A-1208	34	IR25MW53A-1209	34	ug/L	0

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
052480	IR25MW54A	4/26/2005	1,2-Dichlorobenzene	IR25MW54A-1222	3900	IR25MW54A-1223	4440	ug/L	13
	IR25MW54A	4/26/2005	1,3-Dichlorobenzene	IR25MW54A-1222	31 J	IR25MW54A-1223	35 J	ug/L	NC
	IR25MW54A	4/26/2005	1,4-Dichlorobenzene	IR25MW54A-1222	270	IR25MW54A-1223	530	ug/L	65
	IR25MW54A	4/26/2005	2,4-Dimethylphenol	IR25MW54A-1222	770	IR25MW54A-1223	1100	ug/L	35
	IR25MW54A	4/26/2005	Naphthalene	IR25MW54A-1222	25 J	IR25MW54A-1223	30 J	ug/L	NC
	IR25MW54A	4/26/2005	Phenol	IR25MW54A-1222	31 J	IR25MW54A-1223	44 J	ug/L	NC
052742	IR25MW900B	5/11/2005	1,2-Dichlorobenzene	IR25MW900B-1248	3 J	IR25MW900B-1254	10	ug/L	NC
	IR25MW900B	5/11/2005	1,3-Dichlorobenzene	IR25MW900B-1248	5 J	IR25MW900B-1254	4 J	ug/L	NC
	IR25MW900B	5/11/2005	1,4-Dichlorobenzene	IR25MW900B-1248	2 J	IR25MW900B-1254	3 J	ug/L	NC
VOLATILES									
042224	IR25MW37B	3/24/2004	1,2-Dichlorobenzene	IR25MW37B-1008	0.3 J	IR25MW37B-1023	0.5	ug/L	NC
	IR25MW37B	3/24/2004	Methylene Chloride	IR25MW37B-1008	2.4 B	IR25MW37B-1023	3.6 B	ug/L	40
042248	IR25MW900B	3/25/2004	1,2-Dichlorobenzene	IR25MW900B-1016	1250	IR25MW900B-1025	1310	ug/L	5
	IR25MW900B	3/25/2004	1,2-Dichloroethane	IR25MW900B-1016	150	IR25MW900B-1025	160	ug/L	6
	IR25MW900B	3/25/2004	1,3-Dichlorobenzene	IR25MW900B-1016	12 J	IR25MW900B-1025	12 J	ug/L	NC
	IR25MW900B	3/25/2004	1,4-Dichlorobenzene	IR25MW900B-1016	230	IR25MW900B-1025	250	ug/L	8
	IR25MW900B	3/25/2004	Chlorobenzene	IR25MW900B-1016	12 J	IR25MW900B-1025	10	ug/L	NC
	IR25MW900B	3/25/2004	Cis-1,2-Dichloroethene	IR25MW900B-1016	1010	IR25MW900B-1025	1180	ug/L	16
	IR25MW900B	3/25/2004	Methylene Chloride	IR25MW900B-1016	73	IR25MW900B-1025	72	ug/L	1
	IR25MW900B	3/25/2004	Trans-1,2-Dichloroethene	IR25MW900B-1016	130	IR25MW900B-1025	150	ug/L	14
	IR25MW900B	3/25/2004	Vinyl Chloride	IR25MW900B-1016	250	IR25MW900B-1025	301	ug/L	19
043068	IR25MW53A	5/24/2004	1,2-Dichlorobenzene	IR25MW53A-1044	3110	IR25MW53A-1045	3140	ug/L	1
	IR25MW53A	5/24/2004	1,2-Dichloroethane	IR25MW53A-1044	380	IR25MW53A-1045	380	ug/L	0
	IR25MW53A	5/24/2004	1,3-Dichlorobenzene	IR25MW53A-1044	35 J	IR25MW53A-1045	36 J	ug/L	NC
	IR25MW53A	5/24/2004	1,4-Dichlorobenzene	IR25MW53A-1044	960	IR25MW53A-1045	950	ug/L	1
	IR25MW53A	5/24/2004	Chlorobenzene	IR25MW53A-1044	1310	IR25MW53A-1045	1310	ug/L	0
	IR25MW53A	5/24/2004	Cis-1,2-Dichloroethene	IR25MW53A-1044	1780	IR25MW53A-1045	1760	ug/L	1
	IR25MW53A	5/24/2004	Trans-1,2-Dichloroethene	IR25MW53A-1044	150	IR25MW53A-1045	150	ug/L	0
	IR25MW53A	5/24/2004	Vinyl Chloride	IR25MW53A-1044	3930	IR25MW53A-1045	3990	ug/L	2
043242	IR25MW54A	6/8/2004	1,2-Dichlorobenzene	IR25MW54A-1052	19000	IR25MW54A-1053	18000	ug/L	5
	IR25MW54A	6/8/2004	1,2-Dichloroethane	IR25MW54A-1052	23600	IR25MW54A-1053	21100	ug/L	11

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
043242	IR25MW54A	6/8/2004	1,4-Dichlorobenzene	IR25MW54A-1052	5600	IR25MW54A-1053	5700	ug/L	2
	IR25MW54A	6/8/2004	2-Hexanone	IR25MW54A-1052	1200 J	IR25MW54A-1053	1100 J	ug/L	NC
	IR25MW54A	6/8/2004	Cis-1,2-Dichloroethene	IR25MW54A-1052	50500	IR25MW54A-1053	50200	ug/L	1
	IR25MW54A	6/8/2004	Vinyl Chloride	IR25MW54A-1052	4600	IR25MW54A-1053	5300	ug/L	14
043657	IR25MW53A	7/12/2004	1,2,4-Trimethylbenzene	IR25MW53A-1065	4 J	IR25MW53A-1066	3 J	ug/L	NC
	IR25MW53A	7/12/2004	1,2-Dichlorobenzene	IR25MW53A-1065	288	IR25MW53A-1066	287	ug/L	0
	IR25MW53A	7/12/2004	1,2-Dichloroethane	IR25MW53A-1065	68	IR25MW53A-1066	69	ug/L	1
	IR25MW53A	7/12/2004	1,3-Dichlorobenzene	IR25MW53A-1065	11	IR25MW53A-1066	11	ug/L	0
	IR25MW53A	7/12/2004	1,4-Dichlorobenzene	IR25MW53A-1065	818	IR25MW53A-1066	861	ug/L	5
	IR25MW53A	7/12/2004	Benzene	IR25MW53A-1065	24	IR25MW53A-1066	24	ug/L	0
	IR25MW53A	7/12/2004	Chlorobenzene	IR25MW53A-1065	4120	IR25MW53A-1066	4320	ug/L	5
	IR25MW53A	7/12/2004	Cis-1,2-Dichloroethene	IR25MW53A-1065	37	IR25MW53A-1066	5 U	ug/L	NC
	IR25MW53A	7/12/2004	M,P-Xylenes	IR25MW53A-1065	4 J	IR25MW53A-1066	4 J	ug/L	NC
	IR25MW53A	7/12/2004	Naphthalene	IR25MW53A-1065	12	IR25MW53A-1066	12	ug/L	0
	IR25MW53A	7/12/2004	Trans-1,2-Dichloroethene	IR25MW53A-1065	26	IR25MW53A-1066	26	ug/L	0
	IR25MW53A	7/12/2004	Vinyl Chloride	IR25MW53A-1065	15	IR25MW53A-1066	5 U	ug/L	NC
044005	IR25MW53A	8/9/2004	1,2-Dichlorobenzene	IR25MW53A-1078	59	IR25MW53A-1079	58	ug/L	2
	IR25MW53A	8/9/2004	1,2-Dichloroethane	IR25MW53A-1078	22	IR25MW53A-1079	24	ug/L	9
	IR25MW53A	8/9/2004	1,4-Dichlorobenzene	IR25MW53A-1078	430	IR25MW53A-1079	438	ug/L	2
	IR25MW53A	8/9/2004	Benzene	IR25MW53A-1078	28	IR25MW53A-1079	28	ug/L	0
	IR25MW53A	8/9/2004	Chlorobenzene	IR25MW53A-1078	3620	IR25MW53A-1079	3820	ug/L	5
	IR25MW53A	8/9/2004	Cis-1,2-Dichloroethene	IR25MW53A-1078	15	IR25MW53A-1079	14	ug/L	7
	IR25MW53A	8/9/2004	M,P-Xylenes	IR25MW53A-1078	3 J	IR25MW53A-1079	10 U	ug/L	NC
	IR25MW53A	8/9/2004	Naphthalene	IR25MW53A-1078	11	IR25MW53A-1079	12	ug/L	9
	IR25MW53A	8/9/2004	Toluene	IR25MW53A-1078	3 J	IR25MW53A-1079	5 U	ug/L	NC
	IR25MW53A	8/9/2004	Trans-1,2-Dichloroethene	IR25MW53A-1078	11	IR25MW53A-1079	10	ug/L	10
	IR25MW53A	8/9/2004	Vinyl Chloride	IR25MW53A-1078	7	IR25MW53A-1079	7	ug/L	0
044402	IR25MW56A	9/8/2004	1,2,4-Trimethylbenzene	IR25MW56A-1093	3 J	IR25MW56A-1094	3 J	ug/L	NC
	IR25MW56A	9/8/2004	1,2-Dichlorobenzene	IR25MW56A-1093	2430	IR25MW56A-1094	2440	ug/L	0
	IR25MW56A	9/8/2004	1,2-Dichloroethane	IR25MW56A-1093	784	IR25MW56A-1094	806	ug/L	3
	IR25MW56A	9/8/2004	1,2-Dichloropropane	IR25MW56A-1093	3 J	IR25MW56A-1094	3 J	ug/L	NC

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
044402	IR25MW56A	9/8/2004	1,3-Dichlorobenzene	IR25MW56A-1093	18	IR25MW56A-1094	19	ug/L	5
	IR25MW56A	9/8/2004	1,4-Dichlorobenzene	IR25MW56A-1093	478	IR25MW56A-1094	499	ug/L	4
	IR25MW56A	9/8/2004	Benzene	IR25MW56A-1093	8	IR25MW56A-1094	8	ug/L	0
	IR25MW56A	9/8/2004	Chlorobenzene	IR25MW56A-1093	18	IR25MW56A-1094	17	ug/L	6
	IR25MW56A	9/8/2004	Cis-1,2-Dichloroethene	IR25MW56A-1093	1390	IR25MW56A-1094	1360	ug/L	2
	IR25MW56A	9/8/2004	Naphthalene	IR25MW56A-1093	5 J	IR25MW56A-1094	6 J	ug/L	18
	IR25MW56A	9/8/2004	Trans-1,2-Dichloroethene	IR25MW56A-1093	19.7	IR25MW56A-1094	21.2	ug/L	7
	IR25MW56A	9/8/2004	Vinyl Chloride	IR25MW56A-1093	853	IR25MW56A-1094	818	ug/L	4
044797	IR25MW56A	10/5/2004	1,2,4-Trichlorobenzene	IR25MW56A-1106	8	IR25MW56A-1107	7	ug/L	13
	IR25MW56A	10/5/2004	1,2-Dichlorobenzene	IR25MW56A-1106	2810	IR25MW56A-1107	2870	ug/L	2
	IR25MW56A	10/5/2004	1,2-Dichloroethane	IR25MW56A-1106	1120	IR25MW56A-1107	1140	ug/L	2
	IR25MW56A	10/5/2004	1,2-Dichloropropane	IR25MW56A-1106	5 J	IR25MW56A-1107	5 J	ug/L	0
	IR25MW56A	10/5/2004	1,3-Dichlorobenzene	IR25MW56A-1106	24	IR25MW56A-1107	24	ug/L	0
	IR25MW56A	10/5/2004	1,4-Dichlorobenzene	IR25MW56A-1106	684	IR25MW56A-1107	598	ug/L	13
	IR25MW56A	10/5/2004	Benzene	IR25MW56A-1106	13	IR25MW56A-1107	13	ug/L	0
	IR25MW56A	10/5/2004	Chlorobenzene	IR25MW56A-1106	26	IR25MW56A-1107	26	ug/L	0
	IR25MW56A	10/5/2004	Cis-1,2-Dichloroethene	IR25MW56A-1106	1620	IR25MW56A-1107	1640	ug/L	1
	IR25MW56A	10/5/2004	Trans-1,2-Dichloroethene	IR25MW56A-1106	29	IR25MW56A-1107	31.1	ug/L	7
	IR25MW56A	10/5/2004	Vinyl Chloride	IR25MW56A-1106	1560	IR25MW56A-1107	1570	ug/L	1
045286	IR25IW02A	11/3/2004	1,2,4-Trimethylbenzene	IR25IW02A-1116	4 J	IR25IW02A-1117	4 J	ug/L	NC
	IR25IW02A	11/3/2004	1,2-Dichlorobenzene	IR25IW02A-1116	138	IR25IW02A-1117	133	ug/L	4
	IR25IW02A	11/3/2004	1,3-Dichlorobenzene	IR25IW02A-1116	9	IR25IW02A-1117	9	ug/L	0
	IR25IW02A	11/3/2004	1,4-Dichlorobenzene	IR25IW02A-1116	225	IR25IW02A-1117	209	ug/L	7
	IR25IW02A	11/3/2004	Benzene	IR25IW02A-1116	37	IR25IW02A-1117	36	ug/L	3
	IR25IW02A	11/3/2004	Chlorobenzene	IR25IW02A-1116	4890	IR25IW02A-1117	4810	ug/L	2
	IR25IW02A	11/3/2004	M,P-Xylenes	IR25IW02A-1116	3 J	IR25IW02A-1117	3 J	ug/L	NC
	IR25IW02A	11/3/2004	Naphthalene	IR25IW02A-1116	12	IR25IW02A-1117	11	ug/L	9
	IR25IW02A	11/3/2004	Vinyl Chloride	IR25IW02A-1116	6.7	IR25IW02A-1117	5.6	ug/L	18
045738	IR25MW902B	12/6/2004	1,1-Dichloroethene	IR25MW902B-1149	116	IR25MW902B-1152	112	ug/L	4
	IR25MW902B	12/6/2004	1,2,4-Trichlorobenzene	IR25MW902B-1149	50	IR25MW902B-1152	50	ug/L	0
	IR25MW902B	12/6/2004	1,2,4-Trimethylbenzene	IR25MW902B-1149	30	IR25MW902B-1152	30	ug/L	0

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
045738	IR25MW902B	12/6/2004	1,2-Dichlorobenzene	IR25MW902B-1149	46200	IR25MW902B-1152	38900	ug/L	17
	IR25MW902B	12/6/2004	1,2-Dichloroethane	IR25MW902B-1149	85800	IR25MW902B-1152	74600	ug/L	14
	IR25MW902B	12/6/2004	1,2-Dichloropropane	IR25MW902B-1149	230	IR25MW902B-1152	230	ug/L	0
	IR25MW902B	12/6/2004	1,3-Dichlorobenzene	IR25MW902B-1149	230	IR25MW902B-1152	240	ug/L	4
	IR25MW902B	12/6/2004	1,4-Dichlorobenzene	IR25MW902B-1149	10600	IR25MW902B-1152	9180	ug/L	14
	IR25MW902B	12/6/2004	Benzene	IR25MW902B-1149	793	IR25MW902B-1152	770	ug/L	3
	IR25MW902B	12/6/2004	Chlorobenzene	IR25MW902B-1149	340	IR25MW902B-1152	330	ug/L	3
	IR25MW902B	12/6/2004	Cis-1,2-Dichloroethene	IR25MW902B-1149	48500	IR25MW902B-1152	41500	ug/L	16
	IR25MW902B	12/6/2004	M,P-Xylenes	IR25MW902B-1149	41 J	IR25MW902B-1152	43 J	ug/L	NC
	IR25MW902B	12/6/2004	Methylene Chloride	IR25MW902B-1149	50 U	IR25MW902B-1152	110	ug/L	NC
	IR25MW902B	12/6/2004	O-Xylene	IR25MW902B-1149	25 J	IR25MW902B-1152	30	ug/L	18
	IR25MW902B	12/6/2004	Toluene	IR25MW902B-1149	52	IR25MW902B-1152	50	ug/L	4
	IR25MW902B	12/6/2004	Trans-1,2-Dichloroethene	IR25MW902B-1149	2560	IR25MW902B-1152	2520	ug/L	2
	IR25MW902B	12/6/2004	Vinyl Chloride	IR25MW902B-1149	30300	IR25MW902B-1152	26000	ug/L	15
051222	IR25MW53A	1/18/2005	1,2-Dichlorobenzene	IR25MW53A-1169	81	IR25MW53A-1170	85	ug/L	5
	IR25MW53A	1/18/2005	1,2-Dichloroethane	IR25MW53A-1169	58	IR25MW53A-1170	62	ug/L	7
	IR25MW53A	1/18/2005	1,4-Dichlorobenzene	IR25MW53A-1169	55	IR25MW53A-1170	56	ug/L	2
	IR25MW53A	1/18/2005	Benzene	IR25MW53A-1169	11	IR25MW53A-1170	11	ug/L	0
	IR25MW53A	1/18/2005	Chlorobenzene	IR25MW53A-1169	976	IR25MW53A-1170	991	ug/L	2
	IR25MW53A	1/18/2005	Cis-1,2-Dichloroethene	IR25MW53A-1169	43	IR25MW53A-1170	43.5	ug/L	1
	IR25MW53A	1/18/2005	Trans-1,2-Dichloroethene	IR25MW53A-1169	11.9	IR25MW53A-1170	12.5	ug/L	5
	IR25MW53A	1/18/2005	Vinyl Chloride	IR25MW53A-1169	13	IR25MW53A-1170	15	ug/L	14
051398	IR25MW56A	2/1/2005	1,2-Dichlorobenzene	IR25MW56A-1184	2850	IR25MW56A-1185	2860	ug/L	0
	IR25MW56A	2/1/2005	1,2-Dichloroethane	IR25MW56A-1184	906	IR25MW56A-1185	916	ug/L	1
	IR25MW56A	2/1/2005	1,3-Dichlorobenzene	IR25MW56A-1184	20	IR25MW56A-1185	20	ug/L	0
	IR25MW56A	2/1/2005	1,4-Dichlorobenzene	IR25MW56A-1184	634	IR25MW56A-1185	634	ug/L	0
	IR25MW56A	2/1/2005	Benzene	IR25MW56A-1184	20	IR25MW56A-1185	20	ug/L	0
	IR25MW56A	2/1/2005	Chlorobenzene	IR25MW56A-1184	50	IR25MW56A-1185	49	ug/L	2
	IR25MW56A	2/1/2005	Cis-1,2-Dichloroethene	IR25MW56A-1184	1120	IR25MW56A-1185	1140	ug/L	2
	IR25MW56A	2/1/2005	Trans-1,2-Dichloroethene	IR25MW56A-1184	30	IR25MW56A-1185	28	ug/L	7
	IR25MW56A	2/1/2005	Vinyl Chloride	IR25MW56A-1184	612	IR25MW56A-1185	631	ug/L	3

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
051782	IR25MW53A	3/1/2005	1,2-Dichlorobenzene	IR25MW53A-1195	72	IR25MW53A-1196	75	ug/L	4
	IR25MW53A	3/1/2005	1,2-Dichloroethane	IR25MW53A-1195	66	IR25MW53A-1196	71	ug/L	7
	IR25MW53A	3/1/2005	1,4-Dichlorobenzene	IR25MW53A-1195	50	IR25MW53A-1196	52	ug/L	4
	IR25MW53A	3/1/2005	2-Hexanone	IR25MW53A-1195	200 J	IR25MW53A-1196	200 J	ug/L	0
	IR25MW53A	3/1/2005	Acetone	IR25MW53A-1195	200 J	IR25MW53A-1196	200 J	ug/L	0
	IR25MW53A	3/1/2005	Benzene	IR25MW53A-1195	7	IR25MW53A-1196	6	ug/L	15
	IR25MW53A	3/1/2005	Chlorobenzene	IR25MW53A-1195	586	IR25MW53A-1196	584	ug/L	0
	IR25MW53A	3/1/2005	Cis-1,2-Dichloroethene	IR25MW53A-1195	40.8	IR25MW53A-1196	42.2	ug/L	3
	IR25MW53A	3/1/2005	Dichlorodifluoromethane	IR25MW53A-1195	5 J	IR25MW53A-1196	5 J	ug/L	0
	IR25MW53A	3/1/2005	Methylene Chloride	IR25MW53A-1195	10 J	IR25MW53A-1196	10 J	ug/L	0
	IR25MW53A	3/1/2005	Trans-1,2-Dichloroethene	IR25MW53A-1195	6.7	IR25MW53A-1196	6.6	ug/L	2
	IR25MW53A	3/1/2005	Vinyl Chloride	IR25MW53A-1195	5.1	IR25MW53A-1196	5.8	ug/L	13
052096	IR25MW53A	3/29/2005	1,2-Dichlorobenzene	IR25MW53A-1208	84	IR25MW53A-1209	86	ug/L	2
	IR25MW53A	3/29/2005	1,2-Dichloroethane	IR25MW53A-1208	53	IR25MW53A-1209	51	ug/L	4
	IR25MW53A	3/29/2005	1,4-Dichlorobenzene	IR25MW53A-1208	57	IR25MW53A-1209	57	ug/L	0
	IR25MW53A	3/29/2005	Benzene	IR25MW53A-1208	8	IR25MW53A-1209	8	ug/L	0
	IR25MW53A	3/29/2005	Chlorobenzene	IR25MW53A-1208	588	IR25MW53A-1209	592	ug/L	1
	IR25MW53A	3/29/2005	Cis-1,2-Dichloroethene	IR25MW53A-1208	36.6	IR25MW53A-1209	35.1	ug/L	4
	IR25MW53A	3/29/2005	Trans-1,2-Dichloroethene	IR25MW53A-1208	7.7	IR25MW53A-1209	7.7	ug/L	0
	IR25MW53A	3/29/2005	Vinyl Chloride	IR25MW53A-1208	7.5	IR25MW53A-1209	6.5	ug/L	14
052480	IR25MW54A	4/26/2005	1,2-Dichlorobenzene	IR25MW54A-1222	8420	IR25MW54A-1223	9250	ug/L	9
	IR25MW54A	4/26/2005	1,2-Dichloroethane	IR25MW54A-1222	18500	IR25MW54A-1223	19200	ug/L	4
	IR25MW54A	4/26/2005	1,2-Dichloropropane	IR25MW54A-1222	40	IR25MW54A-1223	40	ug/L	0
	IR25MW54A	4/26/2005	1,3-Dichlorobenzene	IR25MW54A-1222	50	IR25MW54A-1223	40	ug/L	22
	IR25MW54A	4/26/2005	1,4-Dichlorobenzene	IR25MW54A-1222	849	IR25MW54A-1223	797	ug/L	6
	IR25MW54A	4/26/2005	Benzene	IR25MW54A-1222	59	IR25MW54A-1223	58	ug/L	2
	IR25MW54A	4/26/2005	Chlorobenzene	IR25MW54A-1222	1310	IR25MW54A-1223	1220	ug/L	7
	IR25MW54A	4/26/2005	Cis-1,2-Dichloroethene	IR25MW54A-1222	13800	IR25MW54A-1223	14000	ug/L	1
	IR25MW54A	4/26/2005	Methylene Chloride	IR25MW54A-1222	26 J	IR25MW54A-1223	25 J	ug/L	NC
	IR25MW54A	4/26/2005	Naphthalene	IR25MW54A-1222	30	IR25MW54A-1223	30	ug/L	0
	IR25MW54A	4/26/2005	Trans-1,2-Dichloroethene	IR25MW54A-1222	218	IR25MW54A-1223	181	ug/L	19

Table 3
Relative Percent Difference between Field Duplicate Pairs - GroundWater
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
052480	IR25MW54A	4/26/2005	Vinyl Chloride	IR25MW54A-1222	2030	IR25MW54A-1223	2060	ug/L	1
052742	IR25MW900B	5/11/2005	1,1-Dichloroethene	IR25MW900B-1248	2.48	IR25MW900B-1254	2.58	ug/L	4
	IR25MW900B	5/11/2005	1,2,4-Trichlorobenzene	IR25MW900B-1248	1	IR25MW900B-1254	1.1	ug/L	10
	IR25MW900B	5/11/2005	1,2-Dichlorobenzene	IR25MW900B-1248	245	IR25MW900B-1254	267	ug/L	9
	IR25MW900B	5/11/2005	1,2-Dichloroethane	IR25MW900B-1248	64.8	IR25MW900B-1254	66	ug/L	2
	IR25MW900B	5/11/2005	1,2-Dichloropropane	IR25MW900B-1248	0.8	IR25MW900B-1254	0.8	ug/L	0
	IR25MW900B	5/11/2005	1,3-Dichlorobenzene	IR25MW900B-1248	5.6	IR25MW900B-1254	5.8	ug/L	4
	IR25MW900B	5/11/2005	1,4-Dichlorobenzene	IR25MW900B-1248	48.5	IR25MW900B-1254	51.4	ug/L	6
	IR25MW900B	5/11/2005	Benzene	IR25MW900B-1248	3.7	IR25MW900B-1254	3.7	ug/L	0
	IR25MW900B	5/11/2005	Chlorobenzene	IR25MW900B-1248	4	IR25MW900B-1254	4.3	ug/L	7
	IR25MW900B	5/11/2005	Chloroethane	IR25MW900B-1248	3.2	IR25MW900B-1254	3	ug/L	6
	IR25MW900B	5/11/2005	Cis-1,2-Dichloroethene	IR25MW900B-1248	620	IR25MW900B-1254	642	ug/L	3
	IR25MW900B	5/11/2005	Methylene Chloride	IR25MW900B-1248	1 U	IR25MW900B-1254	0.3 J	ug/L	NC
	IR25MW900B	5/11/2005	Toluene	IR25MW900B-1248	0.4 J	IR25MW900B-1254	0.5 J	ug/L	NC
	IR25MW900B	5/11/2005	Trans-1,2-Dichloroethene	IR25MW900B-1248	116	IR25MW900B-1254	117	ug/L	1
	IR25MW900B	5/11/2005	Vinyl Chloride	IR25MW900B-1248	59	IR25MW900B-1254	68.6	ug/L	15

General:
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
mg/L - milligrams per liter
µg/L - micrograms per liter

Table 4
Relative Percent Difference between Field Duplicate Pairs - Soil
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
METALS									
045772	IR25MW54A	12/10/2004	Chromium	IR25MW54A-BH-1261	158	IR25MW54A-BH-1265	128	mg/kg	21
	IR25MW54A	12/10/2004	Manganese	IR25MW54A-BH-1261	191	IR25MW54A-BH-1265	733	mg/kg	117
052856	IR25MW53A	5/25/2005	Arsenic	IR25MW53A-BH-1272	1.5 B	IR25MW53A-BH-1274	2 B	mg/kg	NC
	IR25MW53A	5/25/2005	Cadmium	IR25MW53A-BH-1272	0.59 U	IR25MW53A-BH-1274	0.062 B	mg/kg	NC
	IR25MW53A	5/25/2005	Chromium	IR25MW53A-BH-1272	65.5	IR25MW53A-BH-1274	38.4	mg/kg	52
	IR25MW53A	5/25/2005	Manganese	IR25MW53A-BH-1272	181	IR25MW53A-BH-1274	225	mg/kg	22
	IR25MW53A	5/25/2005	Mercury	IR25MW53A-BH-1272	0.06 B	IR25MW53A-BH-1274	0.091 B	mg/kg	NC
PCBS									
045772	IR25MW54A	12/10/2004	Aroclor-1260	IR25MW54A-BH-1261	3 J	IR25MW54A-BH-1265	7 J	ug/kg	NC
SEMIVOLATILES									
045772	IR25MW54A	12/10/2004	1,2,4-Trichlorobenzene	IR25MW54A-BH-1261	100 J	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	1,2-Dichlorobenzene	IR25MW54A-BH-1261	20300	IR25MW54A-BH-1265	170 J	ug/kg	NC
	IR25MW54A	12/10/2004	1,4-Dichlorobenzene	IR25MW54A-BH-1261	4900	IR25MW54A-BH-1265	2700	ug/kg	58
	IR25MW54A	12/10/2004	2,4-Dimethylphenol	IR25MW54A-BH-1261	1200	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	2-Chlorophenol	IR25MW54A-BH-1261	330 U	IR25MW54A-BH-1265	37 J	ug/kg	NC
	IR25MW54A	12/10/2004	2-Methylnaphthalene	IR25MW54A-BH-1261	200 J	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	4-Methylphenol	IR25MW54A-BH-1261	170 J	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	Acenaphthene	IR25MW54A-BH-1261	28 J	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	Benzo(A)Pyrene	IR25MW54A-BH-1261	330 U	IR25MW54A-BH-1265	40 J	ug/kg	NC
	IR25MW54A	12/10/2004	Benzo(B)Fluoranthene	IR25MW54A-BH-1261	330 U	IR25MW54A-BH-1265	120 J	ug/kg	NC
	IR25MW54A	12/10/2004	Chrysene	IR25MW54A-BH-1261	330 U	IR25MW54A-BH-1265	33 J	ug/kg	NC
	IR25MW54A	12/10/2004	Dibenzofuran	IR25MW54A-BH-1261	30 J	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	Fluoranthene	IR25MW54A-BH-1261	500 U	IR25MW54A-BH-1265	34 J	ug/kg	NC
	IR25MW54A	12/10/2004	Naphthalene	IR25MW54A-BH-1261	160 J	IR25MW54A-BH-1265	330 U	ug/kg	NC
	IR25MW54A	12/10/2004	Phenanthrene	IR25MW54A-BH-1261	330 U	IR25MW54A-BH-1265	27 J	ug/kg	NC
	IR25MW54A	12/10/2004	Phenol	IR25MW54A-BH-1261	78 J	IR25MW54A-BH-1265	330 UJ	ug/kg	NC
	IR25MW54A	12/10/2004	Pyrene	IR25MW54A-BH-1261	330 U	IR25MW54A-BH-1265	51 J	ug/kg	NC
052856	IR25MW53A	5/25/2005	Butyl Benzyl Phthalate	IR25MW53A-BH-1272	390 U	IR25MW53A-BH-1274	28 J	ug/kg	NC

Table 4
Relative Percent Difference between Field Duplicate Pairs - Soil
In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134,
Hunters Point Shipyard, San Francisco, California

SDG	Location	Sample Date	Analyte	Sample ID	Result	Duplicate ID	Result	Units	RPD
052856	IR25MW53A	5/25/2005	Phenol	IR25MW53A-BH-1272	390 U	IR25MW53A-BH-1274	1400	ug/kg	NC
VOLATILES									
045772	IR25MW54A	12/10/2004	1,2-Dichlorobenzene	IR25MW54A-BH-1261	600000	IR25MW54A-BH-1265	330000	ug/kg	58
	IR25MW54A	12/10/2004	1,2-Dichloroethane	IR25MW54A-BH-1261	13000 J	IR25MW54A-BH-1265	16000 J	ug/kg	NC
	IR25MW54A	12/10/2004	1,3-Dichlorobenzene	IR25MW54A-BH-1261	5500 J	IR25MW54A-BH-1265	50000 U	ug/kg	NC
	IR25MW54A	12/10/2004	1,4-Dichlorobenzene	IR25MW54A-BH-1261	160000	IR25MW54A-BH-1265	80000	ug/kg	67
052856	IR25MW53A	5/25/2005	1,2-Dichlorobenzene	IR25MW53A-BH-1272	8.3 U	IR25MW53A-BH-1274	2 J	ug/kg	NC
	IR25MW53A	5/25/2005	1,2-Dichloroethane	IR25MW53A-BH-1272	250	IR25MW53A-BH-1274	187	ug/kg	29
	IR25MW53A	5/25/2005	1,4-Dichlorobenzene	IR25MW53A-BH-1272	8.3 U	IR25MW53A-BH-1274	0.7 J	ug/kg	NC
	IR25MW53A	5/25/2005	Benzene	IR25MW53A-BH-1272	1 J	IR25MW53A-BH-1274	1 J	ug/kg	NC
	IR25MW53A	5/25/2005	Chlorobenzene	IR25MW53A-BH-1272	0.9 J	IR25MW53A-BH-1274	3 J	ug/kg	NC
	IR25MW53A	5/25/2005	Cis-1,2-Dichloroethene	IR25MW53A-BH-1272	5.2	IR25MW53A-BH-1274	4	ug/kg	26
	IR25MW53A	5/25/2005	Trans-1,2-Dichloroethene	IR25MW53A-BH-1272	18.6	IR25MW53A-BH-1274	19	ug/kg	2
	IR25MW53A	5/25/2005	Vinyl Chloride	IR25MW53A-BH-1272	48.9	IR25MW53A-BH-1274	53.9	ug/kg	10

General:
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
mg/L - milligrams per liter
µg/L - micrograms per liter

Appendix I
Field Sample Collection Logs

AR_N00217_000936
HUNTERS POINT
SSIC NO. 5090.3.A

APPENDIX I – FIELD SAMPLE COLLECTION LOGS

RAW ANALYTICAL DATA IS CONTAINED ON ELECTRONIC MEDIA AND IS TOO VOLUMINOUS TO PRINT.

FOR ADDITIONAL INFORMATION, CONTACT:

DIANE C. SILVA, RECORDS MANAGER
NAVAL FACILITIES ENGINEERING COMMAND, SOUTHWEST
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132

TELEPHONE: (619) 532-3676
E-MAIL: diane.silva@navy.mil

Appendix J
Response to Comments

Response to Comments on Draft In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134, IR Site 25
Hunters Point Shipyard, San Francisco, California
November 23, 2005, Document Control Number NAV004-031-H

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005

Comment No.	Page No.	Section, Figure, Table	Comments	Response
1		General Comments	The In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study (the Report) includes injection of bromide tracer to evaluate the horizontal and vertical migration of injected substrate outside the treatability study area. However, the results of analysis of groundwater samples for bromide are not discussed in the Report. Since the concentration of chlorinated ethenes decreased in IR25MW56A (Figure F-16), which was screened in the lower-A aquifer and which was not supposed to be impacted by this treatability study (TS), it is important to discuss the bromide tracer results and whether the lower A-aquifer was impacted by the TS. Please revise the Report to include a discussion of results for bromide, and clarify whether bromide was detected in wells outside the TS area. Please also discuss the reduction of chlorinated ethenes in IR26MW56A and explain why the study was continued when the lower A-aquifer was being impacted.	As indicated in Section 7.1.4 of the TS report, the data from well IR25MW56A (provided in Figures F16 and F50 and the table of Appendix C) do not indicate the vertical transport of contaminants from the treatment zone. Reductive dechlorination was occurring in the lower A-aquifer before the start of the TS. Background data collected from well IR25MW56A show high concentrations of vinyl chloride (820 µg/L) and ethene (721 µg/L). It is correct that the concentration of chlorinated ethenes decreased (Figure F16); however, it was not due to rapidly proceeding reductive dechlorination but is considered to be due to horizontal migration of groundwater. Figure F50, originally not included in the TS report, shows concentrations of chlorinated ethenes, ethanes, and benzenes together exhibiting a similar pattern. This change in concentration would be expected as a result of the advective transport of contaminants through this well. Taking into account the bromide tracer results and the data from another deeper well IR25MW15F (Appendix D), our original position that there is no indication of vertical groundwater transport due to TS activities appears to be correct. The text of Section 7.1.4 was revised to include this discussion regarding insignificant vertical groundwater transport. The discussion on the bromide tracer results is provided as a response to Specific Question 13. The TS report was amended by addition of Figure F50.

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
2		General Comments	The Report does not discuss the possible effects of dilution on the observed decrease in contaminant concentrations in TS wells. The fact that evidence of transformation was observed does not eliminate the possibility that dilution was a contributing factor. Please revise the Report to clarify if dilution of contaminant concentrations by injected substrate was taken into account in the evaluation of contaminant degradation.	Dilution was not a contribution factor during re-circulation since groundwater extracted from well IR25EW01A had higher concentrations of chlorinated VOCs than groundwater sampled from injection well IR25IW02A prior to the recirculation. However, dilution may be a contribution factor during direct injection of substrate-amended groundwater into well IR25MW54A (performed from day 70 through 71). Approximately 1,700 gallons groundwater amended with the sodium lactate solution (as described in Section 5.1.2.1) were injected into well IR25MW54A. A significant decrease in the concentration of chlorinated ethenes and benzenes was observed in this well on day 75, which can be partially attributed to dilution, especially taking into account very low permeability of soil in the vicinity of the well. However, groundwater used for this injection was derived from wells IR25MW902B and IR25MW901B (the only wells in the vicinity capable of producing the required groundwater volume) had chlorinated VOC contamination in range of that in well IR25MW54A (data for well IR25MW902B is provided in the table of Appendix D). In conclusion, dilution may have had a factor in this TS investigation, but due to the use of contaminated, site-derived groundwater for the substrate injections and recirculation, the effects were minimal. A statement on the minimal impact of contaminant dilution was added to the results discussion in Section 7.1.2.1.
3		General Comments, Figures 6 through 9	It is unclear why Figures 6 through 9 include a range of dates varying from 3 to 8 days. The range of dates appears to indicate that water levels were not measured on the same day. If this is the case, the groundwater elevation maps may not accurately represent the groundwater elevations or gradients, particularly if it rained during the period. Finally, if water levels were measured over a several day period, it may not be appropriate to calculate vertical gradients, since vertical gradients can only be calculated if water levels in adjacent wells were measured within a short time (e.g., within a few minutes). Please clarify whether groundwater elevations were measured on one day or on more than one day, and if water levels were measured over a period of several days specify whether it rained during the measurement period and discuss the impact of measuring water	Water levels were measured as part of site-wide groundwater sampling events. These sampling events were conducted over several days due to the number of wells involved and the time required to purge each well prior to sampling. Water level data were not measured to support horizontal or vertical groundwater gradient calculations. Horizontal and vertical groundwater gradients cited in the text were derived from the Groundwater Summary Report (TtEMI, 2004). Figures 6 through 9, formerly entitled, "Groundwater Elevation Map, March 23-25, 2004," Figure 6, "Lower A Aquifer, Groundwater Elevation Map, March 23-25, 2004," Figure 7, "Upper A Aquifer, Groundwater Elevation Map, December 6-9, 2004," Figure 8, and "Upper A Aquifer, Groundwater Elevation Map, May 11-18, 2005,"

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
			levels over a period of several days on the accuracy of the groundwater elevations and gradients. Please verify that all groundwater gradients were calculated from data collected from adjacent wells within a few minutes or delete inappropriate vertical gradient data from the Report.	Figure 9, have been excluded from the final report.
1	2-4	Specific Comments, Section 2.1.2.2, A-B Aquitard, and Section 2.1.2.3, B-aquifer	The Report states in Section 2.1.2.3 that "numerous wells have been installed in the B-aquifer, in and around RU-C5," but according to the Final Parcel C Groundwater Summary Report, Phase III Groundwater Data Gaps Investigation (the GDGI) the B-aquifer is not present at RU-C5. Monitoring wells with a "B" at the end of the well identifier are actually completed in the Lower A-aquifer, so it is confusing to read a description of the B aquifer in this Report. Since the B aquifer is not present, the A-B aquitard is also not present in RU-C5. Finally, the discussion of hydraulic conductivity in the B-aquifer actually applies to the lower A-aquifer; this is correctly summarized in Section 2.1.6. Please delete Sections 2.1.2.2 and 2.1.2.3 or revise them to state that the A-B aquitard and the B-Aquifer are not present at RU-C5. Please also move the hydraulic conductivity and pump test discussions to the appropriate paragraphs (i.e., to the paragraphs discussing the upper A-aquifer or the lower A-aquifer) of Section 2.1.2.1.	The TS report text has been revised as stated. The Sections discussing the A-B Aquitard and B-Aquifer have been deleted (formerly Sections 2.1.2.2 and 2.1.2.3, respectively), and Section 2.1.2.1 has been revised.
2	2-5	Specific Comments, Section 2.1.4, Groundwater Flow Patterns	It is unclear why the groundwater gradient in the vicinity of the groundwater trough near IR-06 is described as "steeper, approximately 0.0061 ft/ft, than the gradient for most of RU-C-5" when the gradient in the vicinity of the separator and degreaser is 0.01 feet/feet (ft/ft), which is greater than a gradient of 0.0061. Please resolve this discrepancy, and if necessary, include the gradient for the remainder of RU-C5 as a point of comparison.	The reference to a hydraulic gradient of 0.0061 ft/ft was removed from the TS report text of Section 2.1.4 to align with the data presented in the Groundwater Summary Report (TtEMI, 2004).
3	2-7	Specific Comments, Section 2.1.6, Hydrogeological Conceptual Model Summary	The third bullet on page 2-7 states that the lower A-aquifer is semi-confined in the separator and degreaser area, but based on Figure 4 of the Report and Figure 7-2 from the GDGI, sand and clayey sand are present from the bottom of the degreaser (currently from the bottom of the degreaser excavation) to bedrock; groundwater cannot be semi-confined in these conditions. Please revise the text of this bullet to state where the lower A-aquifer is and is not semi-confined.	Cross sections N-N' and O-O' from Figure 7-2 of the Groundwater Summary Report (TtEMI, 2004) show sandy clay and clayey sand beneath the degreaser pit. If the two permeable zones were hydraulically connected, then water levels would be relatively similar. However water levels between monitoring wells IR25MW56A and IR25MW54A were consistently different, with IR25MW56 water levels being lower than IR25MW54A. This difference is likely caused by a

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
				semi-confining regime between the two wells. The text of Section 2.1.6 has been modified to state that the lower A-aquifer is semi-confined between wells MW54A and MW56A. Aquifer test results presented in Section 7.2.5.1 of the GDGI (TtEMI, 2000, [last sentence of the next to the last paragraph]) show that the lower A-Aquifer is semi-confining. Further, Section 7.2.5.1 of the GDGI reports that there was no hydraulic connection between the upper and lower A-Aquifers near the separator and degreaser pit area during the aquifer test.
4	4-1	Specific Comments, Section 4.0, Performance Boring Drilling and Temporary Well Installation, and Appendix A, Boring Logs	The Final Work Plan in Support of In-Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study, Remedial Unit-C5, Building 134 (the Work Plan) indicates that monitoring wells IR25MW53A, IR25MW54A, IR25MW55A, IR25MW56A and IR25MW55A and Injection well IR25IW02A would be installed for this program, but the installation of these wells is not discussed in the Report and the boring and well completion logs were not included in Appendix A. Please provide the missing boring logs and well completion diagrams. Please also discuss the installation of these wells in Section 4. If the wells were not installed during this program, please specify the program in which they were installed and provide the boring logs and well completion diagrams in Appendix A. Finally, the boring logs from the CD could not be printed out; please provide hard copy of all boring logs and well completion diagrams in the next version of the Report.	The monitoring wells IR25MW53A, IR25MW54A, IR25MW55A, IR25MW56A and IR25MW55A and injection well IR25IW02A were installed by Shaw as part of EMAC CTO 0001 Task 5. The boring logs and well completion diagrams for these wells were included in the report entitled, "Construction Report, Well Decommissioning/Installation and Site Excavation," dated June 2004. The boring logs and well completion diagrams for these wells were reproduced and included with the other boring logs in Appendix A of the TS report. Appendix A was provided as a hardcopy in the TS report.
5	5-2	Specific Comments, Section 5.1.2.1, Phase 1 - Substrate Injection and Distribution,	Groundwater extraction from IW02A was terminated on Day 70, and substrate was injected directly into monitoring well MW54A. Groundwater was extracted from monitoring wells MW901B and MW902B at this time. It is not clear why these wells, which are located outside the treatment area, were selected for extraction. In addition, it is not clear if the direct injection into MW54A resulted in the substrate reaching EW01A. Please revise the Report to clarify how the extraction wells were selected, and if any substrate was detected in wells MW901B and MW902 B or in EW01A during the pilot study.	Wells MW901B and MW902B were chosen due to their close proximity to well MW54A and due to the fact that they were capable of producing enough water for the injection. Alkalinity concentration remained the same in well MW902B during the TS; therefore, because alkalinity has been shown to be an effective surrogate for sodium lactate, it may be concluded that there was no substrate in this well. Well MW901B was not sampled and was not scheduled to be sampled during the TS. Substrate was detected in extraction well EW01A on day 75 of the TS and thereafter. A 3- to 4-fold increase in the alkalinity from pre-study levels as well as a substantial increase in bromide concentration were also observed in EW01A. The substrate

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
				detected in well EW01A was the result of the injection in well MW54A. The TS report text in Section 5.1.2.1 was amended to include these statements.
6	5-2	Specific Comments, Section 5.1.2.2, Phase 2 - Biodegradation Monitoring	The Report states that sampling from the monitoring well MW54A indicated that potential biodegradation enhancement may result from hydrogen injection at this location; however, it is not clear which monitoring parameter or parameters indicated that hydrogen injection would enhance biodegradation. Please revise the Report to clarify how this conclusion was made.	The text for Section 5.1.2.2 was modified to include the following sentences, "Sampling from monitoring well MW54A indicated the presence of sufficient substrate to support reductive dechlorination, yet the concentration of chlorinated ethenes was unchanged. Hydrogen injection was implemented with the idea that increasing the availability of dissolved hydrogen may result in a subsequent increase in the degradation." The presence of DNAPL in the area was likely a constant source of chlorinated ethenes in MW54A. However this was not known until performance soil samples were collect from location MW54A-BH at the end of the Stage 1 Anaerobic ISB.
7	6-7	Specific Comments, Section 6.1.5.2, Chlorinated Ethanes	The increase in 1,2-dichloroethane (1,2-DCA) in MW54A during the aerobic phase of the TS is not discussed. Please discuss the increase in 1,2-DCA in MW54A during the aerobic phase of the TS.	The persistence and fluctuation of in the concentration of 1,2-DCA is attributable to the presence of DNAPL adjacent to monitoring well MW54A. An explanation for the 1,2-DCA concentration fluctuation during anaerobic stage of the TS was presented in Section 7.1.2.3. This concentration variability applies to the aerobic stage of the TS as well.
8	6-8	Specific Comments, Section 6.1.7.1, Chlorinated Benzenes	This section address[es] the reduction of chlorinated benzenes in the TS area; however, the second half of the paragraph refers to chlorinated ethenes. It is not clear if this text is relevant to chlorinated benzenes. In addition, the increases in chlorobenzene concentration in EW01A, MW56A, MW53A, and IW02A are not discussed; the discussion should include a discussion of why chlorobenzene concentration decreased during the aerobic stage in some wells (e.g. MW53A and IW02A) but not in others (e.g., EW01A). Please replace the discussion of chlorinated ethenes with a discussion of the chlorinated benzenes. In addition, please discuss the observed increases in chlorobenzene concentrations.	The text of Section 6.1.7.1 has been corrected to state: "It took approximately three months from the beginning of substrate injection to reduce most of the 1,2-DCB around injection well IW02A and the well closest to it (MW53A). The reduction of chlorinated benzenes progressed differently in the other wells and is discussed in details in Sections 7.1.2.2 and 7.2.2.1. The concentrations of chlorinated benzenes are graphed for each well on Figures F32 through F36, and their molar concentrations on Figures F37 through F41." A discussion of chlorinated benzenes degradation was presented in Sections 7.1.2.2 and 7.2.2.1.

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
9	6-11	Specific Comments, Section 6.2, Results for Groundwater for the Locations Outside of Treatment Area	The Report concludes that changes in concentrations of analytes in wells adjacent to the treatment area do not indicate that the contamination dispersed during the TS due to injection and extraction activities in the treatment area; however, the changes in concentrations are not described. It is not clear if the concentrations in these wells increased or decreased. Furthermore, no evidence is provided to support the conclusion that changes in concentrations in these wells were [not] related to the TS activities. It appears likely that the injection of substrate would cause some hydraulic dispersal of contaminants. For example, contamination had not reached well MW904B prior to the TS, so it is possible that contaminants were mobilized by the injection of substrate. Please revise the Report to describe the changes in concentrations in adjacent wells during the TS and provide evidence, if available, to support the conclusion that injection did not cause contamination dispersal. Alternatively, please revise the Report to clarify that injection and extraction activities may have contributed to the observed changes in concentrations in adjacent wells.	Three Figures, F51 through F53, showing changes in concentrations of the major contaminants were added to Appendix F. These data were also provided in tabular form in Appendix D. There is no indication in these graphs that the contamination was dispersed during the TS injection/extraction activities. We concur that it is not clear if the concentration in wells adjacent to the treatment area generally increased or decreased. Only three rounds of sampling were performed and it would be impractical to evaluate injection/extraction activities task by task. Evaluation of analytical data from these wells was performed carefully so that deceptive trends were not obtained. An increase in chlorinated ethenes, 1,2-DCA, and dichlorobenzenes concentration in well MW902B after the anaerobic stage possibly suggests that it was caused by injection of 1,700 gallons of water in well MW54A, which may have raised groundwater level in MW54A enough to create an artificial hydraulic gradient towards MW902B. However the water level in the extraction well EW01A location was completely drawn down at the time of the injection, which would have created a substantial gradient in that direction. The fact that substrate was encountered in the extraction well after the injection into MW54A and the fact that the excavation in which the extraction well was installed had a capacity for approximately 1,000 gallons suggests that most of the injected water went to the EW01A location. Post-aerobic stage sampling at MW902B showed contaminant concentrations in line with pre-treatment sampling (actually slightly lower than the pre-treatment sampling). We believe that the concentration changes observed in MW902B were due to groundwater movement, not due to the injection and extraction performed as part of the TS. Water movement in the direction of MW902B may have been the result of meteoric water entering the subsurface at the extraction well location due to the removed asphalt cap and gravel backfill which would allow for easy percolation into the ground. A steady decrease in chlorinated ethenes, 1,2-DCA, and dichlorobenzenes in well MW900B suggests enhanced bioremediation

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
				due to the influence of substrate injection in TS area. However, well MW902B located almost halfway between MW900B, and the TS area does not show this trend. Also, alkalinity concentrations (provided in the table of Appendix D) in wells adjacent to TS area remain steady, showing no influence of substrate injection. Additional justification for contaminant transport due to hydraulic gradient was that there was no increase in contaminant levels (rather a decrease) in wells MW55A and MW57A despite the fact that MW55A is located closer to TS area than MW904B and MW57A is adjacent to MW904B. The Navy concludes that the contamination appearing in well MW904B (Figure F53) is likely due to natural down gradient movement of the contamination plume. The TS report was amended to include a reference to the three new figures.
10	7-9	Specific Comments, Section 7.1.2.2, Chlorobenzenes Biodegradation (1,2,4-TCB, 1,2-DCB, 1,4-DCB, and CB), and Figures F32 through F41	Since chlorobenzene degrades to benzene, benzene concentrations should be shown on the figures that depict the concentrations/ degradation of the chlorobenzenes. Please include benzene concentrations on Figures F32 through F41.	Figures F54 through F56 showing comparisons between benzene and chlorobenzene concentrations in the TS wells have been added to the figures of Appendix F, and a reference to these figures has been inserted in Section 7.1.2.2.

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
11	7-9	Specific Comments, Section 7.1.2.2, Chlorobenzenes Biodegradation (1,2,4-TCB, 1,2-DCB, 1,4-DCB, and CB)	The text states, "Degradation of 1,2-DCB occurred approximately twice as fast as that of 1,4-DCB," but it appears that the half-life of 1,2-dichlorobenzene (1,2-DCB) is about the same as 1,4-DCB, based on Figures F32 (IR25EW01A), F33 (IR25MW54A), and F34 (IR25MW56A). Please delete the quoted statement or provide evidence and calculations to support the statement and discuss the significance of the statement.	The report stated that the degradation of dichlorobenzenes was measurable only in wells EW01A, MW53A, and IW02A. It is difficult to infer rate constants from a plot of Concentration versus time (Figures F32 through F34). However if the natural logarithm of concentration is plotted versus time, the slope of the best-fit line through the data is the rate constant. First order degradation rate constants were calculated for 1,2-DCB and 1,4-DCB in these wells, using data from day 25 through day 173, the period during which most of the 1,2-DCB degradation occurred. The following rates were obtained: Well ID — 1,2-DCB, day^{-1} — 1,4-DCB, day^{-1} EW01A — 0.034 — 0.0022 MW53A — 0.039 — 0.019 IW02A — 0.044 — 0.022 Based on the observed rates, it appears 1,2 DCB degraded approximately twice as fast that of 1,4-DCB. The text of Section 7.1.2.2 was modified to provide the detail on the degradation rate comparison.
12	7-10	Specific Comments, Section 7.1.2.2, Chlorobenzenes Biodegradation (1,2,4-TCB, 1,2-DCB, 1,4-DCB, and CB)	The text states that only "minor amounts of benzene (~40 μg/L) were generated" during reductive dechlorination, but by day 40 the concentration of benzene in MW54A increased from 250 to 500 micrograms per liter (μg/L). In addition, it is unclear why 40 μg/L is considered a minor amount of benzene, when this site is located beneath a building and the preliminary remediation goal (PRG), which takes inhalation into account, is 0.35 μg/L. Please revise the quoted statement and explain why an increase of 40 μg/L benzene is considered minor.	There was no appreciable increase in benzene concentrations in well MW54A by day 40, since the 500 μg/L concentration of benzene on day 40 and 54 as well as the 250 μg/L concentration on day 25 are actually non-detected values shown numerically as half the reporting limit. They are highlighted yellow in the table of Appendix C table to note this approximation. The text of Section 7.1.2.2 was revised to state, "a minor increase (~40 μg/L) in benzene concentrations was observed, relative to initial concentrations which were up to 320 μg/L in well MW54A."

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
13	7-11	Specific Comments, Section 7.1.4, Vertical Migration	Monitoring well MW52F is referred to in this section, but MW52F is not shown in the figures or data tables. Please revise this section to clarify which wells were used to monitor vertical migration. Also, the Report concludes that data from this well indicates that contaminants were not transported vertically from the treatment zone; however, it is not clear what data is referred to. According to the data in Appendix C and D, bromide tracer was detected in MW56A and MW15F and reductive dechlorination was observed in MW56A. Please revise the Report to describe the data used to evaluate vertical migration from the treatment zone. In addition, please provide tables with water level elevations and vertical hydraulic gradient calculations to support this discussion.	The reference to monitoring well MW52F was erroneous. The correct well is MW15F, and the text of Section 7.1.4 was modified accordingly. The bromide tracer test was not a good indicator for vertical transport during the TS. Bromide was detected in wells MW56A and MW15F after injection of the bromide tracer. However bromide was also detected in these wells prior to the injection of bromide tracer and at even higher concentrations than during the TS. Bromide concentrations remained steady in well MW56A during the injection-extraction activities at the TS area. Reductive dechlorination was observed in well MW56A. However it was proceeding before the start of the TS. Significant concentrations of ethene and vinyl chloride were detected in this well during pre-treatment sampling. So the change in concentration does not appear to be an indicator of vertical groundwater transport either. However the alkalinity concentrations in wells MW56A and MW15F did not rise after the substrate injections, which suggests that substrate transport to these wells was not occurring. A table of the water elevations was included in the text, referred to as Table 3 and referenced in the text of Section 2.1.4. Vertical hydraulic gradients were not calculated based upon the water level elevations due to the extended sampling periods over which they were collected. The vertical hydraulic gradients referenced in the text were derived from the Groundwater Summary Report (TtEMI, 2004).
14	7-15	Specific Comments, Section 7.2.2.1, Chlorinated Organics	The text states, "During Stage 1 chlorinated organics including chlorinated ethenes and 1,2-DCA were degraded to ethene and ethane and therefore did not require additional treatment," but this is not true for MW54A. Please revise the text to state that complete degradation did not occur in MW54A.	The last paragraph in Section 7.2.2.1 was revised to state, "Because a DNAPL is believed to be present near MW54A, 1,2-DCB, 1,4-DCB, and the other chlorinated organics were not completely degraded in this well during Stage 1."

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
15	7 -17 and 8-1	Specific Comments, Section 7.3, Evaluation of Large Diameter Well for Enhancement of Groundwater Extraction and Section 8.1, Design Information	The Report concludes that "large diameter wells are considered ineffective for enhancement of groundwater extraction for recirculation and substrate distribution," but this statement is only applicable to hydrogeologic conditions like those at IR25, where fill is extremely heterogeneous and there are significant percentages of silt and clay in most of the fill material. In other geologic environments that are dominated by sand and gravel, large diameter extraction wells may be effective. Please revise the quoted statement to clarify that this conclusion is applicable for IR25 or for geologic environments with significant percentages of silt and clay.	The evaluation only pertains to the investigation at RU-C5 and was not intended to indicate the effectiveness of the large diameter well at other locations. The text was revised to indicate that the evaluation only applies to Site RU-C5.
16	7-19	Specific Comments, Section 7.5, Evaluation of Dehalococcoides sp Population	There are several inconsistencies between the description of Dehalococcoides sp (DHC) and the numbers presented in this section. The Report states that only the DHC concentrations in samples from MW02A and MW54A matched the anticipated increase during the anaerobic stage and decrease during the aerobic stage; however, on page 7-18 the Report states that DHC was not analyzed in the baseline sample for MW54A. The Report states that DHC concentrations decreased one order of magnitude in well IW02A and MW54A, but the Report lists the concentration of DHC in these wells in Stage 1 and Stage 2 as identical. It does not appear from the information provided, that any of the wells exhibited the anticipated changes in DHC concentrations. Please revise the Report to correct these discrepancies.	After Stage 1, DHC was detected in groundwater samples collected from IW02A and MW54A at concentrations of 1,020 cells/mL and 1,200 cells/mL, respectively. The concentrations listed, IW02A (200 cells/mL) and MW54A (42 cells/mL), were erroneous. The text was corrected to reflect this. The statement that, "Only the DHC concentrations in groundwater samples from MW02A and MW54A matched the anticipated change in DHC concentrations," requires correction and qualification. The reference to "MW02A" is erroneous, and should be IW02A. Because baseline DHC measurements were not available for MW54A, a before and after comparison for this well requires an assumption for the baseline concentrations. The text was revised as follows: "Only the DHC concentrations in groundwater samples from IW02A and MW54A matched the anticipated change in DHC concentrations, assuming baseline DHC concentrations in MW54A to be at or near that of IW02A (120 cells/mL) or MW53A (450 cells/mL). During Stage 1 DHC concentrations in groundwater did increase approximately one order of magnitude in well IW02A, and between 2-fold and an order of magnitude in MW54A."

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
17	8-1	Specific Comments, Section 8.1, Design Information	The Report concludes that adequate substrate distribution was accomplished by injecting amended groundwater into both the injection well and monitor well; however, it is not clear what was considered adequate distribution (e.g., based on distance, concentration of substrate, decrease in contaminants achieved, etc.). It does not appear that substrate was distributed much beyond the immediate vicinity of the injection points. Please revise the Report to specify the basis for a conclusion that adequate distribution was achieved.	Distribution was considered adequate if substrate (sodium lactate) was observed in each of the TS performance monitoring points (i.e., IW2, MW53, MW54 and EW01). Since sodium lactate was observed in these wells and subsequent biological degradation occurred, substrate distribution was considered effective. Although it appears that oxygen delivery was limited to the area immediately adjacent to the wells, the presence of sodium lactate in well MW53 and EW01 after injection into IW02 and MW54 respectively indicates that the substrate was distributed through the aquifer matrix, at least that distance. The text of Section 8.1 was revised to specify the basis for adequate substrate distribution.
18	8-4	Specific Comments, Section 8.4, Recommendations	The recommendations suggest that dense nonaqueous phase liquid (DNAPL) recovery and substrate distribution may be enhanced by fracturing the aquifer matrix, but it is likely that fracturing will spread DNAPL and make treatment or recovery more difficult. Further, if substrate is injected under higher pressures, it is possible that DNAPL could be mobilized. Since DNAPL mobilization may cause isolated globules of DNAPL to merge, which in turn could allow the DNAPL to move deeper into the aquifer or into bedrock, technologies that could mobilize DNAPL are undesirable. Alternatives like excavation or zero-valent iron, which can be injected below the zone of interest to minimize vertical migration of DNAPL and which can be injected beginning in outlying areas to minimize potential horizontal migration, should be considered before fracturing is considered or attempted. Please revise the text to state that DNAPL recovery or destruction could be made more difficult by fracturing of the aquifer matrix or by injecting substrate under pressure.	It is recognized that DNAPL mobilization could potentially be enhanced by fracturing the aquifer. However, fracturing appears to be limited to about 15 feet radially based on previous treatability studies. ZVI injection that begins below the contaminated portion of the aquifer and proceeds upward minimizes the potential to mobilize DNAPL. Excavation is an effective method to remove DNAPL from aquifer material for shallow to moderate depths. The text was revised to reflect this.
19		Specific Comments, Figure 9	Figure 9, Upper A-Aquifer Groundwater Elevation Map, May 11-18, 2005: The 3.0 foot contour is missing in the area north of the degreaser. Please revise this figure to include the missing contour.	Figure 9, formerly entitled, "Upper A Aquifer, Groundwater Elevation Map, May 11-18, 2005," has been excluded from the final report. Please refer to the response to General Comment No. 3.

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
1	1-4	Minor Comments, Section 1.2, Installation Restoration Site 25	There are several errors: - 4,4-dichloro-diphenyl-trichloroethane is misspelled.	The missing letter "c" was inserted in the text.
	1-4	Minor Comments, Section 1.2, Installation Restoration Site 25	- The text in the second page states that DNAPL analysis "was dominated by chlorobenzene and PCE [tetrachloroethene]," but it was actually dominated by the dichlorobenzenes or by chlorinated benzenes and PCE.	The word "chlorobenzene" was changed to the correct "dichlorobenzenes."
	1-6	Minor Comments, Section 1.4, Scope of Work	- The text uses the present tense when the past tense should be used.	The text was updated.
	2-2, and 2-5	Minor Comments, Section 2.1.1.5, Bedrock, Section 2.1.2.5, Bedrock Water-bearing Zone	- Serpentinite is misspelled as "serpentonite" several times in these sections.	The text was updated.
	2-7	Minor Comments, Section 2.2, Nature and Extent of Contamination in Groundwater at RU-C5	- MW-1542 does not exist.	The text should read "former monitoring well IR25MW15A2" and was corrected.

Comments by: Michael Work, EPA Remedial Project Manager, Superfund Division (SFD-8-3), dated October 11, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
	7-7	Minor Comments, Section 7.1.2.1, Chlorinated Ethenes Biodegradation (PCE, TCE, DCE, and VC)	- MW02A, referenced in the first paragraph, does not exist.	The erroneous "MW02A" was replaced by the correct "IW02A".
2	6-1	Minor Comments, Section 6.1.2, Field Parameters and General Chemistry Results	There appears to be text missing from the last sentence on this page: "These parameters were monitored in the field and used to determine as groundwater...". Please revise the sentence to clarify its meaning.	The text was changed to the following: "These parameters were collected during well purging, as part of the groundwater stabilization monitoring performed prior to sampling."
3	6-6	Minor Comments, Section 6.1.4, Total Organic Carbon	Text appears to be missing from the fifth sentence in this section: "Organic carbon was continually utilized by the bacteria ...during the TS concentration subsided." Please revise the sentence to clarify its meaning.	The text has been revised to read, "Organic carbon was continually utilized by the bacteria during Stage 1 and as expected, the concentration of organic carbon decreased during the TS." The erroneous text, "concentration subsided," has been deleted.
4	7-8	Minor Comments, Section 7.1.2.1, Chlorinated Ethenes Biodegradation (PCE, TCE, DCE, and VC)	The third complete paragraph indicates that Figure 10 depicts the mass balance or molar change in chlorinated ethenes, but this figure only shows the dechlorination pathway. Please cite the correct figure.	The text was updated to correctly cite Figures F19 through F23.

Comments by: Mark Berscheid, DTSC Hazardous Substances Engineer, Engineering Services Unit, dated October 21, 2005

Comment No.	Page No.	Section, Figure, Table	Comments	Response
1			Gas Injection – The TS indicates a gas was injected into the saturated zone in both stages of the TS, hydrogen in Stage 1 and oxygen in Stage 2. The TS indicates that gas sparging was eliminated by using the ISOC diffuser located in the injection well. The ESU considers the proprietary injection system to be capable of reducing the effect of sparging from injecting gases but does not consider the use of the term eliminate as appropriate. By definition, the need to inject a gas at a given depth indicates the need to attain a given injection pressure to overcome the groundwater head at the given depth. In addition, the gas is compressed to meet these requirements. The ESU considers these factors as sufficient to indicate some sparging is occurring as the gas is injected and infiltrates through the saturated zone. Based on the presence of: 1. An extremely thin vadose zone at this site; and 2. Recently developed Indoor air intrusion screening levels (CHSSLs) that are more conservative than the risk based on exposure of the surface receptor, the ESU recommends that any future gas injection activities of this nature contain vadose zone monitoring infrastructure, in the near vicinity of the injection well, capable of assessing a possible threat from VOC indoor air intrusion.	Vadose zone monitoring will be considered in future treatability studies.

Comments by: Mark Berscheid, DTSC Hazardous Substances Engineer, Engineering Services Unit, dated October 21, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
2			Oxidation Reduction Potential (ORP) – The ESU has found in the technical review of similar treatment technologies the ambient saturated zone level of ORP to be very important indicator to the success of the degradation of both parent and daughter products. The presence of inappropriate ORP indicators (i.e., + ORP number in reducing area) can indicate an inability to reduce a given compound. A review of ORP data summarized in Appendix F indicates the presence of significant variations in ORP in each well over time for both Stage 1 and 2. The ESU recommends the final TS address the relationship of chlorinated compounds and ORP with: a. Published data on the optimum ORP for each parent and daughter product; b. A comparison of chlorinated compounds found in each groundwater sample with ORP result; c. A discussion on the reasons for fluctuating ORP numbers versus time.	Optimum ORP values for the degradation of chlorinated organic parent and daughter products are useful in microcosm studies but have less application in the field. In the field, it is impractical to establish certain ORP levels in specific wells at specific times. Staff have observed in several field applications of in situ anaerobic bioremediation that an ORP level of -200 to -250 mV is sufficient for complete degradation of chlorinated compounds, including PCE, TCE, 1,2-DCE, Vinyl Chloride, 1,2-DCA, 1,-DCB, and 1,4-DCB. Establishing very low ORP levels (towards -400 mV) is not necessary and would be less desirable due to the potential for metals dissolution, including arsenic and manganese. High variability in ORP values have been observed in all applications. There are many factors influencing ORP in groundwater, including advection, bacterial activity, stage of degradation of chlorinated organics, and temperature. Sampling variability is also an important factor. Groundwater in the treatment area can slow the ORP sensor response, which has been observed due to ferrous sulfide specks settling on the sensor. ORP sensor calibration is performed only at +235 - +250 mV, yet the instrument is used to measure high negative ORP. Different instruments perform differently in the high negative ORP range. The text of Section 6.1.2.5 has been modified to address the inherent variability of field ORP measurements.
3			Radius of Influence (ROI) – The TS indicates the need to obtain the data necessary for full scale application of the treatment technologies. The ESU considers an assessment of the effective ROI for injection of substrates as a mandatory requirement for the placement of injection wells across the width of the subject aquifer. The ESU recommends the inclusion of an evaluation of this nature in the final TS.	The radius of influence of the substrate injection system was highly variable because of the heterogenous nature of the sediments at the TS area. Sodium lactate distribution was observed to be about 5 feet from IW02 to MW53A and about 12 feet from MW54 to EW01. It is anticipated that further distribution may be achieved with longer injection rates and higher pressures. Oxygen delivery radius of influence using the iSOC technology was limited. It is anticipated that, based upon oxygen concentrations in the monitoring points, oxygen delivery was limited to less than 1 foot from the injection wells. This is considered to be the result of high

Comments by: Mark Berscheid, DTSC Hazardous Substances Engineer, Engineering Services Unit, dated October 21, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
				biological and chemical oxygen demand of the aquifer and the low permeability of the aquifer matrix. The text of Section 8.1 was revised to include statements on the observed ROI and suggestions for further distribution.
4			Section 1.2, Installation Restoration Site 25, of the TS lists the contaminants of potential concern. The list provided in the TS does not include naphthalene. This compound has recently been evaluated by US EPA and was found to present a greater exposure risk than previously thought. The result was a modification of risk screening levels for this compound. A review of soil analysis data in Appendix E indicates the presence of low levels of naphthalene in most wells. However, due to the high level of PCE in soil sample IR25MW54A-BH, the result for naphthalene was masked and led to a concentration of < 50,000 µg/kg. The ESU recommends the final TS resolve the issue of definitive levels of naphthalene in soil and soil gas and the comparison of these levels to recently revised risk levels.	We understand the importance of the naphthalene results especially considering recent changes in the risk screening levels provided by the EPA for this compound. For this reason naphthalene results are included in all data tables of the report. However, naphthalene was not identified as a compound of concern prior to the start of the TS. Due to low levels of naphthalene in both soil and groundwater samples in comparison with high levels of the chlorinated compounds, definitive quantitation of naphthalene for all samples at all times is not possible due to sample dilution. None of the soil samples showed concentrations of naphthalene exceeding the EPA PRG level (1.7 mg/kg, residential soil) or the stricter Water Board Environmental Screening Level (0.46 mg/kg, residential soil). None of the groundwater samples inside or outside the TS area showed naphthalene concentration exceeding EPA National Recommended Ambient Water Quality Criterion (470 µg/L). Only one groundwater sample had naphthalene at a concentration slightly exceeding the Water Board Environmental Screening Level (149 µg/L, residential land use), which was well MW55A at 190 µg/L.

Comments by: Mark Berscheid, DTSC Hazardous Substances Engineer, Engineering Services Unit, dated October 21, 2005				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
5		General Comments	The TS indicates the intent to compare the results of soil samples obtained from the subject area of the saturated zone in the form of: a. Established baseline samples obtained during the implementation of monitoring wells; b. Soil samples collected from the same general area and depth next to each well at the completion of Stage 1; c. Soil samples collected from the same area as above at the completion of Stage 2. The ESU concurs with this means of evaluating the level of treatment attained in the reduction of the adsorbed phase of COC contamination in the saturated zone. The ESU has found that few in situ saturated zone treatment technology projects obtain data from both the dissolved and adsorbed phase by means of groundwater and soil samples respectively. This is especially relevant in the case of PCE as a COC. This compound has a very high distribution coefficient, resulting in a significant adsorbed phase mass of contaminant with respect to the dissolved phase. For instance, the distribution coefficient for PCE can be as much as five times that of TCE. Therefore, in a saturated zone containing the same concentrations of PCE and TCE, there may be as much as five times the mass of TCE in the form of PCE contamination in the same volume of soil. However, the TS devotes only a small paragraph in Stage 1 conclusions (Section 8.2) to indicate the soil sample results are inconclusive. The ESU recommends the final TS contain graphs of soil sample results similar to those provided for other evaluation parameters.	The graphs for soil samples collected during the TS were added as Figures F57 and F58 to Appendix F of the report, and a reference to these new figures was inserted in Section 6.3.

Response to Comments on Draft In Situ Sequential Anaerobic-Aerobic Bioremediation Treatability Study
Remedial Unit C5, Building 134, IR Site 25
Hunters Point Shipyard, San Francisco, California
November 23, 2005, Document Control Number NAV004-031-H

Comments by: James D. Ponton, R.G., California Regional Water Quality Control Board Project Manger, No Date Provided.				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
1		General Comments	We support the remediation of the chlorinated and non-chlorinated volatile organic groundwater plume that originates from beneath Building 134. We are encouraged by the pre and post treatment groundwater data that is included in the TSR. The data strongly suggests that in-situ sequential anaerobic-aerobic bioremediation methods hold promise in the remediation of groundwater that is contaminated by chlorinated and non-chlorinated organic compounds.	Thank you. The Navy appreciates this positive feedback.
2		General Comments	We understand that aquifer heterogeneity in the vicinity of Building 134 poses a significant challenge to the effective, complete, and uniform delivery of the biological substrate/oxygen used in the in-situ treatment process. Additional complications arise from the occasional occurrence of free product (i.e., dense non-aqueous phase liquid (DNAPL)) in some of the aquifer sampling points. The DNAPL serves as a continuing source of chlorinated and non-chlorinated organic compounds to groundwater in the Building 134 area. In an effort to enhance biological substrate/oxygen delivery and overcome the permeability contrasts inherent to a heterogeneous aquifer, the TSR suggests the possible use of high-pressure aquifer injection and fracturing as a means of enhancing substrate/oxygen delivery. We are concerned that high-pressure aquifer injection and fracturing may spread DNAPL both laterally and vertically within the aquifer and force DNAPL into tighter pore spaces and bedrock fractures, making DNAPL recovery and remediation potentially more difficult. We request that before employing high-pressure aquifer injection and fracture strategies, that you evaluate alternate injection strategies to address the concern above.	It is agreed that fracturing of the aquifer may result in mobilization of DNAPLs. Alternate injection strategies should be evaluated and discussed with the Navy and the regulators prior to implementation of the proposed delivery methods. Please also refer to the response to EPA Specific Comment No. 18, dated October 11, 2005.

Comments by: James D. Ponton, R.G., California Regional Water Quality Control Board Project Manger, No Date Provided.				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
3		General Comments	As mentioned above, aquifer heterogeneity limits the capture zone for an extraction well and by contrast, the radius of influence for an injection well. The scattered occurrence of DNAPL can further complicate the complete remediation of the aquifer. We request that consideration be given to conducting additional excavation in the vicinity of the source area to remove ongoing DNAPL sources; and to backfilling the subsurface with materials (e.g., gravel) that are more permeable and conducive to groundwater extraction, injection and circulation	The Navy will consider additional excavation to remove DNAPL from aquifer material, and subsequent backfilling to facilitate substrate circulation.
1		Specific Comments, Figure 1, Site Location Map	Figure 1 depicts two separate groundwater volatile organic compound (VOC) plumes. Both are named RU-C5. One RU-C5 plume occurs in IR-06. The second RU-C5 plume (which is the focus of the TSR), originates from historic VOC releases from Building 134 (IR-25). Please correct the TSR as appropriate, to better describe the nature and extent of the IR-06 VOC plume and its relation to the IR-25 VOC plume.	The Building 134 RU-C5 plume was the focus of the TS. All references to the IR-06 RU-C5 plume were removed from the TS report text.
2		Specific Comments, Figures 8, Upper A Aquifer, Groundwater Elevation Map, December 6-9, 2004; and Figure 9, Upper A Aquifer, Groundwater Elevation Map, May 11-18, 2005	The groundwater elevation contours provided on Figures 8 and 9 appear to be missing the 3-ft elevation contour between wells IR25MW51A and IR06MW44A. Please review the contours and data shown on Figures 8 and 9 and correct these maps as appropriate.	Figures 8 and 9, formerly entitled, "Upper A Aquifer, Groundwater Elevation Map, December 6-9, 2004" and "Upper A Aquifer, Groundwater Elevation Map, May 11-18, 2005," respectively, have been exclude from the final report. Please refer to the response to EPA General Comment No. 3, dated October 11, 2005.

Comments by: James D. Ponton, R.G., California Regional Water Quality Control Board Project Manger, No Date Provided.				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
3	1-3	Specific Comments	The TSR states that the RU-C5 area will be zoned to accommodate mixed land use. Please amend the TSR to define what is meant by mixed land use.	The comment appears to refer to text on Page 1-2; which has been revised to indicate the zoning classification as "mixed land use" refers to combined commercial, industrial and residential.
4	1-3	Specific Comments, Physical features in the vicinity of RU-C5	Our collective experience demonstrates that underground utilities (i.e., physical features) can serve as subsurface conduits and can influence contaminant migration, transport, and the effectiveness of groundwater treatment systems. Although the locations of these physical features in the Building 134 area are referenced back to earlier reports (i.e., Groundwater Summary Report, TtEMI, 2004), we believe that the relationship between the Building 134 physical features, in-situ treatment system, and the groundwater plumes should be shown and included in the appropriate sections of the TSR. Please amend the TSR to include those physical features that are located in the Building 134 area.	A figure showing underground utilities was added to the report, and was labeled Figure 3.
5		Specific Comments, Figure 5, Fraction of Organics in DNAPL (collected from well IR25MW902B)	Figure 5 shows that approximately 60%(by weight) of the organic fraction reported from the DNAPL sampled that was collected from well IR25MW902B is comprised of chlorinated benzenes, with much lesser amounts of chlorinated organics. Please amend the text to explain how the relative proportions of chlorinated and non-chlorinated organics reported in the DNAPL sample compare to relative concentrations of chlorinated and non-chlorinated compounds that are reported for groundwater.	The Navy could not identify any direct correlation between fractions of different compounds in DNAPL and their proportions in groundwater, even in wells in close proximity to DNAPL. A number of factors influence concentrations of organic compounds in groundwater, including solubility, soil absorption fractioning, degradation, specific gravity, and diffusion, and therefore interfere with identifying any direct correlations.
6	7-11	Specific Comments, Section 7.1.4, and Table 2, Groundwater Sampling Locations and Frequency	The potential for vertical migration of contaminants to deeper aquifers was evaluated by sampling wells 56A and 52F. From our review it appears that monitoring well 52F may have been left off of Table 2. Please amend the TSR to include this monitoring well.	The reference to well MW52F is erroneous. The correct well is MW15F, and the text of Section 7.1.4 was changed accordingly.

Comments by: James D. Ponton, R.G., California Regional Water Quality Control Board Project Manger, No Date Provided.				
Comment No.	**Page No.**	**Section, Figure, Table**	**Comments**	**Response**
7		Specific Comments, Section 2.0, Site Geology	Section 2.0 provides a great amount of detail on the Building 134 area's hydrogeology and hydrostratigraphy (i.e., upper A-aquifer, lower A-aquifer, bedrock aquifer, etc.). We recommend amending the TSR to include geologic cross sections that support the hydrogeologic and hydrostratigraphic discussion provided in Section 2.0.	The information presented in Section 2.0 was largely derived from the Groundwater Summary Report (TtEMI, 2004). The cross sections from that report support the hydrogeologic and hydrostratigraphic discussion in this section. Please also refer to the response to EPA Specific Comment No. 3, dated October 11, 2005.