Naval Facilities Engineering Command, Southwest
San Diego, California
Contract No. N68711-04-D-1106
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Final Technical Memorandum
Installation Restoration Program Site 70
Installation of Enhanced In Situ Bioremediation System
Well Installation Phase
Naval Weapons Station Seal Beach
Seal Beach, California

Prepared by:

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January 2008

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LIST OF ACRONYMS AND ABBREVIATIONS

Bechtel	Bechtel Environmental, Inc.
bgs	below ground surface
COC	contaminant of concern
CSM	conceptual site model
CTO	contract task order
Cal-EPA	California Environmental Protection Agency
DNAPL	dense non-aqueous phase liquid
DOE	United States Department of Energy
DON	United States Department of the Navy
DTSC	California Department of Toxic Substances Control
DVD	digital video disc
ECC	Environmental Chemical Corporation
EISB	enhanced *in situ* bioremediation
ERSE	Extended Removal Site Evaluation
ESTCP	Environmental Security Technology Certification Program
EVO	emulsified vegetable oil
EVS	Environmental Visualization Systems
FSB	First Sand Biobarrier
ft	feet
Geosyntec	Geosyntec Consultants
gpm	gallons per minute
GMR	Final Fifth Annual Groundwater Monitoring Report IR Sites 40 and 70
HASP	Health and Safety Plan
IDW	Investigation Derived Waste
IR	Installation Restoration
IW	injection well
K	hydraulic conductivity
KB-1®	dechlorinating microbial culture
µg/L	micrograms per liter
MNA	monitored natural attenuation
MW	monitoring well
NAD83	North American Datum, 1983
NASA	National Aeronautics and Space Administration
NGVD29	National Geodetic Vertical Datum, 1929
NAVFAC SW	Naval Facilities Engineering Command, Southwest Division
NAVWPNSTA	Naval Weapons Station

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PMW	performance monitoring well
POC	point of compliance
PPE	personal protective equipment
Prosonic	Prosonic, Inc.
PVC	polyvinyl chloride
QC	quality control
RA	Remedial Action
RD	Remedial Design
RDO	Remedial Design Optimization
RFC	Request for Change
RFI	Request for Information
RT&E	Research, Testing and Evaluation
RWQCB	California Regional Water Quality Control Board, Santa Ana Region
SAB	Source Area Biobarrier
SAP	Sampling and Analysis Plan
SAT	Source Area Treatment
SHB	Shell Horizon Biobarrier
SOW	scope of work
SSB	Second Sand Biobarrier
TCE	trichloroethene
TCGs	target cleanup goals
TDS	total dissolved solids
TM	Technical Memorandum
VOC	volatile organic compound
WDC	Water Development Corporation
WP	work plan

EXECUTIVE SUMMARY

This Technical Memorandum (TM) presents the technical and operational work performed during installation of groundwater wells for an enhanced *in situ* bioremediation (EISB) system to address groundwater contaminated with chlorinated solvents at Installation Restoration (IR) Program Site 70, Naval Weapons Station (NAVWPNSTA) Seal Beach, California (Figure 1.1). This TM documents the following:

- Documentation of the drilling and well installation program;
- Reevaluation of the subsurface hydrostratigraphy at the site based on observations and data collected during drilling and well installation;
- Reevaluation of the dissolved-phase trichloroethene (TCE) plume morphology; and
- Update of the Conceptual Site Model (CSM).

Environmental Chemical Corporation (ECC), in collaboration with Geosyntec Consultants (Geosyntec), prepared this TM for Naval Facilities Engineering Command, Southwest (NAVFAC SW) under contract N68711-04-D-1106, Contract Task Order (CTO) 003.

Field work on this project commenced in January 2007 and concluded in October 2007. The field program was performed in conformance with the methods and procedures described in the approved work plan (WP) titled *Final Work Plan, Construction of Enhanced In Situ Bioremediation System for Groundwater, Installation Restoration Site 70, Naval Weapons Station Seal Beach, Seal Beach, California* [ECC, 2007] and is consistent with the *Final Remedial Design (RD) for Installation Restoration Site 70 Enhanced In Situ Bioremediation, Naval Weapons Station Seal Beach, Seal Beach, California* [Geosyntec, 2006]. Update of the CSM occurred concurrently with the field activities as the new geologic and hydrogeologic data were collected and interpreted.

Figure 1.3 shows the conceptual layout of the EISB system that is comprised of the Source Area Treatment (SAT) and Source Area Biobarrier (SAB). It also shows the one or two biobarriers constructed in each of the First Sand (designated Biobarrier FSB-1, and FSB-2), Shell Horizon (designated Biobarrier SHB-1 and SHB-3), and Second Sand (designated Biobarrier SSB-1) hydrostratigraphic units. These units are shown in more detail on Figures 3.1 to 3.9. The field program included installation or

rehabilitation of a total of 238 wells, consisting of 195 injection wells (IWs), 26 performance monitoring wells (PMWs), and 17 monitored natural attenuation (MNA) wells.

Wells were surveyed for location and elevation by Dulin & Boynton Licensed Surveyors Inc. The horizontal survey was completed in the California North American Datum 1983 (NAD83) State Plane Zone VI feet coordinate system with vertical elevations reported relative to National Geodetic Vertical Datum 1929 (NGVD29).

Variances from the final WP [ECC, 2007] were documented and submitted to the Navy in the following requests for information (RFIs) and requests for change (RFCs). The following RFIs that pertain to this TM include:

- RFI 001 – Preparation of WP;
- RFI 002 – On-site disposal of IDW water;
- RFI 003 – Redesign of well head completion;
- RFI 004 – Relocation of wells due to above and below ground obstructions;
- RFI 005 – Relocation of wells due to above- and below-ground obstructions;
- RFI 006 – Relocation of wells due to above- and below-ground obstructions;
- RFI 007 – Relocation of wells due to above- and below-ground obstructions;
- RFI 008 – Change of well construction material – stainless steel centralizers;
- RFI 009 – Well design changes due to lithology encountered;
- RFI 010 – Well design changes due to lithology encountered;
- RFI 011 – Relocation and renaming of wells due to lithology and contaminant concentrations encountered;
- RFI 012 – Well design changes due to lithology encountered;
- RFI 013 – Change of decontamination procedure for injection wells;
- RFI 014 – Consolidation of TM deliverables for EISB installation;
- RFI 015 – Wellhead redesign and construction for base year and Option 1-3 (Phases 1-4); and
- RFC02 – Source Area Piping Demolition

Technical problems encountered and addressed during the field operations included:

- Heaving sands at most borehole locations;
- Relocation of biobarriers due to above- or below-ground obstructions;
- Cracked or broken well materials in a few wells; and
- Poor production rates in a few wells during development.

Mitigation of these issues was performed as follows:

- Heaving sands were controlled with hydrostatic pressure provided while drilling.
- As field activities progressed and obstructions were identified, biobarrier locations were adjusted to avoid identified above- or below-ground obstructions.
- Broken well screens were identified in a few wells by the presence of filter-pack sand in the well during well development. In the case of broken well screens, the issue was resolved by removing the broken well screen and casing and then reconstructing the well with a new well screen. The cracked well screens were determined to be the result of hairline fractures in a limited number of well screens caused during transportation to the site. Two wells were found to have broken end caps. These wells were also reconstructed.
- Poor production rates during development were addressed by redeveloping poorly performing wells. In one case, MW-70-PMW05A, the well was destroyed and reinstalled.

Investigation derived waste (IDW) was disposed of as indicated in the approved WP in one of two ways based on the waste matrix:

- Solid IDW (i.e., drill cuttings) was sampled, tested, characterized, transported, and disposed of off site in roll-off bins or drums; and
- Liquid IDW was stored in on-site tanks, sampled, tested, characterized, and, if needed, aerated prior to percolating to the ground near the source area.

Demolition activities occurred in the source area to allow the limited access rig to install treatment wells. A number of pipes, supports, and other decommissioned lines were permanently removed. Prior to removing, the lines and associated piping were verified to be inert and de-energized.

One active 3-in. water line was temporarily disconnected and then put back in service once drilling operations were complete. A hot work permit was obtained from the base Fire Marshall for the pipe cutting activities.

Geosyntec performed updates to the hydrogeologic portion of the CSM based on review of the lithologic logs generated throughout the SAT, SAB, First Sand Biobarrier (FSB),

Shell Horizon Biobarrier (SHB), and Second Sand Biobarrier (SSB) work areas. Additionally, the groundwater analytical data from the *Final Fifth Annual Groundwater Monitoring Report IR Sites 40 and 70, Naval Weapons Station Seal Beach, Seal Beach, California* [Bechtel, 2006] (GMR) were supplemented by data collected in 2006, subsequent to the GMR by Bechtel Environmental, Inc. (Bechtel) in accordance with the *Final Work Plan for Groundwater Monitoring at Installation Restoration Sites 4, 5, 6, and 7, Naval Weapons Station Seal Beach, Seal Beach, California* [Bechtel, 2003]. The GMR and supplemental chemical data were evaluated with newly generated lithologic data from boreholes and wells from this field program using Environmental Visualization Systems (EVS) software. The data were loaded into EVS for visualization, reporting, and analysis purposes. The groundwater chemical data (i.e., the dissolved concentration of TCE in groundwater) were used to generate iso-concentration surfaces of dissolved-phase TCE concentrations greater than 250 micrograms per liter (µg/L) by using the internal kriging algorithm within EVS.

Updates to the CSM include the following:

- Refinement of the Upper Fines, First Sand, Shell Horizon and Second Sand Hydrostratigraphic Units; and
- Refinement of the dissolved-phase TCE plume morphology.

Based on the updated CSM, the 1,000 µg/L extent in the source area is slightly larger, more rounded than previously depicted and the areal extent of the source area 250-µg/L plume is consistent with the RD [Geosyntec, 2006]. The current dissolved-phase TCE plume morphology interpretation is generally consistent with the previous interpretation presented in the RD [Geosyntec, 2006], with one exception as described below. Additional groundwater chemical data near the downgradient, leading edge of the TCE plume support a revised interpretation for the location of the leading edge of the plume. The revised interpretation extends the downgradient limit of the 250 µg/L iso-concentration contour for TCE approximately 200 feet to the southeast. The findings of this study are concluded to be generally consistent with design assumptions provided in the RD [Geosyntec, 2006] except the elevated TCE concentration observed in MW-70-42A (510µg/L TCE). This elevated TCE value and the lower TCE concentration observed at MW-70-44A resulted in relocating SHB-3 downgradient of MW70-42A. The SHB-3 biobarrier was modified to provide treatment in both the First Sand and Shell Horizon.

1. INTRODUCTION

This Technical Memorandum (TM) presents the technical and operational work performed during installation of an injection and monitoring system for an enhanced *in situ* bioremediation (EISB) system for cleanup of groundwater contaminated with chlorinated solvents at Installation Restoration (IR) Program Site 70, Naval Weapons Station (NAVWPNSTA) Seal Beach, California (Figure 1.1). Environmental Chemical Corporation (ECC), in collaboration with Geosyntec Consultants (Geosyntec), prepared this TM under contract N68711-04-D-1106, Contract Task Order (CTO) 003 to Naval Facilities Engineering Command, Southwest (NAVFAC SW). The work was performed in accordance with the Final Work Plan (WP), *Construction of Enhanced In Situ Bioremediation System for Groundwater, Installation Restoration Site 70, Naval Weapons Station Seal Beach, Seal Beach, California,* prepared by ECC in January 2007 [ECC, 2007] and is consistent with the *Final Remedial Design (RD) for Installation Restoration Site 70 Enhanced In Situ Bioremediation, Naval Weapons Station Seal Beach, Seal Beach, California* [Geosyntec, 2006].

NAVWPNSTA Seal Beach is an active federal facility located in Seal Beach, California. NAVWPNSTA Seal Beach is surrounded by several municipalities including Los Alamitos to the north, Westminster to the east, Huntington Beach to the southeast, and Seal Beach and Long Beach to the west. The Pacific Ocean borders NAVWPNSTA Seal Beach to the south (Figure 1.1). The station is not on the National Priorities List. The lead agency for remedial action (RA) at this station is the United States Department of the Navy (DON). Regulatory agencies providing support and oversight include the California Environmental Protection Agency (Cal-EPA), California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) Santa Ana Region.

1.1 Background

IR Site 70 is a former rocket engine test facility within the former National Aeronautics and Space Administration (NASA) Research, Testing, and Evaluation (RT&E) area. IR Site 70 encompasses approximately 40 acres and currently consists of multi-story office and production buildings, asphalt-paved parking areas, above-ground tanks, above- and below-ground piping distribution systems, and several concrete-lined sumps. From 1962 to 1973, NASA utilized the area for the design and manufacture of the second stage of the Saturn V launch vehicle for the Apollo Space Program. Subsequent to NASA leaving the area, the United States Department of Energy (DOE) and Garrett Engineering (Allied Signal) conducted pilot test assembly operations for a classified uranium enrichment process in portions of Building 112 located within IR

Site 70. These tests were conducted from 1980 to 1985 but did not include either the manufacture or enrichment of uranium. Currently, Building 112 is used for storage, electronic research, and office space. Past operations at facilities within IR Site 70 included the use of dilute acids, volatile organic compounds (VOCs) including chlorinated solvents such as trichloroethene (TCE), phenol compounds, petroleum oils, sodium dichromate containing hexavalent chromium, detergents, metals containing paint wastes, and machine lubricating oil. Discharged wastewater contained high total dissolved solids (TDS), sodium chloride, and high or low pH.

Groundwater contamination at IR Site 70 exists in two distinct areas:

(i) A source area with suspected residual dense non-aqueous phase liquids (DNAPLs), and dissolved (TCE) concentrations exceeding 1,000 micrograms per liter (µg/L); and

(ii) A dissolved-phase (VOC) plume extending downgradient in a south-southeasterly direction from the source area (Figure 1.2). The principal contaminant of concern (COC) in the dissolved-phase plume is TCE. The areal extent of the dissolved TCE plume in groundwater as defined by Bechtel Environmental, Inc. (Bechtel) in the *Final Fifth Annual Groundwater Monitoring Report IR Sites 40 and 70, Naval Weapons Station Seal Beach, Seal Beach, California* [Bechtel, 2006] (GMR) is approximately 4000 feet (ft) by 2200 ft, with vertical migration to depths of approximately 160 ft below ground surface (bgs). The water table is approximately 13 ft bgs. The dissolved-phase plume is identified in the following three hydrostratigraphic units; a) the First Sand Unit (60 to 105 ft bgs), b) the Shell Horizon Unit (105 to 135 ft bgs), and c) the Second Sand Unit (135 to 170 ft bgs).

The remedial approach for IR Site 70 is presented in detail in the RD [Geosyntec, 2006]. Figure 1.3 presents the EISB system layout including the approximate 250 µg/L TCE plume footprint. In the suspected source area, EISB will be accomplished by injecting emulsified vegetable oil (EVO) and the dechlorinating culture KB-1® in a grid of source area treatment (SAT) injection wells, combined with a downgradient biobarrier (source area biobarrier [SAB-1]) as shown in Figures 1.4 and 1.5, respectively. The biobarrier consists of appropriately spaced injection wells that will be used to deliver EVO as a long-term electron donor and KB-1® to facilitate a more rapid onset of complete reductive dechlorination of TCE to ethene.

The dissolved-phase plume will be treated with five biobarriers of EISB that will be installed in targeted hydrostratigraphic units, transecting the plume at five locations

along the longitudinal axis of the plume (Figure 1.3). Two biobarriers will be installed in both the First Sand Hydrostratigraphic Unit and the Shell Horizon Hydrostratigraphic Unit and one biobarrier will be installed in the Second Sand Hydrostratigraphic Unit. The First Sand Biobarriers (FSBs) are designated FSB-1 and FSB-2 (Figure 1.6); the Shell Horizon Biobarriers (SHBs) are designated SHB-1 and SHB-3 (Figure 1.7); and the Second Sand Biobarrier (SSB) is designated SSB-1 (Figure 1.8). Each biobarrier consists of appropriately spaced injection wells that will be used to deliver EVO mixed with the dechlorinating culture KB-1®. Groundwater containing dissolved-phase contaminants will be treated by EISB, as the groundwater flows through each biobarrier under ambient groundwater flow, and by natural attenuation process between the biobarriers.

The EISB approach described above will target TCE concentrations above 1,000 µg/L in the source area and above 250 µg/L in the dissolved-phase plume. Results from monitoring will be used to determine when EVO will be reinjected through the treatment wells in the source and plume treatment areas. EVO will be reinjected until TCE concentrations within these areas are reduced to below the active phase target cleanup goal (TCG) of 200 µg/L [Geosyntec, 2006]. Monitored natural attenuation (MNA) will be employed after the active EISB treatment phase until target TCGs are achieved. MNA will also be employed throughout the remainder of the plume not actively treated (i.e., where TCE concentrations are below the active phase TCG of 200 µg/L).

The scope of work (SOW) for EISB at IR Site 70 includes:

1. Installing EISB injection and monitoring wells;
2. Conducting a baseline groundwater monitoring event following well installation;
3. Implementing the program to inject reagents and cultures promoting an EISB treatment of the high concentration source area;
4. Use of passive *in situ* biobarriers and MNA to treat the dissolved-phase plume;
5. Performing periodic groundwater monitoring to evaluate EISB and MNA performance; and
6. Maintaining land use controls.

This TM addresses EISB injection well installation, monitoring well installation, and updates to the Conceptual Site Model (CSM) for the source area and dissolved phase plume. A separate TM will be prepared to document the injection of EISB reagents and cultures and the evaluation of biobarrier and MNA performance.

The purpose of the drilling program was to install the grid of injection wells in the source area, install the six passive biobarriers, and place the monitoring wells required to monitor the effectiveness of EISB in the source area and dissolved phase plume. During the well installation process, the geologic materials encountered in the boreholes were carefully logged and provided detailed site stratigraphic and hydrogeologic information to update the CSM.

1.2 Project Organization

Site activities under this phase of work commenced in January 2007 and were substantially completed in October 2007. As the prime contractor, ECC coordinated and managed the subcontractors needed for this project. During the field activities, ECC provided a Site Superintendent and field office to perform these responsibilities onsite. In addition to their other activities on the site, ECC conducted demolition activities in the source area, removing piping to allow the drill rig access in and around the tank farm.

The lead technical subcontractor was Geosyntec. Geosyntec was responsible for technical oversight, including geologic logging of borings, well design and well construction oversight, well development oversight and documentation, and providing general technical input on design changes during field activities. Additionally, Geosyntec was responsible for updating the CSM with the lithologic data generated during the EISB installation phase of this project. The CSM update also incorporated additional groundwater chemical data that was collected subsequent to the *Final Fifth Annual Groundwater Monitoring Report IR Sites 40 and 70, Naval Weapon Station Seal Beach, Seal Beach, California* (GMR) prepared by Bechtel [2006] as well as lithologic data collected during installation of point of compliance (POC) wells.

The following additional firms served as subcontractors on the project. Geophysical surveys for underground utilities clearance for drill sites were conducted by Spectrum Geophysical Services. Drilling was performed by Prosonic, Inc. (Prosonic), well development was conducted by Prosonic in the source area and by Water Development Corporation (WDC) in the dissolved phase plume area, and well location surveying was conducted by Dulin & Boynton Licensed Surveyors Inc. Waste disposal transportation services for IDW were provided by Denbeste Transportation.

The remainder of this document is organized as follows:

- Section 2 – Field Activities; describes field mobilization, drilling, well installation and development, surveying, variances from the work plan, and IDW management.
- Section 3 – CSM Update; describes revisions and refinements to the site hydrogeology and TCE plume morphology in the CSM.
- Section 4 – Findings; presents the findings of the field investigation and the update of the CSM.
- Section 5 – Planned Activities for IR Site 70 TCE Plume; describes future activities planned for the dissolved-phase plume area.
- Section 6 – References; provides references cited in this document.

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2. FIELD ACTIVITIES

This section describes the field activities, including the methods and procedures used for drill site utility clearance, drilling, geologic logging, well installation, well development, and the processes for addressing and obtaining approval for variances to the WP.

2.1 Mobilization

Mobilization to the site occurred in January 2007. A field office was established at the site by ECC for the purpose of project management and support for evaluation of progress against schedule, quality control (QC), safety training and monitoring, reporting, financial tracking, and on-site meetings. The office housed representatives from ECC, Geosyntec, Prosonic, and WDC. Mobilization activities are addressed in the project WP [ECC, 2007] and included the following:

- Coordinating base passes for field personnel;
- Preparing digging (included traffic control plans) and hot-work permits;
- Scheduling and performing land and utility clearance surveys;
- Coordinating local trucking services for transport of solid investigation derived waste (IDW);
- Coordinating and documenting the disposal of solid IDW with Waste Management Services;
- Coordinating with NAVWPNSTA and regulatory personnel for on-site purge water disposal;
- Interacting with NAVWPNSTA personnel to prevent disruption of base activities; and
- Conducting weekly QC meetings.

Field activities were conducted in overlapping sequence such that work occurred in the source area and concurrently in the six biobarrier work areas of the EISB, including SAB, FSB, SHB, and SSB (Figure 1.3).

2.2 Well Installation and Development

The EISB system installation field program consisted of installation or rehabilitation of a total of 238 wells, consisting of 195 injection wells (IWs), 26 performance monitoring wells (PMWs), and 17 monitored natural attenuation (MNA) wells The 195 IWs included under this project are as follows:

- Source Area Treatment (Figure 1.4) consists of 34 injection wells;
- Biobarrier SAB-1 (Figure 1.5) consists of 14 injection wells;
- Biobarrier FSB-1 (Figure 1.6) consists of 36 injections wells (including 4 RDO wells);
- Biobarrier FSB-2 (Figure 1.6) consists of 29 injection wells;
- Biobarrier SHB-1 (Figure 1.7) consists of 37 injection wells;
- Biobarrier SHB-2 (Figure 1.7) consists of three injection wells;
- Biobarrier SHB-3 (Figure 1.7) consists of 20 injection wells; and
- Biobarrier SSB-1 (Figure 1.8) consists of 22 injection wells.

Wells were installed by using the sonic drilling technique, which provides a continuous soil core sample that supports detailed lithologic logging of the boreholes by field geologists and is consistent with the WP. In accordance with the WP, at least one out of six borings was selected for presentation in formalized lithologic boring logs as representative of the area lithology. Formalized lithologic boring logs for each area are presented in Appendix A. The locations of the formalized lithologic logs are identified on Figures 1.4 - 1.8. Well construction logs were developed by using the software program gINT Version 8.2 and are presented in Appendix B. During drilling activities, photographs were obtained of lithologic cores and are presented in digital video disc (DVD) format in Appendix C. Furthermore, close up photographs were taken of each core bag where a formalized lithologic boring log was planned. After the well surface completions were finished, photographs were taken of the completed well boxes and are also included in Appendix C.

Injection and monitoring wells were drilled, constructed, and developed according to standards set forth in the WP, except as noted in section 2.3 where variances were requested and approved in advance. Prior to drilling each well, drill rods / casing and other miscellaneous equipment were thoroughly decontaminated in accordance with the WP. Equipment decontamination was facilitated through the use of a steam pressure unit and water at a concrete containment area located in the investigation derived waste (IDW) decontamination yard on Bolsa Avenue. Injection and monitoring wells were constructed with 4-inch, Schedule 80 polyvinyl chloride (PVC) casing. The diameter of

the drill casing was measured to be 8 inches, and the diameter of the drill shoe was measured to be 8.25 inches. Measurements in the field show that the resulting borehole diameters were approximately 8.5 inches. The pilot boring diameter is noted in well construction logs as 8-inch nominal. Field work was performed in health and safety Level D in each work area with no reportable events during drilling, installation, and development.

Lithologic boring logs detailing lithology encountered while drilling were generated during the drilling phase of the project. Field lithologic boring logs are presented in Appendix D. Similarly, field well construction logs were generated for wells constructed under this phase of work and are presented in Appendix E.

Field data summary tables were compiled for each treatment zone and included: supporting documents generated for each well; planned and completed well screen intervals; and applicable variances from the WP are presented in Section 2.4. The field data summary tables for SAT, SAB, FSB, SHB, and SSB are presented in Tables 2.1 through 2.5, respectively.

Reconstruction of four Remedial Design Optimization (RDO) wells, RDO-1, RDO-2, RDO-3B, and RDO-4 (Figure 1.6) was required to rehabilitate these wells for use in the injection phase at the site. These wells were also redeveloped consistent with the procedures described below.

Well development was performed for each of the 238 wells installed during this field program as per the WP. Well development consisted of bailing and surging followed by pumping. Well development was performed by Prosonic (Source Area) and WDC (Dissolved Phase Plume) with Geosyntec personnel monitoring well development rates and field parameters as described in the WP. Well development field measurements and quantities were recorded on well development logs and are included in Appendix F. Wells were pumped until at least three consistent field parameter readings (i.e., pH, temperature, electrical conductivity and dissolved oxygen) were obtained. A summary of well development rates and water levels are presented with associated screen intervals in Tables 2.6 and 2.7.

2.3 Survey

The wellhead location survey (i.e., vertical elevation and horizontal location of well casings and surface completions) was completed by Dulin & Boynton Licensed Surveyors Inc. The horizontal survey was completed in the California North American Datum 1983 (NAD83), State Plane Zone VI feet coordinate system with vertical

elevations reported relative to National Geodetic Vertical Datum 1929 (NGVD29). The final survey data is summarized in Table 2.8 and original survey records are presented in Appendix G. The locations of the wells plotted in Figures 1.4 through 1.8 are prepared using the site survey data.

2.4 Request for Information (RFI) or Change (RFC), and Variances from the Work Plan

During the course of this project, field conditions required modifications to the planned work. These variances from the WP were documented in the Request for Information (RFI) and/or Request for Change (RFC) format and submitted to the Navy. The approved RFIs submitted in conjunction with this phase of work (i.e., RFIs 001 through 015) are attached in Appendix H. The approved variances for work performed in this TM are as follows:

- RFI 001 – Preparation of WP (ECC, 2007a). ECC prepared a comprehensive, site-specific WP with Sampling and Analysis Plan (SAP), Health and Safety plan (HASP), Waste Management Plan, and Environmental Protection Plan under one cover within 30 days of notice to proceed. This deliverable addressed specific activities related to site mobilization, drilling/ installation/development of EISB system wells, demobilization, and the preparation of the conceptual site model/technical memorandum.

- RFI 002 – On-site disposal of development water. ECC treated the source area development water by volatilizing the TCE in water with an air sparging system. ECC operated the system for 7 to 8 hours and collected samples of the stored water for laboratory analysis to confirm treatment has lowered TCE concentrations to and/or below compliance guidance.

- RFI 003 – Redesign of well head completions. Many of the 155 Option 1-3 (Phase 2-4) injection wells are located in unimproved areas adjacent to and/or east of the Kitts Highway. The injection wells were completed with 17 x 17-inch steel flush mounted monuments equipped with a watertight rubber gasket and 2-inch sloped concrete pads. Injection wells in low drainage areas were constructed with elevated (6-inch) sloped concrete pads to minimize water leakage into the well box. These alternate well monument construction methods provided the Navy with a finished product that has a much lower profile, lower costs for landscaping maintenance, and better visual aesthetics.

- RFI 004 – Relocation of specific wells due to above- and below-ground obstruction in the Source Area. Due to overhead, surface, and/or subsurface obstructions a number of well locations had to be moved. The final locations were surveyed and are presented on Figures 1.4 and 1.5 as well as Table 2.8.

- RFI 005 – Relocation of specific wells due to above- and below-ground obstructions. Due to surface and/or subsurface obstructions a number of well locations in the FSB-1 and FSB-2 biobarrier alignments were adjusted. Additionally, the relocation of FSB-1 allowed for the utilization of existing monitoring wells as injection wells. The final locations were surveyed (Table 2.8) and are presented on Figure 1.6.

- RFI 006 – Relocation of wells due to above- and below-ground obstructions. Due to surface and/or subsurface obstructions, the SSB-1 biobarrier alignment was relocated. The final locations were surveyed and are presented on Figure 1.8.

- RFI 007 – Relocation of wells due to above- and below-ground obstructions. Due to surface and/or subsurface obstructions the SHB-1 and SHB-2 biobarrier alignment locations were adjusted. The final locations were surveyed and are presented on Figure 1.7.

- RFI 008 – Change of well construction material – stainless-steel centralizers. Stainless-steel centralizers were used during well construction as a stronger alternative to PVC centralizers which were approved in the WP [ECC, 2007a] and RD [Geosyntec, 2006]. The PVC centralizers were suggested in the RD to prevent interference with future down-hole geophysical logging in wells where continuous cores were not collected. Since the drilling for this field study was completed using the sonic drilling method, each borehole drilled resulted in a continuous core, precluding the need for subsequent down-hole geophysical logging. Additionally, stainless steel centralizers were more readily available than PVC centralizers, which helped the well construction program progress at a higher rate.

- RFI 009 – Well design changes due to lithology encountered in well MW-70-MNA07. During drilling, the top of the clayey portion of the Shell Horizon was encountered at approximately 105 ft bgs in nearby wells. The well construction of MW-70-MNA07 was changed in the field with the Navy's approval to allow monitoring closer to the base of the First Sand Unit.

MW-70-MNA07 was completed to a total depth of 100 ft bgs with a screen interval from 90 to 100 ft bgs.

- RFI 010 – Well design changes due to clay lens encountered at approximately 80 ft bgs in wells IW-70-SAB01 and IW-70-SAB04. A clay lens approximately five to ten feet thick was encountered at approximately 80 ft bgs that appeared to be continuous throughout the SAB alignment. MW-70-MNA05 was drilled to provide a third point of reference for the clay to determine its extent to the north. A determination was made in the field, with concurrence of the Navy, to update the design of the wells as follows: IW-70-SAB01 was completed to a total depth of 80 ft bgs with a screen interval from 60 ft bgs to 80 ft bgs; IW-70-SAB04 was completed to a total depth of 105 ft bgs with a screen interval from 60 ft bgs to 80 feet bgs, a blank interval from 80 ft bgs to 85 ft bgs, and a screen interval from 85 ft bgs to 105 ft bgs. IW-70-SAB01 was completed above the clay layer. IW-70-SAB04 was completed with a blank interval across the clay layer. The two designs provided the most flexibility for additional design changes along the barrier, if needed. Subsequent borings along the SAB alignment did not encounter the clay layer leading to the later determination that the clay layer is a non-extensive clay lens.

- RFI 011 – Relocation and renaming of specific wells due to lithology and contaminant concentrations encountered; Due to observed conditions in MW-70-42A and wells MW-70-MNA15 and MW-70-MNA17, planned biobarrier SHB-2 was relocated and renamed SHB-3 to indicate that it is a new location for that biobarrier. A detection of TCE in excess of 500 μg/L in the interval between 86 to 106 ft bgs in MW-70-42A required placement of a treatment biobarrier further downgradient. By moving the biobarrier from the planned SHB-2 location to the new SHB-3 location and screening the wells across both the First Sand and Shell Horizon Hydrostratigraphic Units, treatment will be provided across the leading edge of the plume. Also, the location of monitoring well MW-70-MNA14 was shifted to be along SHB-3 biobarrier (Figure 1.7). Additionally, performance monitoring wells MW-70-PMW11A/B and -PMW12A/B were relocated and additional screen intervals were added.

- RFI 012 – Well design changes due to lithology encountered at biobarrier SHB-1; Due to lithologic logs showing a continuous fine-grained layer (i.e., increased clay and silt content) at least 5 feet thick ranging from

approximately 110-120 ft bgs wells in this area were completed with screen intervals from 105 to 130 ft bgs with 5- to 10-ft blank casings constructed across the fine-grained layer. The length of the casing was consistent with the thickness of the fine-grained unit. The placement of blank casing between screen intervals provides additional flexibility during the injection phase of the project, whereby separate injection schemes can be used in each screen interval, if necessary.

- RFI 013 – Change of decontamination procedure; Due to the extended time required for the track-mounted drill rig to travel to and from the decontamination site (i.e., two hours), the procedure for traveling offsite for decontamination was eliminated and replaced with an alternative, more efficient decontamination method. The alternative method combined using decontamination procedures implemented near the drill site plus sequencing the drilling to proceed from the outer edge of the plume (i.e., low contamination potential) toward the center of the plume (i.e., higher contamination potential) within each biobarrier alignment. The revised procedure consisted of rinsing the down-hole equipment in the well head tub using potable water. Once the conductor casing and core barrel were rinsed of soil debris, they were stacked and dried for use on the next injection well. When the drill rig was moved to other alignments and into MNA and PMW wells, decontamination procedures were resumed in accordance to the RD [Geosyntec, 2006].

- RFI 014 – Consolidation of technical memorandum deliverables for EISB installation; In order to optimize project resources, one TM shall document the field work and findings of the EISB installation work done in the FSB, SSB, and SHB biobarrier areas, instead of three separate TM documents as proposed in the RD [Geosyntec, 2006]. This approved change conforms to the SOW criteria for addressing all site areas and field activities. The consolidated TM will include boring logs, well completion diagrams, well development logs, well location survey, work plan deviations, and updates to the lithologic CSM.

- RFI 015 – Wellhead surface completion redesign and construction for base year and Options 1-3 (Phases 1-4); A revised wellhead configuration will be used for wellhead completions. The revised design will facilitate a water-tight union from the 4-inch outer diameter well casing to the 2-inch outer diameter PVC pipe manifold piping for the EVO delivery system. The revised design

will improve the EVO delivery system performance for the 147 injection wells. The approved cam-lock system will enable a quick-release coupling that provides a pressure tight seal required for EVO injection. The quick-release coupling mechanism will reduce the labor time needed for injection setup, speed up the field operations, and provide better wellhead security over the original bolt-and-plate flange design proposed in the RD [Geosyntec, 2006].

- RFC 002 – Source Area piping demolition. Piping demolition was required for a small portion of the existing tank farm to facilitate access for installing 19 injection and monitoring wells in the IR Site 70 source area. Work required specialized subcontractors to verify inert and de-energize piping prior to cutting and removing select sections with a 3-inch waterline brought back into service upon well completion. Limited site access also included support of a 60-ton heavy lift crane to hoist a Spider sonic drill rig over piping deemed critical to the existing fire suppression system.

2.5 Technical Issues Encountered During the Drilling Program

The drilling program consisted of 238 injection and/or monitoring wells with screen interval depths ranging between 25 and 170 ft bgs. The drilling program comprised 26,383 feet of total drilling which was completed over the 10-month period from January 2007 through October 2007. The program was substantially completed on time and on schedule with no recordable Health and Safety incidents. Typical for a drilling program of this size and complexity, a few technical issues or challenges were encountered during the drilling program as described below.

During the well construction phase of work, the project team noted cracks in a few of the well screens shipped to the site. The cracks appeared to be caused from over-tightening of the shipping straps during transportation. Following a careful inspection of the screens shipped to the site, screens identified as damaged were discarded.

Heaving sands occur when unconsolidated, saturated sand sediments are intercepted during drilling. The unconsolidated sand material flows into the borehole, disrupting further drilling and well installation. As expected, heaving sands were encountered throughout the drilling program. In general, heaving sands were controlled by introducing additional hydrostatic head while drilling. However, in 16 wells, the heaving sand condition in conjunction with defective drill materials (cracked screen, worn drill casing) was severe enough to require re-drilling.

Relocation of wells and biobarrier alignments occurred at a number of locations due to above- and below-ground obstructions, as well as, lithology and chemical results. In cases where biobarriers were relocated (FSB-1, SHB-3, and SSB-1), the new alignments were entered into the fate and transport model generated as part of the RD (Geosyntec, 2006). Once entered into the model, simulations were run to determine effects to predicted longevity of the biobarriers. Generally the longevity of the biobarriers increased as a result of relocations. The greatest increase occurred with the relocation of SHB-2 to SHB-3 showing an increase of approximately two years of projected active treatment time for the barrier.

The following subsections discuss specific issues encountered at each of the biobarriers, including heaving sands, broken screens, and difficulties due to the properties of the encountered geologic materials.

2.5.1 Source Area Treatment and Biobarrier (SAT and SAB)

There were 40 wells constructed as part of the SAT area and 19 wells constructed as part of the SAB area. The total footage for the SAT area was 2,240 feet and the total for the 19 SAB wells was 2,015 feet. The SAT injection wells were installed from 25 to 55 ft bgs. The SAB-1 biobarrier injection wells were installed from 60 to 105 ft. The monitoring wells for the source area zone were constructed with a 10-foot screen interval and ranged in depths starting from 45 to 100 ft bgs.

<u>Source Area Treatment SAT</u>

During installation of the SAT wells, heaving sands, defective well construction, and low development rates were encountered in some wells. The following are details of technical issues encountered specific to SAT wells.

- Injection well IW-70-SAT08 - Heaving sands were encountered while installing well IW-70-SAT08. The boring was re-drilled in the same location and the well was installed in accordance with the RD.

- Injection wells IW-70-SAT10, IW-70-SAT14, and IW-70-SAT28 - Well development produced evidence of filter pack within wells IW-70-SAT10, IW-70-SAT14, and IW-70-SAT28. Filter pack within the screen interval is indicative of a broken screen or broken end cap. It was determined that the wells were inadequately constructed and were subsequently reconstructed in the same borings.

- IW-70-SAT32, IW-70-SAT33, and IW-70-SAT34 - Concurrent with field operations, well development logs were reviewed periodically. These wells were re-developed based on their low production rates. Wells IW-70-SAT32, IW-70-SAT33, and IW-70-SAT34 originally exhibited low production rates of approximately 3 gallons per minute (gpm). Redevelopment of these wells resulted in final pumping rates ranging from approximately 4 gpm to 6 gpm.

Source Area Biobarrier SAB

SAB were the first wells drilled under this CTO. Heaving sands and defective well construction were encountered in select wells. The following are details of technical issues encountered specific to SAB wells.

- Injection well IW-70-SAB03 - Heaving sands were encountered while drilling IW-70-SAB03. The well could not be set in these conditions resulting in the relocation of the well approximately 5 ft to the southeast. The original borehole was abandoned with approximately 475 pounds (9.5 bags) of grout mixed with approximately 267 gallons of water.

- Injection well IW-70-SAB12 - Well development produced evidence of filter pack within well IW-70-SAB12. Filter pack within the screen interval is indicative of a broken screen or broken end cap. It was determined that the well was inadequately constructed and was subsequently reconstructed in the same boring.

2.5.2 First Sand Biobarriers (FSB-1 and FSB-2)

Two biobarriers (FSB-1 and FSB-2) were constructed in the First Sand Hydrostratigraphic Unit. FSB-1 consists of 42 wells (including injection and monitoring wells) and FSB-2 consists of 36 wells (including injection and monitoring wells). The total drilled footage for the 42 wells in FSB-1 was 4,371 feet, and the total for the 36 wells in FSB-2 was 3,612 feet. In the upgradient First Sand biobarrier FSB-1, the injection wells were screened from 60 to 105 ft bgs. In the downgradient First Sand biobarrier FSB-2, the injection wells were screened from 65 to 100 ft bgs. The monitoring wells for biobarriers FSB-1 and FSB-2 were constructed with a 10-foot screen interval and ranged in depths starting from 65 to 90 ft bgs.

First Sand Biobarrier FSB-1 and FSB-2

The FSB-1 biobarrier was relocated upgradient due to underground utilities and/or other site obstructions. These wells were relocated in accordance with the RD [Geosyntec, 2006] following input from Geosyntec and Navy approval. The orientation and well spacing within the biobarrier was maintained per the RD [Geosyntec, 2006]. The following are details of technical issues encountered specific to FSB-1 and FSB-2.

- Injection Well IW-70-FSB209 – Heaving sands were encountered while installing this well. The boring was redrilled and the injection well installed in accordance with the RD.

- Injection Well IW-70-FSB222 – Concurrent with field operation, well development logs were reviewed periodically. Wells were redeveloped if low groundwater production rates were observed following an initial round of well development. Following the initial well development of IW-70-FSB222, the well exhibited a low production rate of approximately 3 gallons per minute (gpm). Redevelopment of this well resulted in an increased production rate of approximately 8 gpm to 10 gpm, which is within the range of production of other wells in the FSB-1 biobarrier.

- Monitoring Well MW-70-PMW05A – During well development, monitoring well MW-70-PMW05A was found to have a very low production rate of 1 gpm. Based on this result, it was concluded the well did not have a viable connection to the aquifer (i.e., the screen interval was not in hydraulic connection with the aquifer), therefore, this well was redrilled and reconstructed in a new boring 10 feet cross-gradient. The original well was removed and the boring abandoned with bentonite grout. The original well was likely located within the radius of grout proliferation of MW-70-PMW5B. The relocated well developed satisfactorily.

2.5.3 Shell Horizon Unit Biobarriers (SHB-1 and SHB-3)

Two biobarriers (SHB-1 and SHB-3) were installed in the Shell Horizon Hydrostratigraphic Unit. Biobarrier SHB-1 comprised 40 installed wells (including injection and monitoring wells) and biobarrier SHB-3 comprised 25 wells (including injection and monitoring wells). Due to lithology and contaminant concentrations encountered, one of the planned barrier alignments (SHB-2) was abandoned and a new biobarrier alignment was located further downgradient and designated as SHB-3 (see RFI 011). The total footage of drilling for SHB-1 was 5,718 ft, and SHB-3 had a

total drilled footage of 3,229 ft. In the upgradient biobarrier SHB-1, the wells were screened from 100 to 130 ft bgs. In the downgradient biobarrier SHB-3, the wells were screened from 80 to 130 ft bgs, with a 10-foot blank riser at approximately 100 to 110 ft bgs.

Shell Horizon Biobarrier SHB-1

Due to underground utilities and/or obstructions, the planned location of biobarrier SHB-1 needed to be moved slightly downgradient (i.e., to the southeast). The orientation and spacing of the wells within the biobarrier were maintained per the RD [Geosyntec, 2006]. A fine-grained layer (i.e., increased silt and clay content), more than 5 feet thick, was observed at approximately 110 to 120 ft bgs, which was within the proposed screen interval at 24 well locations in the SHB-1 biobarrier (Table 2.4). For these 24 wells, the well screen design included a 5-foot blank casing section that was constructed at the depth interval of the fine-grained layer. The following are details of technical issues encountered specific to SHB-1.

- Injection Well IW-70-SHB106 – During the drilling of this well a series of events occurred, including loss of the outer drill casing and damage by forklift. Drill Rig SR-117 lost a portion of the 8-inch diameter outer drill casing into the bottom of the borehole. To recover the lost 8-inch diameter casing, the driller used 9-inch diameter casing to over-drill and recover the casing from the bottom of the borehole. As a result, the new borehole diameter was a nominal 9 inches. After construction was complete, IW-70-SHB106 was damaged by a forklift and deemed not viable for injection purposes. The well was reconstructed in the same borehole with the 9-inch diameter outer casing and a new surface completion.

- Injection Well IW-70-SHB111 – During the drilling effort, 20 feet of outer drill casing was lost down the borehole at approximately 110-130 ft bgs and left in the ground. The well was relocated at a new location approximately 20 feet upgradient. The abandoned borehole was properly grouted to the surface with bentonite-cement grout.

- Injection Well IW-70-SHB113 – Following well construction, well development was performed at IW-70-SHB113. During the well development process, filter-pack sand was observed in the development bailer. It was determined that the well was inadequately constructed and subsequently reconstructed in the same boring. Following well reconstruction, well development proceeded in conformance with the WP.

- Injection Wells IW-70-SHB118 and IW-70-SHB119 – During drilling, 20 feet of outer steel drill casing broke off at 110 to 130 ft bgs in both the IW-70-SHB118 and IW-70-SHB119 boreholes. Both boreholes were drilled to 132 ft bgs prior to the casing breaking off. In both cases, the drill casing could not be recovered from the borehole which prevented well construction. Thus, each original borehole was properly abandoned and a new borehole was advanced and well constructed approximately 5 feet to the southeast of the original borehole. The abandoned borehole was properly grouted to the surface with Wyo-Ben grout.

- Injection Well IW-70-SHB123 – Following well construction, well development was performed at IW-70-SHB123. During the well development process, filter-pack sand was observed in the development bailer. It was determined the well was inadequately constructed and subsequently reconstructed in the same boring. Following well reconstruction, well development proceeded in conformance with the WP.

- Injection Well IW-70-SHB127 – Following an initial round of well development, Well IW-70-SHB127 exhibited a low production rate of approximately 5 gpm. Upon completing a second round of development, an increased production rate was not achieved and it was concluded the aquifer interval screened by this well had limited groundwater production capacity. Therefore, this well will have a limited capacity for the rate of injection.

Shell Horizon Biobarrier SHB3

Three wells in the SHB-2 biobarrier were installed. Based on the observed geologic materials (i.e., fine-grained soils with limited production capacity) and chemical conditions at MW-70-42A, the biobarrier was abandoned, moved to a new location, and renamed biobarrier SHB-3. The three SHB-2 wells were kept to allow versatility for monitoring capacity in the future. Relocation of wells was done in accordance with the RD [Geosyntec, 2006] with input from Geosyntec and Navy concurrence. The following are details of technical issues encountered specific to SHB-3.

- Injection Well IW-70-SHB311 – Due to extreme heaving sand conditions, this well casing had to be pulled out and reinserted multiple times in an attempt to set the well casing. As a result, it was deemed appropriate for new casing material to be used in the reconstruction of the well.

- Monitoring Wells MW-70-PMW11B and MW-70-PMW-12B – These two monitoring wells were included into the SHB-3 biobarrier zone to monitor the deeper screen interval (Shell Horizon) in the injection wells. MW-70-PMW-11A and MW-70-12A were installed in the First Sand interval.

- Monitoring Well MW-70-MNA14 – Monitoring well MW-70-MNA14 was moved downgradient to adjust for the relocation of SHB-3.

2.5.4 Second Sand Biobarrier SSB-1

The drilling program for the SSB-1 biobarrier consisted of 29 wells with a total of 4,759 feet of drilling. The injection wells were screened from 125 to 165 ft bgs and the monitoring wells were screened from 140 to 150 ft bgs.

Injection wells for the SSB-1 biobarrier were relocated due to underground utilities and/or overhead or underground obstructions. Relocation of wells was done in accordance with the RD [Geosyntec, 2006] with input from Geosyntec and approval by the Navy. To maintain the biobarrier alignment and avoid identified obstructions, the SSB-1 biobarrier was repositioned downgradient approximately 200 feet (i.e., to the southeast). The orientation and well spacing within the biobarrier was maintained per the RD [Geosyntec, 2006]. The following are details of technical issues encountered specific to SSB-1.

- Injection Well IW-70-PMW14A – During drilling, the outer drill casing was lost down the borehole and could not be recovered. Thus, the drill casing was left in the ground and the borehole was abandoned. The well was relocated approximately 5 feet crossgradient and completed as designed. The original borehole abandonment consisted of filter pack sand placed from the bottom of the borehole at 138 feet up to a depth of approximately 120 ft bgs. Six feet of hydrated bentonite chips were placed above the filter pack, and the remainder of the borehole was subsequently filled to ground surface with bentonite-cement grout.

2.6 Procedures for Decontamination of Down-Hole Drilling Assembly

The decontamination of down-hole drill casing and pipe is designed to prevent cross-contamination of soils and liquids collected on down-hole equipment from one borehole being added to the next borehole. To reduce the potential for cross-contamination, the injection wells were drilled in a sequence where drill sites at the outer edge of the plume (i.e., low contamination potential) were drilled first. Drill sites in the center of

the plume (i.e., higher contamination potential) were drilled last. Thus, given the drilling sequence described above, performing time consuming, off-site decontamination of the down-hole drilling assembly between injection wells was concluded to be of very limited technical benefit. The approved alternate decontamination method between borehole/wells was to rinse the down-hole drilling equipment in the wellhead tub using potable water. Once the conductor casing and the core barrel were free of soil debris and liquids, they were stacked and prepared for use on the next borehole. Eliminating the decontamination step at the IDW decontamination yard helped the drilling program proceed more efficiently. Decontamination procedures were completed at the IDW Decontamination Yard for all PMW, MNA, and other monitoring wells. Most of the injection well decontamination was completed at the IDW Decontamination Yard until the Navy approved "on-site" decontamination.

2.7 Investigation Derived Waste (IDW) Management

IDW was disposed of as described in the approved WP [ECC, 2007a] in one of two ways based on its matrix as listed below:

- Solid IDW, which consists of soil cuttings, inert refuse, and personal protection equipment (PPE), was sampled, tested, and characterized prior to being transported, and disposed of offsite as non-hazardous waste in roll-off bins or drums; and

- Liquid IDW, which consists of decontamination water and purge water from development, was stored in on-site tanks, sampled, tested, characterized, and aerated prior to discharging to the ground near the source area (see Figure 2.4). Aeration of the water was conducted in compliance with South Coast Air Quality Management guidelines and standards for daily emission levels.

The following is a summary of how IDWs were managed during the field program. As described above, IDW generated at IR Site 70 included soil cuttings, decontamination water, purge water (from well development), PPE, and inert refuse. Prior to being filled, IDW containers were labeled and entered into a computer database. The database contained the history of all the bins, tanks, and drums that were utilized during the field program. The disposition of the solid IDW is presented in Table 2.9. Solid IDW was stored on site in 20-cubic yard capacity bins. Grab samples from two bins in the source area were collected and sent to an off-site laboratory for analysis. With regard to solid waste disposal, source area soils were expected to present the worst-case scenario for soils encountered at the site. Results of laboratory analysis of solid IDW,

provided in Appendix I, showed materials in these two bins to be classified as non-hazardous and all subsequent bins were shipped using this profile. As the bins were filled (50 to 75 percent of full capacity due to weight restrictions), they were shipped off site to one of three approved Waste Management Services facilities: Bradley Landfill; Antelope Valley Landfill; and Simi Valley Landfill.

Liquid IDW from decontamination activities and well development was stored on site in 22,000-gallon tanks while characterization samples were collected and tested (Appendix I). The liquids in the tanks were then air-sparged (i.e., aerated) to decrease the TCE concentrations. After the aeration, the water was discharged on site in one of three locations (Figure 2.1). Each tank was thoroughly cleaned and pressure washed prior to on-site relocation and/or off-site transport. A summary of the disposition records for the liquid IDW is presented in Table 2.10

In addition, some solid refuse in the form of paint chips, metal shavings, and other particulates was generated as a result of demolition activities in the source area. This solid waste was containerized in a 55-gallon drum, characterized by sending composite samples of the waste for chemical analyses (Appendix I), characterized as hazardous, and shipped offsite to Clean Harbors in Wilmington, Ca.

2.8 Piping Demolition

ECC performed demolition activities in a small part of the source area to allow the limited access rig to install treatment wells. A number of pipes, supports, and other decommissioned lines were permanently removed. Prior to removing, the lines and associated piping were verified to be inert and de-energized and a hot work permit was obtained from the base Fire Marshall. Subsequent to removal, the metal piping was recycled in the stations steel recycling program.

One active 3-in. water line was temporarily disconnected and then put back in service once drilling and development operations were complete.

3. CONCEPTUAL SITE MODEL UPDATE

Geosyntec performed updates to the CSM concurrently with the installation of the SAT, SAB, FSB, SHB, and SSB work areas. The CSM update included the following:

- As the drilling program progressed, new borehole lithologic data were added to the hydrogeologic interpretation in the CSM developed for the RD [Geosyntec, 2006]. The new borehole lithologic data were added to the CSM data set and were compared with the hydrogeologic interpretation in the CSM. When new borehole lithologic data were not consistent with the CSM interpretation (i.e., the depth or material properties of hydrogeologic units differed), the CSM was refined or revised to conform to the newly acquired data. Lithologic data collected during the installation of the POC wells were also included in this revised CSM.

- The CSM developed in the RD [Geosyntec, 2006] also includes an interpretation of the vertical and lateral extent of migration of the dissolved-phase plume by using the TCE 250 µg/L iso-concentration limit. Prior to this drilling program, the dissolved-phase TCE plume morphology interpretation in the CSM [Geosyntec, 2006] was based on the groundwater chemical data from the GMR [Bechtel, 2006]. Since the time of the CSM development, additional analytical data (i.e., TCE concentrations in groundwater) became available and were added to the CSM data set. These new data were used to update the dissolved-phase TCE plume morphology in the CSM.

Appendix J contains additional lithologic logs, well construction logs, and analytical data collected by Bechtel subsequent to the GMR [Bechtel, 2006] that comprise the additional data set collected and used in support of updating the CSM from the RD [Geosyntec, 2006]. The data were collected by Bechtel in accordance with the *Final Work Plan for Groundwater Monitoring at Installation Restoration Sites 4, 5, 6, and 7, Naval Weapons Station Seal Beach, Seal Beach, California* [Bechtel, 2003]. The data collection efforts included installation and sampling of wells MW-70-44A/B/C, MW-70-45A/B/C, MW-70-46A/B, MW-70-47, and MW70-48. Lithologic and well construction logs generated for MW-70-POC01, MW-70-POC02, MW-70-POC03, and MW-70-POC04 are also included in Appendix J.

Geosyntec combined the existing and newly acquired subsurface lithologic data and dissolved-phase TCE plume data into an aggregate data set which was then evaluated using Environmental Visualization Systems (EVS) software. EVS provides a tool for 3-dimensional analysis and visualization of both the subsurface hydrogeology and

dissolved-phase TCE plume morphology. Geosyntec used the internal kriging algorithm within EVS to generate iso-concentration surfaces of dissolved-phase TCE concentrations greater than 250 µg/L.

An overview of the existing hydrogeologic CSM from the RD [Geosyntec, 2006] is provided in the following section. Updates to the CSM follow in section 3.2 below.

3.1 Existing Conceptual Site Model (CSM)

The information presented within this section is based upon the CSM that was developed from the results of the Pilot Study activities of the RD [Geosyntec, 2006]. The hydrostratigraphic units in the site vicinity have been defined based upon variations in soil material properties and hydraulic conductivity (K). Hydrostratigraphic units with low hydraulic conductivities (e.g., silt and clay horizons) are expected to impede transport of dissolved-phase solutes, whereas hydrostratigraphic units with high hydraulic conductivities (e.g., sand and shell layers) are expected to provide potential pathways for dissolved-phase solute transport and also are targeted for injection of EVO and KB-1®. The hydrostratigraphic units in the CSM are shown in the cross-sectional view in Figure 2.6 in the RD [Geosyntec, 2006]. This CSM consists of six separate hydrostratigraphic units or model layers. Proceeding from shallowest to deepest, the hydrostratigraphic units are identified as follows:

- **Upper Fines Unit (ground surface to approximately 60 ft bgs).** The Upper Fines Unit comprises three zones: a) a shallow zone of surficial soils and recent clayey sediments; b) an intermediate zone of interbedded silts, clays, and sandy silts and clays that include a semi-perched zone; and c) a lower zone of interbedded silts, clays, and fine- to coarse-grained, silty to clayey sands. A zone of organic material, mainly wood chips, was encountered in a number of boreholes at a depth of approximately 45 to 50 ft bgs.

- **First Sand Unit (approximately 60 to 105 ft bgs).** The First Sand Unit consists of poorly-graded, fine-grained sands and silty sands. A coarse sand/fine gravel layer was encountered in several borings between 80 and 95 ft bgs. This coarse layer lies just above or slightly within the underlying Shell Horizon Unit. The First Sand Unit varies in thickness from approximately 30 to 50 ft.

- **Shell Horizon Unit (approximately 105 to 135 ft bgs).** The Shell Horizon Unit is characterized by a sequence of interbedded clays, silts, sands, and gravels with laterally discontinuous interbeds of dense shells and shell

fragments. This unit is characterized by a sequence of interbedded clays, silts, sands, and gravels below the source area grading to predominantly fine-grained sand in the vicinity of remedial design optimization (RDO) well RDO-6A/B between 1st and 2nd Street in the dissolved-phase plume area. This unit has been subdivided into the Shell Horizon (interbedded clays) and Shell Horizon (fine-grained sands) to reflect differences in the hydrogeologic characteristics and potential plume migration behavior. Shell and gravel layers were encountered in some but not all borings, comprising interbeds within the Shell Horizon Unit that do not appear to be spatially extensive. Wood chips were encountered in several borings at a depth of about 110 ft bgs.

- **Second Sand Unit (approximately 135 to 170 ft bgs).** Similar in character to the First Sand Unit, however, this lower unit appears to be slightly coarser in its upper section.

- **Deep Clay Unit (approximately 170 to 190 ft bgs).** The Deep Clay Unit consists of an upper clay to silty clay horizon and an underlying clayey silt, silt, sandy silt, or sandy clay layer. The upper clay to silty clay horizon appears to be a continuous low-permeability unit that is encountered at depths ranging between 164 to 176 ft bgs. The upper clay to silty clay unit grades downward to clayey silt, silt, sandy silt, or sandy clay. This underlying layer is 3 to 20 ft thick, extending to depths of 175 to 188 ft bgs. Below the clayey silt, silt, sandy silt, or sandy clay layer is a silty sand and sand layer, up to 6 feet thick, which has been found to a depth of 191 ft bgs in extended removal site evaluation (ERSE) borings at NAVWPNSTA Seal Beach.

- **Deep Sand Unit (approximately 190 ft bgs and below).** The Deep Sand Units consists of variable sands (i.e., fine-grained sands and silty sands) and appears to be similar in character to the First and Second Sand Units; however, the Deep Sand Unit has been encountered and logged in only a few boreholes on NAVWPNSTA Seal Beach [Bechtel, 2002].

3.2 Updates to Conceptual Site Model (CSM)

3.2.1 Lithologic Conceptual Site Model Updates

Lithologic information gathered from borehole logs from the SAT, SAB, FSB, SHB, and SSB work areas and associated monitoring wells installed during this work were used to update the CSM defined in the RD [Geosyntec, 2006]. Additionally, lithologic

data collected during installation of the POC wells relating to the Deep Clay contact were also used in this revision. Lithologic boring logs, used for defining the CSM within EVS for the RD, were reviewed and interpretations were made consistent with the established hydrostratigraphic units.

Geosyntec revised the hydrogeologic interpretation of the CSM in the source area based on the lithologic logs from the 59 wells in the source area. These revisions were carried throughout the remaining area and used while interpreting the additional 179 wells which were part of this drilling program. In summary, updates to the CSM included: a) revision of the Upper Fines Unit (ground surface to approximately 60 ft bgs) into distinct hydrogeologic layers; and b) updates to the depth to the previously defined hydrostratigraphic units.

The revised hydrostratigraphic definition of the Upper Fines Unit consists of the following from the top to bottom of the unit:

- From the ground surface to a depth of approximately 20 ft bgs, the unit consists of predominantly clayey soils (i.e., “surficial fines”);
- At a depth of approximately 20 ft bgs, a predominantly fine-grained sand is intercepted that ranges in thickness from 2 to 17 ft thick (i.e., “20 ft sand”);
- At a depth of approximately 30 to 38 ft bgs, a predominantly clayey unit is intercepted that ranges in thickness from approximately 3 to 10 ft thick (i.e., “30 ft fines”);
- At depths of 38 to 57 ft bgs, a fine- to medium-grained sand unit is intercepted that ranges in thickness from 13 to 20 ft thick (i.e., “40 ft sand”); and
- At approximately 57 to 60 ft bgs, a silty clay to clay layer is intercepted that ranges in thickness from 2 to 3 ft thick (i.e., “60 ft clay”).

The SAB wells penetrating into the First Sand show a similar lithology down to a depth of approximately 60 ft bgs which then changes to interbedded fine-grained and medium-grained sands to approximately 100 ft bgs with local clay units from approximately 80 ft bgs to 90 ft bgs. This change in lithology remains consistent with the First Sand Unit beginning at approximately 60 ft as described previously.

The lithology encountered from approximately 100 ft bgs to approximately 105 ft bgs consists of fine-grained sand grading to a silty clay/clayey silt with an approximately

six-inch shell layer occurring at about 99 ft bgs. This shell layer along with the grading to a finer-grained unit (e.g., silty very fine sand to silt) is consistent with the lower portion of the First Sand Unit and the top of the Shell Horizon.

The revisions made to the hydrostratigraphic units in the Upper Fines Unit have been incorporated throughout the CSM. It is important to note that while the "60 ft clay" appears continuous along the lines of cross-section, the unit grades from clays to silts throughout the CSM.

The definition of units occurring hydrostratigraphically below the Upper Fines Unit appears consistent with the previous hydrostratigraphic interpretation; therefore, their definitions are not updated here. Hydrostratigraphic contact depths were adjusted in the CSM based on the new data.

The updated lithologic interpretation in the CSM is presented in a series of cross-sections. Figure 3.1 presents a cross-sectional view of the Upper Fines from the west to the east looking to the north. Figure 3.2 presents a north-south cross-section along the long axis of the Upper Fines plume in this area. Directly below the tank farm, Figures 3.1 and 3.2 present intersecting cross sections that show an apparent depression of the lower contact of the fine-grained sand unit, which begins at approximately 20 ft bgs, and a thinning of the fine-grained unit (generally found beginning at approximately 30 ft bgs).

A cross-section is presented in Figure 3.3 depicting the subsurface hydrogeology along the SAB alignment. The southwest to northeast trending cross section shows the multilayered hydrogeology present along this alignment. A non-continuous clay layer between 80 ft bgs and 90 ft bgs was encountered while drilling some of the wells along this alignment. This finding raised concern that the design would require modification. Based on interpretations made in the field and review of nearby lithologic logs it was determined that this fine-grained layer was not a significant enough influence on the groundwater flow to include in the updated CSM.

Figures 3.4 and 3.5 present cross-sections of biobarriers FSB-1 and -2, respectively; Figures 3.6 through 3.8 present cross-sections of biobarriers SHB-1, -2, and -3, respectively; and Figure 3.9 presents a cross-section of biobarrier SSB-1. Each of the cross-sections listed above are oriented perpendicular to the general longitudinal axis of the dissolved-phase TCE plume. Figure 3.10 presents a northwest-southeast trending cross-section that is oriented parallel to the general longitudinal axis of the dissolved-phase TCE plume.

Note that a clay layer was encountered at approximately 110 ft bgs in wells IW-70-SHB104 through IW-70-SHB137 with a thickness ranging from approximately 1 to 17 feet. This layer was added to the Shell Horizon Unit in the CSM. Lithologic logs to the southeast do not show the continuation of the clay lens, however, blank casing was installed in wells where a significant thickness of clay (more than 5 feet) was observed to allow increased flexibility in the injection phase of the project.

3.2.2 TCE Plume Conceptual Site Model Updates

The TCE plume morphology has been updated to conform to the latest set of chemical data. The data set includes the groundwater chemical data collected during the Pilot Study presented in the RD [Geosyntec, 2006], the TCE concentration data presented in the GMR [Bechtel, 2006], and TCE chemical data collected by Bechtel subsequent to the GMR (Appendix J). The data collected since the GMR is comprised of boring logs, well construction logs and chemical data from wells MW-70-44A/B/C, MW-70-45A/B/C, MW-70-46, MW-70-47, MW-70-48, MW-70-POC01, MW-70-POC02, MW-70-POC03, and MW-70-POC04 (Appendix J).

The updated interpretation of the lateral extent of the TCE plume 1,000 µg/L iso-concentration contour is shown in plan view in Figure 3.11. The updated interpretation of the lateral and vertical extent of the TCE plume 250 µg/L iso-concentration contour is presented in Figures 3.12 through 3.15. Figure 3.12 and 3.13 present intersection cross sections of the lithology with the 250 µg/L TCE plume overlain below the tank farm. Figure 3.14 presents an oblique view of the plume and Figure 3.15 presents a view along the longitudinal axis of the plume (i.e., northwest-southeast direction).

Note the plume in the source area appeared vertically non-continuous based on the analytical dataset. Since the behavior of chemical plumes at these concentrations tend to be relatively consistent and continuous, a point was selected consistent with the contours of the modeled plume and likely concentration of the plume at the given coordinates. The point added in the source area is located at approximately Easting 6005904, Northing 2224083 at 60 ft bgs with a TCE value of 500 µg/L. This simulated data point was added to provide the conceptualized continuity from the source area Upper Fines Unit to the 250 µg/L plume in the First Sand Unit. Similarly, Geosyntec added simulated data points at approximately Easting 6006646, Northing 2223445 at a depth of 20 ft bgs and at approximately Easting 6006236, Northing 2223236 at a depth of 15 ft bgs to constrain the conceptualized vertical extent of the TCE plume in the EVS simulation.

The source area 1,000 µg/L TCE plume appears generally consistent, but slightly larger at the design depth of approximately 45 ft bgs to 60 ft bgs. The additional MW-70-47 and MW-70-48 (Figure 3.11) data points fill a data gap showing a more oval shape of the plume rather than the elongated plume previously seen in the RD [Geosyntec, 2006]. This difference is not expected to have a significant impact on the remediation design. The updated 250 µg/L TCE plume appears generally consistent with the previous depiction of the dissolved phase plume. However, due to refinement of the sampling well network and addition of data near the downgradient, leading edge of the plume, the interpreted downgradient extent of the plume has been extended approximately 200 feet to the southeast. The final location of SSB-1 includes the additional extent of the plume.

3.2.3 Integrated Conceptual Site Model

Integrating the conceptual hydrogeologic site model and the conceptual plume morphology presents a comprehensive view of the contaminant plume (Figures 3.15).

As shown in Figure 3.15, the dissolved-phase TCE plume migration occurs predominantly in relatively coarse-grained units (i.e., sand and shell horizons). However, intervening fine-grained horizons (i.e., silt and clay layers) locally impede downward plume migration. Thus, downward dissolved-phase plume migration occurs at locations where the fine-grained horizons terminate. The termination of the fine-grained horizons causes a downward “stair casing” of the plume as it migrates laterally. Downward “stair casing” of the plume, through the differing hydrogeologic units, may be seen as the plume migrates vertically from the Source Area, laterally along the fine-grained portion of the Shell Horizon Unit, vertically through the coarse-grained section of the Shell Horizon Unit, and then laterally within the Second Sand Unit (Figure 3.15).

Figure 3.16 presents the location of injection wells along the longitudinal and transverse axes of the plume. The targeted treatment zone for each of the biobarriers corresponds with the yellow portion of the wells. Based on review of the updated CSM, the locations of the SAT wells and biobarriers appear consistent with the objectives and design basis stated in the EISB RD [Geosyntec, 2006] and with subsurface conditions.

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4. FINDINGS

4.1 Source Area Findings

The lithology encountered while installing the EISB system in the source area is generally consistent with the CSM developed prior to the construction of the EISB system. The Upper Fines Unit has been refined into the following units: Surficial Fines; 20 foot sand; 30 foot fines; 40 foot sand; and the 60 foot clay. The First Sand Unit was found to be generally consistent with the existing CSM with the exception of a non-extensive clayey unit from approximately 80 ft bgs to approximately 90 ft bgs appearing in some locations.

Based on the lithology encountered in the SAT area, an interpretation of the lithologic data infers a depression and thinning of the 30 foot fines unit and possible pathway from the 20 ft sand through to the 40 ft sand in numerous borings. This apparent depression is consistent with the waxing and waning of fine-grained layers reinforced by the absence of the 30-foot fines layer in well MW-70-27 (Bechtel, 2005).

The 1,000-µg/L TCE source area plume has a greater lateral extent in the source area (Figure 3.11) than previously depicted due to the additional data from MW-70-47 and MW-70-48. The source area plume remains centered in the tank farm area. Vertical migration of the contaminants in this area may be due to the thinning of the 30-foot fines unit below the tank farm in the source area.

The current layout of the SAT wells in the tank farm appears to be sufficient to address this depression and possible vertical migration pathway to the 40-foot sand unit by allowing for adequate coverage of the inferred depression and while still having sufficient areal coverage to address the 1,000-µg/L TCE source area plume. Furthermore, the 60-foot clay at the base of the Upper Fines Unit appears locally extensive and provides a good base to the injection interval.

The surface expression of the dissolved phase 250 µg/L TCE plume (Figure 3.15) appears consistent with the footprint presented in the RD [Geosyntec, 2006]. The location of SAB-1 appears appropriate to address possible contaminant migration out of the source area.

4.2 Dissolved Phase Plume Findings

Relocation of wells and biobarrier alignments occurred at a number of locations due to above- and below-ground obstructions, as well as, lithology and chemical results. Fate and transport modeling simulations were run on the using the updated alignments to

determine effects to predicted longevity of the biobarriers. Generally the longevity of the biobarriers increased as a result of relocations. The greatest increase occurred with the relocation of SHB-2 to SHB-3 showing an increase of approximately two years of projected active treatment time for the barrier. Biobarrier SHB-2 had the greatest projected active phase longevity of 16 years, SHB-3 has a projected longevity of 18 years.

The lithology encountered while installing the EISB system in the dissolved-phase plume area is generally consistent with the CSM developed in the RD [Geosyntec, 2006]. Noteworthy was the existence of a laterally discontinuous clayey unit within the Shell Horizon encountered from approximately 110 to 127 ft bgs, which was intercepted in biobarrier SHB-1 at locations IW-70-SHB104 through IW-70-SHB137.

The updated 250-µg/L TCE dissolved phase plume appears generally consistent with the previous depiction of the dissolved phase plume presented in the RD [Geosyntec, 2006]. However, due to refinement of the sampling well network and addition of data near the downgradient, leading edge of the plume, the interpretation of the downgradient extent of the plume has been extended approximately 200 feet to the southeast.

The relocation of SHB-3 downgradient of MW-70-42A provides treatment capacity in both the First Sand and Shell Horizon. This modification to the design provides treatment of all 3 zones at the leading edge of the plume.

Based on the representation of the integrated CSM (Figure 3.16), it appears that the locations of the biobarriers are consistent with the conceptual design of the remediation system and with the conditions encountered during installation and described above.

5. PLANNED ACTIVITIES FOR IR SITE 70 TCE PLUME

The next activity planned in the SOW at IR Site 70 is to initiate the baseline sampling event, install the EISB injection system in injection wells, and implement long-term performance, MNA, and POC monitoring for the source area. Additionally, the remainder of the SAT wells, which were not installed due to an anticipated Environmental Security Technology Certification Program (ESTCP) study in the area, will be installed to complete the remedial system in the source area, on an as needed basis, dependent on annual monitoring results. Incidental activities may include well rehabilitation, tracer studies, aquifer testing, and additional EVO or KB-1® injection should EVO and KB-1® performance monitoring indicate the need for additional treatment.

The baseline sampling event, as defined in the RD [Geosyntec, 2006], will occur prior to any injection of EVO or KB-1®. The baseline sampling event will consist of sampling of the following:

- PMW wells;
- MNA wells;
- POC Wells;
- Select injection wells (IWs) within the treatment zones; and
- Select existing monitoring wells installed for the characterization of IR Site 70.

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6. REFERENCES

Bechtel Environmental, Inc., 2006, Final Fifth Annual Groundwater Monitoring Report IR Sites 40 and 70, Naval Weapons Station Seal Beach, Seal Beach, California, April.

Bechtel Environmental, Inc., 2003, Final Work Plan for Groundwater Monitoring at Installation Restoration Sites 4, 5, 6, and 7, Naval Weapons Station Seal Beach, Seal Beach, California, August.

Bechtel National, Inc., 2002, Final Groundwater Feasibility Study Report, Installation Restoration Program Sites 40 and 70, Naval Weapons Station, Seal Beach, Seal Beach, California. CTO 0127/0609. June.

Environmental Chemical Corporation (ECC), 2007, Final Work Plan, Construction of Enhanced In Situ Bioremediation System for Groundwater, Installation Restoration Site 70, Naval Weapons Station Seal Beach, Seal Beach, California, January.

Geosyntec Consultants, 2006, Final Remedial Design (RD) for Installation Restoration Site 70 Enhanced In Situ Bioremediation, Naval Weapons Station Seal Beach, Seal Beach, California, December.

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Geosyntec consultants

TABLES

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TABLE 2.1

SOURCE AREA TREATMENT FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-SAT01	SAT/UF	✓	✓	✓	✓	✓	✓	2/22/07	2/22/07	2/22/07	60	25-55	0-25	25-55	57	
IW-70-SAT02	SAT/UF		✓	✓	✓	✓	✓	2/13/07	2/13/07	2/14/07	60	25-55	0-25	25-55	57	
IW-70-SAT03	SAT/UF		✓	✓	✓	✓	✓	6/5/07	6/5/07	6/5/07	60	25-55	0-25	25-55	57	
IW-70-SAT04	SAT/UF		✓	✓	✓	✓	✓	6/7/07	6/7/07	6/7/07	60	25-55	0-25	25-55	57	
IW-70-SAT05	SAT/UF		✓	✓	✓	✓	✓	4/24/07	4/24/07	4/25/07	60	25-55	0-25	25-55	57	
IW-70-SAT06	SAT/UF		✓	✓	✓	✓	✓	4/30/07	5/1/07	5/1/07	60	25-55	0-25	25-55	57	
IW-70-SAT07	SAT/UF		✓	✓	✓	✓	✓	6/6/07	6/6/07	6/6/07	60	25-55	0-25	25-55	57	
IW-70-SAT08	SAT/UF		✓	✓	✓	✓	✓	2/8/07	2/8/07	2/12/07	60	25-55	0-25	25-55	62	Redrilled to 62' on 2/12/07 because of sand filling in to 55'. Installation complete on 2/12/07.
IW-70-SAT09	SAT/UF		✓	✓	✓	✓	✓	4/23/07	4/23/07	4/23/07	60	25-55	0-25	25-55	57	
IW-70-SAT10	SAT/UF		✓	✓	✓	✓	✓	4/26/07	4/26/07	4/30/07	60	25-55	0-25	25-55	57	Reconstructed on 5/2-5/3/07 because of cap blowout and failure of original casing.
IW-70-SAT11	SAT/UF		✓	✓	✓	✓	✓	4/18/07	4/19/07	4/19/07	60	25-55	0-25	25-55	57	
IW-70-SAT12	SAT/UF		✓	✓	✓	✓	✓	6/4/07	6/4/07	6/4/07	60	25-55	0-25	25-55	57	
IW-70-SAT13	SAT/UF		✓	✓	✓	✓	✓	6/1/07	6/1/07	6/1/07	60	25-55	0-25	25-55	57	
IW-70-SAT14	SAT/UF		✓	✓	✓	✓	✓	5/30/07	5/30/07	5/30/07	60	25-55	0-25	25-55	57	
IW-70-SAT15	SAT/UF		✓	✓	✓	✓	✓	5/31/07	5/31/07	5/31/07	60	25-55	0-25	25-55	57	
IW-70-SAT16	SAT/UF		✓	✓	✓	L	✓	5/29/07	5/29/07	5/29/07	60	25-55	0-25	25-55	57	
IW-70-SAT17	SAT/UF		✓	✓	✓	✓	✓	2/28/07	2/28/07	2/28/07	60	25-55	0-25	25-55	57	
IW-70-SAT18	SAT/UF		✓	✓	✓	✓	✓	2/22/07	2/22/07	2/22/07	60	25-55	0-25	25-55	57	
IW-70-SAT19	SAT/UF		✓	✓	✓	L	✓	2/21/07	2/21/07	2/21/07	60	25-55	0-25	25-55	57	
IW-70-SAT20	SAT/UF	✓	✓	✓	✓	✓	✓	2/7/07	2/7/07	2/7-2/8/07	60	25-55	0-25	25-55	57	
IW-70-SAT21	SAT/UF		✓	✓	✓	✓	✓	2/13/07	2/13/07	2/13/07	60	25-55	0-25	25-55	57	
IW-70-SAT22	SAT/UF		✓	✓	✓	✓	✓	2/27/07	2/27/07	2/28/07	60	25-55	0-25	25-55	57	
IW-70-SAT23	SAT/UF		✓	✓	✓	✓	✓	2/12/07	2/12/07	2/12/07	60	25-55	0-25	25-55	57	
IW-70-SAT24	SAT/UF		✓	✓	✓	✓	✓	2/14/07	2/14/07	2/14/07	60	25-55	0-25	25-55	57	
IW-70-SAT25	SAT/UF	✓	✓	✓	✓	✓	✓	2/6/07	2/6/07	2/7/07	60	25-55	0-25	25-55	62	
IW-70-SAT26	SAT/UF	✓	✓	✓	✓	✓	✓	2/26/07	2/26/07	2/26/07	60	25-55	0-25	25-55	57	
IW-70-SAT27	SAT/UF		✓	✓	✓	✓	✓	2/27/07	2/27/07	2/27/07	60	25-55	0-25	25-55	57	
IW-70-SAT28	SAT/UF		✓	✓	✓	✓	✓	3/1/07	3/1/07	3/1/07	60	25-55	0-25	25-55	57	Reconstructed on 4/3/07 because of 3" hole in casing at 45'.
IW-70-SAT29	SAT/UF		✓	✓	✓	✓	✓	2/15/07	2/15/07	2/15/07	60	25-55	0-25	25-55	57	
IW-70-SAT30	SAT/UF		✓	✓	✓	✓	✓	2/28/07	2/28/07	2/28/07	60	25-55	0-25	25-55	57	
IW-70-SAT31	SAT/UF	✓	✓	✓	✓	✓	✓	2/28/07	2/28/07	2/28/07	60	25-55	0-25	25-55	57	
IW-70-SAT32	SAT/UF		✓	✓	✓	✓	✓	2/23/07	2/23/07	2/23/07	60	25-55	0-25	25-55	57	Redeveloped due to low production rates.
IW-70-SAT33	SAT/UF	✓	✓	✓	✓	✓	✓	2/22/07	2/22/07	2/23/07	60	25-55	0-25	25-55	57	Redeveloped due to low production rates.
IW-70-SAT34	SAT/UF		✓	✓	✓	✓	✓	2/22/07	2/22/07	2/22/07	60	25-55	0-25	25-55	57	Redeveloped due to low production rates.
MW-70-PMW01A	SAT/UF		✓	✓	✓	✓	✓	2/26/07	2/26/07	2/26/07	40	25-35	0-25	25-35	37	
MW- 70-PMW01B	SAT/UF		✓	✓	✓	✓	✓	2/27/07	2/27/07	2/27/07	60	45-55	0-45	45-55	57	
MW-70-MNA01	SAT/UF	✓	✓	✓	✓	✓	✓	2/21/07	2/21/07	2/21/07	55	40-50	0-40	40-50	57	
MW-70-MNA02	SAT/UF		✓	✓	✓	✓	✓	2/13/07	2/13/07	2/13/07	50	35-45	0-35	35-45	47	
MW-70-MNA03	SAT/UF	✓	✓	✓	✓	✓	✓	2/26/07	2/26/07	2/26/07	50	35-45	0-35	35-45	47	
MW-70-MNA04	SAT/UF		✓	✓	✓	✓	✓	2/14/07	2/14/07	2/14/07	50	35-45	0-35	35-45	47	

Notes:
Check mark indicates document complete
App = Appendix
FSB = First Sand Biobarrier
ft bgs = feet below ground surface
IW = Injection Well
L = Photographs lost due to technical difficulties with camera
MNA = Monitored Natural Attenuation
MW = Monitoring Well
PMW = Performance Monitoring Well
SAT = Source Area Treatment
TD = Total Depth
UF = Upper Fines

TABLE 2.2

SOURCE AREA BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-SAB01	SAB/FS	✓	✓	✓	✓	✓	✓	1/22/07	1/23/07	1/24/07	110	60-105	0-60	60-80	120	
IW-70-SAB02	SAB/FS		✓	✓	✓	✓	✓	1/29/07	1/29/07	1/29-1/30/07	110	60-105	0-65	65-105	117	
IW-70-SAB03	SAB/FS		✓	✓	✓	✓	✓	1/31/07	1/31/07	1/31/07	110	60-105	0-65	65-105	107	Redrilled and reconstructed because of heaving sands in original boring. Replacement offset well drilled and constructed on 2/12/07.
IW-70-SAB04	SAB/FS		✓	✓	✓	✓	✓	1/23/07	1/23/07	1/24/07	110	60-105	0-60 80-85	60-80 85-105	107	Dual completion due to clay layer encountered at approximately 80 ft bgs.
IW-70-SAB05	SAB/FS		✓	✓	✓	✓	✓	2/7/07	2/7/07	2/7-2/8/07	110	60-105	0-65	65-105	107	
IW-70-SAB06	SAB/FS		✓	✓	✓	✓	✓	2/5/07	2/5/07	2/5-2/6/07	110	60-105	0-65 80-85	65-80 85-105	117	
IW-70-SAB07	SAB/FS		✓	✓	✓	✓	✓	2/8/07	2/8/07	2/12/07	110	60-105	0-65	65-105	107	
IW-70-SAB08	SAB/FS	✓	✓	✓	✓	✓	✓	1/31/07	1/31/07	1/31/07	110	60-105	0-65	65-105	117	
IW-70-SAB09	SAB/FS		✓	✓	✓	✓	✓	2/1/07	2/1/07	2/1/07	110	60-105	0-65	65-105	107	
IW-70-SAB10	SAB/FS		✓	✓	✓	✓	✓	2/5/07	2/5/07	2/5/07	110	60-105	0-67 87-92	67-87 92-107	117	
IW-70-SAB11	SAB/FS		✓	✓	✓	✓	✓	2/6/07	2/6/07	2/7/07	110	60-105	0-65	65-105	107	
IW-70-SAB12	SAB/FS		✓	✓	✓	✓	✓	1/29/07	1/29/07	1/29/07	110	60-105	0-65	65-105	117	Reconstructed on 4/2/07 because of broken end cap.
IW-70-SAB13	SAB/FS		✓	✓	✓	✓	✓	4/16/07	4/16/07	4/17/07	110	60-105	0-65	65-105	106	
IW-70-SAB14	SAB/FS	✓	✓	✓	✓	✓	✓	1/25/07	1/25/07	1/25/07	110	60-105	0-60	60-105	107	
MW- 70-PMW02A	SAB/FS		✓	✓	✓	✓	✓	2/15/07	2/15/07	2/15/07	85	70-80	0-70.5	70.5-80.5	82	
MW- 70-PMW02B	SAB/FS		✓	✓	✓	✓	✓	2/21/07	2/21/07	2/21/07	105	90-100	0-90	90-100	102	
MW- 70-PMW03A	SAB/FS		✓	✓	✓	✓	✓	2/15/07	2/15/07	2/20/07	85	70-80	0-70	70-80	82	
MW- 70-PMW03B	SAB/FS		✓	✓	✓	✓	✓	2/20/07	2/20/07	2/21/07	105	90-100	0-90	90-100	102	
MW-70-MNA05	SAB/FS	✓	✓	✓	✓	✓	✓	1/24/07	1/24/07	1/24/07	85	70-80	0-70	70-80	87	

Notes:
Check mark indicates document complete
App = Appendix
FS = First Sand
ft bgs = feet below ground surface
IW = Injection Well
L = Photographs lost due to technical difficulties with camera
MNA = Monitored Natural Attenuation
MW = Monitoring Well
PMW = Performance Monitoring Well
SAB = Source Area Biobarrier
TD = Total Depth
UF = Upper Fines

TABLE 2.3

FIRST SAND BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-FSB101	FSB1	✓	✓	✓	✓	✓	✓	4/30/07	5/1/07	5/1/07	110	60-105	0-60.5	60.5-105.5	107	Detailed Log
IW-70-FSB102	FSB1		✓	✓	✓	✓	✓	4/26/07	4/26/07	4/30/07	110	60-105	0-61	61-106	107	
IW-70-FSB103	FSB1		✓	✓	✓	✓	✓	4/25/07	4/25/07	4/25/07	110	60-105	0-60	60-105	107	
IW-70-FSB104	FSB1		✓	✓	✓	✓	✓	4/23/07	4/24/07	4/24/07	110	60-105	0-60	60-105	107	
IW-70-FSB105	FSB1		✓	✓	✓	✓	✓	4/19/07	4/19/07	4/23/07	110	60-105	0-60	60-105	107	
IW-70-FSB106	FSB1		✓	✓	✓	✓	✓	4/18/07	4/18/07	4/19/07	110	60-105	0-60	60-105	107	
IW-70-FSB107	FSB1		✓	✓	✓	✓	✓	4/18/07	4/18/07	4/18/07	110	60-105	0-60	60-105	107	
IW-70-FSB108	FSB1		✓	✓	✓	✓	✓	4/17/07	4/17/07	4/17/07	110	60-105	0-60	60-105	107	
IW-70-FSB109	FSB1		✓	✓	✓	✓	✓	4/16/07	4/16/07	4/16/07	110	60-105	0-60	60-105	107	
IW-70-FSB110	FSB1		✓	✓	✓	✓	✓	4/11/07	4/11/07	4/12/07	110	60-105	0-59	59-104	107	
IW-70-FSB111	FSB1	✓	✓	✓	✓	✓	✓	4/11/07	4/11/07	4/11/07	110	60-105	0-60.7	60.7-105.7	107	Detailed Log
IW-70-FSB112	FSB1		✓	✓	✓	✓	✓	4/10/07	4/10/07	4/10/07	110	60-105	0-60	60-105	107	
IW-70-FSB113	FSB1		✓	✓	✓	✓	✓	4/9/07	4/9/07	4/9/07	110	60-105	0-60	60-105	107	
IW-70-FSB114	FSB1		✓	✓	✓	✓	✓	4/3/07	4/3/07	4/4/07	110	60-105	0-60	60-105	107	
IW-70-FSB115	FSB1		✓	✓	✓	✓	✓	5/9/07	5/9/07	5/9/07	110	60-105	0-65	65-105	107	
IW-70-FSB116	FSB1		✓	✓	✓	✓	✓	5/7/07	5/8/07	5/8/07	110	60-105	0-60	60-105	107	
IW-70-FSB117	FSB1		✓	✓	✓	✓	✓	5/2/07	5/7/07	5/7/07	110	60-105	0-60	60-105	107	
IW-70-FSB118	FSB1	✓	✓	✓	✓	✓	✓	5/2/07	5/2/07	5/3/07	110	60-105	0-60	60-105	107	Detailed Log
IW-70-FSB119	FSB1		✓	✓	✓	✓	✓	5/1/07	5/1/07	5/1-5/2/07	110	60-105	0-60	60-105	107	
IW-70-FSB120	FSB1		✓	✓	✓	✓	✓	4/30/07	4/30/07	4/30/07	110	60-105	0-60	60-105	107	
IW-70-FSB121	FSB1		✓	✓	✓	✓	✓	4/25/07	4/25/07	4/26/07	110	60-105	0-60	60-105	107	
IW-70-FSB122	FSB1		✓	✓	✓	✓	✓	4/24/07	4/24/07	4/24-4/25/07	110	60-105	0-60	60-105	107	
IW-70-FSB123	FSB1		✓	✓	✓	✓	✓	4/23/07	4/23/07	4/23/07	110	60-105	0-60	60-105	107	
IW-70-FSB124	FSB1		✓	✓	✓	✓	✓	4/18/07	4/19/07	4/19/07	110	60-105	0-60	60-105	107	
IW-70-FSB125	FSB1	✓	✓	✓	✓	✓	✓	4/17/07	4/17/07	4/18/07	110	60-105	0-60	60-105	107	Detailed Log
IW-70-FSB126	FSB1		✓	✓	✓	✓	✓	4/16/07	4/16/07	4/16-4/17/07	110	60-105	0-60	60-105	107	
IW-70-FSB127	FSB1		✓	✓	✓	✓	✓	4/12/07	4/12/07	4/12/07	110	60-105	0-60	60-105	107	
IW-70-FSB128	FSB1		✓	✓	✓	✓	✓	4/11/07	4/11/07	4/11/07	110	60-105	0-60	60-105	107	
IW-70-FSB129	FSB1		✓	✓	✓	L	✓	4/10/07	4/10/07	4/10/07	110	60-105	0-60	60-105	107	
IW-70-FSB130	FSB1		✓	✓	✓	✓	✓	4/5/07	4/5/07	4/5/07	110	60-105	0-60	60-105	107	
IW-70-FSB131	FSB1		✓	✓	✓	✓	✓	4/3/07	4/3/07	4/4/07	110	60-105	0-60	60-105	107	
IW-70-FSB132	FSB1	✓	✓	✓	✓	✓	✓	4/2/07	4/2/07	4/2/07	110	60-105	0-60	60-105	112	Detailed Log
MW-70-PMW04A	FSB1		✓	✓	✓	✓	✓	5/7/07	5/7/07	5/7/07	85	70-80	0-70	70-80	92	
MW-70-PMW04B	FSB1		✓	✓	✓	✓	✓	5/7/07	5/7/07	5/8/07	105	90-100	0-90	90-100	102	
MW-70-PMW05A	FSB1	✓	✓	✓	✓	✓	✓	5/14/07	5/14/07	5/14/07	85	70-80	0-70	70-80	82	Redrilled and reconstructed on 7/24/07 because of low production rates during development and no viable connection to the aquifer; detailed log.
MW-70-PMW05B	FSB1		✓	✓	✓	✓	✓	5/14/07	5/14/07	5/15/07	105	90-100	0-90	90-100	102	
MW-70-PMW06A	FSB1		✓	✓	✓	✓	✓	5/8/07	5/8/07	5/9/07	85	70-80	0-69.5	69.5-79.5	82	
MW-70-PMW06B	FSB1		✓	✓	✓	✓	✓	5/9/07	5/9/07	5/10/07	105	90-100	0-91	91-101	102	
MW-70-MNA06	FSB1	✓	✓	✓	✓	✓	✓	5/1/07	5/3/07	5/3/07	95	80-90	0-80	80-90	92	Detailed Log
MW-70-MNA07	FSB1		✓	✓	✓	✓	✓	5/9/07	5/10/07	5/10/07	95	80-90	0-90	90-100	102	
MW-70-MNA08	FSB1	✓	✓	✓	✓	✓	✓	3/29/07	3/29/07	3/29/07	95	80-90	0-80	80-90	92	Detailed Log
MW-70-MNA11	FSB1	✓	✓	✓	✓	✓	✓	3/28/07	3/28/07	3/28/07	95	80-90	0-80	80-90	94	Detailed Log
RDO-1	FSB1	N/A	N/A	N/A	N/A	N/A	✓	8/19/05	8/19/05	8/19/05	N/A	N/A	0-65.1	65.1-105.1	110	Wellhead reconstructed.
RDO-2	FSB1	N/A	N/A	N/A	N/A	N/A	✓	8/18/05	8/18/05	8/19/05	N/A	N/A	0-65.1	65.1-105.1	110	Wellhead reconstructed.
RDO-3B	FSB1	N/A	N/A	N/A	N/A	N/A	✓	8/23/05	8/23/05	8/24/05	N/A	N/A	0-65	65-105	107	Wellhead reconstructed.
RDO-4	FSB1	N/A	N/A	N/A	N/A	N/A	✓	8/16/05	8/16/05	8/17/05	N/A	N/A	0-65	65-105	111.5	Wellhead reconstructed.
IW-70-FSB201	FSB2	✓	✓	✓	✓	✓	✓	3/5/07	3/6/07	3/6/07	105	65-100	0-65	65-100	107	Detailed Log
IW-70-FSB202	FSB2		✓	✓	✓	✓	✓	3/6/07	3/6/07	3/6-3/7/07	105	65-100	0-65	65-100	107	
IW-70-FSB203	FSB2		✓	✓	✓	✓	✓	3/7/07	3/7/07	3/7/07	105	65-100	0-65	65-100	107	

TABLE 2.3

FIRST SAND BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-FSB204	FSB2		✓	✓	✓	✓	✓	3/7/07	3/8/07	3/8/07	105	65-100	0-65	65-100	107	
IW-70-FSB205	FSB2		✓	✓	✓	✓	✓	3/12/07	3/12/07	3/12/07	105	65-100	0-65	65-100	107	
IW-70-FSB206	FSB2		✓	✓	✓	✓	✓	3/12/07	3/13/07	3/13/07	105	65-100	0-65	65-100	107	
IW-70-FSB207	FSB2		✓	✓	✓	✓	✓	3/14/07	3/14/07	3/15/07	105	65-100	0-65	65-100	107	
IW-70-FSB208	FSB2		✓	✓	✓	✓	✓	3/13/07	3/13/07	3/14/07	105	65-100	0-65	65-100	107	
IW-70-FSB209	FSB2		✓	✓	✓	✓	✓	3/15/07	3/15/07	3/19/07	105	65-100	0-65	65-100	107	Reconstructed on 5/15/07 due to filter pack found in casing during development.
IW-70-FSB210	FSB2	✓	✓	✓	✓	✓	✓	3/20/07	3/21/07	3/21/07	105	65-100	0-65	65-100	102	Detailed Log
IW-70-FSB211	FSB2		✓	✓	✓	✓	✓	3/20/07	3/20/07	3/20/07	105	65-100	0-65	65-100	102	
IW-70-FSB212	FSB2		✓	✓	✓	✓	✓	3/19/07	3/19/07	3/19/07	105	65-100	0-65	65-100	102	
IW-70-FSB213	FSB2	✓	✓	✓	✓	✓	✓	3/20/07	3/20/07	3/20/07	105	65-100	0-65	65-100	102	Detailed Log
IW-70-FSB214	FSB2		✓	✓	✓	✓	✓	3/20/07	3/20/07	3/21/07	105	65-100	0-65	65-100	102	
IW-70-FSB215	FSB2		✓	✓	✓	✓	✓	3/5/07	3/5/07	3/5/07	105	65-100	0-66	66-101	102	
IW-70-FSB216	FSB2		✓	✓	✓	✓	✓	3/5/07	3/6/07	3/6/07	105	65-100	0-65	65-100	102	
IW-70-FSB217	FSB2		✓	✓	✓	✓	✓	3/6/07	3/6/07	3/6/07	105	65-100	0-65	65-100	102	
IW-70-FSB218	FSB2		✓	✓	✓	✓	✓	3/7/07	3/7/07	3/7/07	105	65-100	0-65	65-100	102	
IW-70-FSB219	FSB2	✓	✓	✓	✓	✓	✓	3/7/07	3/7/07	3/8/07	105	65-100	0-65.5	65.5-100.5	102	Detailed Log
IW-70-FSB220	FSB2		✓	✓	✓	✓	✓	3/26/07	3/26/07	3/26/07	105	65-100	0-65	65-100	102	
IW-70-FSB221	FSB2		✓	✓	✓	✓	✓	3/8/07	3/8/07	3/12/07	105	65-100	0-65	65-100	102	
IW-70-FSB222	FSB2		✓	✓	✓	✓	✓	3/12/07	3/12/07	3/12/07	105	65-100	0-65	65-100	102	Redeveloped on 4/2/07 due to low production rates.
IW-70-FSB223	FSB2		✓	✓	✓	✓	✓	3/13/07	3/13/07	3/13/07	105	65-100	0-65	65-100	102	
IW-70-FSB224	FSB2		✓	✓	✓	✓	✓	3/13/07	3/13/07	3/14/07	105	65-100	0-65	65-100	102	
IW-70-FSB225	FSB2		✓	✓	✓	✓	✓	3/14/07	3/15/07	3/14/07	105	65-100	0-65	65-100	102	
IW-70-FSB226	FSB2		✓	✓	✓	✓	✓	3/15/07	3/15/07	3/15/07	105	65-100	0-65	65-100	102	
IW-70-FSB227	FSB2		✓	✓	✓	✓	✓	3/19/07	3/19/07	3/19/07	105	65-100	0-65	65-100	102	
IW-70-FSB228	FSB2		✓	✓	✓	✓	✓	3/21/07	3/21/07	3/21-3/22/07	105	65-100	0-65	65-100	102	
IW-70-FSB229	FSB2	✓	✓	✓	✓	✓	✓	3/22/07	3/22/07	3/22/07	105	65-100	0-65	65-100	102	Detailed Log
MW-70-PMW07A	FSB2		✓	✓	✓	L	✓	3/22/07	3/22/07	3/22/07	80	65-75	0-65	65-75	77	
MW-70-PMW07B	FSB2		✓	✓	✓	✓	✓	3/27/07	3/27/07	3/27/07	100	85-95	0-85	85-95	97	
MW-70-PMW08A	FSB2		✓	✓	✓	✓	✓	3/28/07	3/28/07	3/28/07	80	65-75	0-65	65-75	77	
MW-70-PMW08B	FSB2		✓	✓	✓	✓	✓	3/28/07	3/28/07	3/28/07	100	85-95	0-85	85-95	97	
MW-70-MNA09	FSB2	✓	✓	✓	✓	✓	✓	3/5/07	3/5/07	3/5/07	90	75-85	0-64.25	64.25-74.25	87	Detailed Log
MW-70-MNA10	FSB2		✓	✓	✓	✓	✓	3/27/07	3/27/07	3/27/07	90	75-85	0-74.5	74.5-84.5	87	
MW-70-MNA12	FSB2	✓	✓	✓	✓	✓	✓	3/29/07	3/29/07	3/29/07	90	75-85	0-75	75-85	87	Detailed Log

Notes:
Check mark indicates document complete
App = Appendix
ft bgs = feet below ground surface
FSB1 = First Sand Biobarrier 1
FSB2 = First Sand Biobarrier 2
ID = Identification
IW = Injection Well
L = Photographs lost due to technical difficulties with camera
MNA = Monitored Natural Attenuation
MW = Monitoring Well
N/A = Not Applicable
PMW = Performance Monitoring Well
RDO = Remedial Design Optimization (Well)
TD = Total Depth

SHELL HORIZON BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-SHB101	SHB1	✓	✓	✓	✓	✓	✓	5/21/07	5/22/07	5/22/07	135	105-130	0-105	105-130	137	Detailed Log
IW-70-SHB102	SHB1		✓	✓	✓	✓	✓	7/17/07	7/17/07	7/17/07	135	105-130	0-105	105-130	132	
IW-70-SHB103	SHB1		✓	✓	✓	✓	✓	7/26/07	7/26/07	7/26/07	135	105-130	0-105	105-130	132	
IW-70-SHB104	SHB1		✓	✓	✓	✓	✓	7/30/07	7/30/07	7/30/07	135	105-130	0-105	105-130	132	
IW-70-SHB105	SHB1		✓	✓	✓	✓	✓	7/31/07	7/31/07	7/31/07	135	105-130	0-105	105-130	132	
IW-70-SHB106	SHB1		✓	✓	✓	✓	✓	7/10/07	7/10/07	7/12/07	135	105-130	0-105	105-130	132	Reinstalled after being hit with a forklift and deemed not viable for injection purposes.
IW-70-SHB107	SHB1		✓	✓	✓	✓	✓	6/18/07	6/18/07	6/19/07	135	105-130	0-105	105-130	132	
IW-70-SHB108	SHB1	✓	✓	✓	✓	✓	✓	6/20/07	6/20/07	6/20/07	135	105-130	0-105 110-115	105-110 115-130	132	Detailed Log
IW-70-SHB109	SHB1		✓	✓	✓	✓	✓	6/21/07	6/21/07	6/25/07	135	105-130	0-100 110-115	100-110 115-130	135	
IW-70-SHB110	SHB1		✓	✓	✓	✓	✓	6/25/07	6/26/07	6/26/07	135	105-130	0-105	105-130	132	
IW-70-SHB111	SHB1		✓	✓	✓	✓	✓	7/9/07	7/9/07	7/16/07	135	105-130	0-100 110-120	100-110 120-130	132	Reinstalled because steel casing broke off in borehole during drilling and could not be recovered.
IW-70-SHB112	SHB1		✓	✓	✓	✓	✓	6/27/07	6/28/07	6/28/07	135	105-130	0-100 110-115	100-110 115-130	132	
IW-70-SHB113	SHB1		✓	✓	✓	✓	✓	5/16/07	5/16/07	5/29/07	135	105-130	0-105	105-130	132	Reconstructed and redeveloped because of filter pack found in well during development.
IW-70-SHB114	SHB1	✓	✓	✓	✓	✓	✓	5/17/07	5/21/07	5/21/07	135	105-130	0-105	105-130	137	Detailed Log
IW-70-SHB115	SHB1		✓	✓	✓	✓	✓	5/30/07	5/30/07	5/30-5/31/07	135	105-130	0-105 110-115	105-110 115-130	132	
IW-70-SHB116	SHB1		✓	✓	✓	✓	✓	5/31/07	5/31/07	5/31-6/1/07	135	105-130	0-105 110-115	105-110 115-130	132	
IW-70-SHB117	SHB1		✓	✓	✓	✓	✓	6/6/07	6/6/07	6/12/07	135	105-130	0-105.5 110.5-115.5	105.5-110.5 115.5-130.5	132	
IW-70-SHB118	SHB1		✓	✓	✓	✓	✓	6/13/07	6/13/07	6/26/07	135	105-130	0-100 110-115	100-110 115-130	132	Redrilled on 6/26/07 because steel casing broke off in borehole during drilling and could not be recovered.
IW-70-SHB119	SHB1		✓	✓	✓	✓	✓	6/19/07	6/19/07	6/25/07	135	105-130	0-100 110-115	100-110 115-130	132	Redrilled on 6/25/07 because steel casing broke off in borehole during drilling and could not be recovered.
IW-70-SHB120	SHB1	✓	✓	✓	✓	✓	✓	6/21/07	6/21/07	6/21/07	135	105-130	0-100 110-120	100-110 120-130	137	Detailed Log
IW-70-SHB121	SHB1		✓	✓	✓	✓	✓	6/14/07	6/14/07	6/14/07	135	105-130	0-100 110-120	100-110 120-130	132	
IW-70-SHB122	SHB1		✓	✓	✓	✓	✓	6/12/07	6/13/07	6/13/07	135	105-130	0-100 110-120	100-110 120-130	132	
IW-70-SHB123	SHB1		✓	✓	✓	✓	✓	6/11/07	6/11/07	6/27-6/28/07	135	105-130	0-100 110-120	100-110 120-130	132	Reconstructed and redeveloped because of filter pack found in well during development.
IW-70-SHB124	SHB1		✓	✓	✓	✓	✓	6/1/07	6/1/07	6/1/07	135	105-130	0-105 110-115	105-110 115-130	132	
IW-70-SHB125	SHB1	✓	✓	✓	✓	✓	✓	5/31/07	5/31/07	5/31/07	135	105-130	0-105	105-130	135	Detailed Log
IW-70-SHB126	SHB1		✓	✓	✓	✓	✓	5/30/07	5/30/07	5/30/07	135	105-130	0-105 110-115	105-110 115-130	132	
IW-70-SHB127	SHB1		✓	✓	✓	✓	✓	5/17/07	5/17/07	5/17/07	135	105-130	0-103.5	103.5-128.5	132	Reconstructed and redeveloped due to low production rates during
IW-70-SHB128	SHB1		✓	✓	✓	✓	✓	5/16/07	5/16/07	5/16/07	135	105-130	0-105	105-130	132	

SHELL HORIZON BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-SHB129	SHB1		✓	✓	✓	✓	✓	7/10/07	7/11/07	7/11/07	135	105-130	0-100 110-120	100-110 120-130	132	
IW-70-SHB130	SHB1		✓	✓	✓	✓	✓	7/13/07	7/13/07	7/16/07	135	105-130	0-100 110-120	100-110 120-130	132	
IW-70-SHB131	SHB1		✓	✓	✓	✓	✓	7/12/07	7/12/07	7/12/07	135	105-130	0-100 110-120	100-110 120-130	132	
IW-70-SHB132	SHB1	✓	✓	✓	✓	✓	✓	6/6/07	6/7/07	6/7/07	135	105-130	0-105 110-115	105-110 115-130	135	Detailed Log
IW-70-SHB133	SHB1		✓	✓	✓	✓	✓	6/5/07	6/5/07	6/5/07	135	105-130	0-100 110-120	100-110 120-130	132	
IW-70-SHB134	SHB1		✓	✓	✓	✓	✓	6/4/07	6/4/07	6/4/07	135	105-130	0-105 115-120	105-115 120-130	132	
IW-70-SHB135	SHB1		✓	✓	✓	✓	✓	7/2/07	7/2/07	7/2-7/3/07	135	105-130	0-105 110-120	105-110 120-130	134	
IW-70-SHB136	SHB1		✓	✓	✓	✓	✓	7/3/07	7/9/07	7/10/07	135	105-130	0-105 110-120	105-110 120-130	132	
IW-70-SHB137	SHB1	✓	✓	✓	✓	✓	✓	5/29/07	5/29/07	5/29/07	135	105-130	0-105 115-120	105-115 120-130	137	Detailed Log
MW-70-PMW09	SHB1		✓	✓	✓	✓	✓	6/28/07	6/28/07	7/2/07	130	115-125	0-120	120-130	132	
MW-70-PMW10	SHB1		✓	✓	✓	✓	✓	7/2/07	7/2/07	7/3/07	130	115-125	0-120	120-130	132	
MW-70-MNA13	SHB1		✓	✓	✓	✓	✓	7/17/07	7/17/07	7/17/07	130	115-125	0-115	115-125	128	
IW-70-SHB201	SHB2	✓	✓	✓	✓	✓	✓	5/22/07	5/23/07	5/23/07	135	105-130	0-105	105-130	137	SHB2 Discontinued
IW-70-SHB217	SHB2	✓	✓	✓	✓	✓	✓	5/24/07	5/24/07	5/24/07	135	105-130	0-105	105-130	137	SHB2 Discontinued
IW-70-SHB232	SHB2	✓	✓	✓	✓	✓	✓	5/22/07	5/23/07	5/23/07	135	105-130	0-105	105-130	137	SHB2 Discontinued
IW-70-SHB301	SHB3/FS	✓	✓	✓	✓	✓	✓	7/26/07	7/26/07	7/30/07	135	105-130	0-80 95-105	80-95 105-130	132	Detailed Log
IW-70-SHB302	SHB3/FS		✓	✓	✓	✓	✓	7/31/07	7/31/07	7/31/07	135	105-130	0-80 95-105	80-95 105-130	132	
IW-70-SHB303	SHB3/FS		✓	✓	✓	✓	✓	8/1/07	8/1/07	8/2/07	135	105-130	0-80 95-105	80-95 105-130	132	
IW-70-SHB304	SHB3/FS		✓	✓	✓	✓	✓	7/23/07	7/23/07	7/23/07	135	105-130	0-82 97-107	82-97 107-127	132	
IW-70-SHB305	SHB3/FS		✓	✓	✓	✓	✓	7/24/07	7/24/07	7/24/07	135	105-130	0-80.5 95.5-105.5	80.5-95.5 105.5-130.5	132	
IW-70-SHB306	SHB3/FS		✓	✓	✓	✓	✓	8/7/07	8/7/07	8/8/07	135	105-130	0-80 95-105	80-95 105-130	132	
IW-70-SHB307	SHB3/FS		✓	✓	✓	✓	✓	8/8/07	8/8/07	8/9/07	135	105-130	0-80 95-105	80-95 105-130	133	
IW-70-SHB308	SHB3/FS		✓	✓	✓	✓	✓	8/9/07	8/10/07	8/10/07	135	105-130	0-80 95-105	80-95 105-130	132	
IW-70-SHB309	SHB3/FS		✓	✓	✓	✓	✓	7/25/07	7/26/07	7/26/07	135	105-130	0-80 95-105	80-95 105-130	132	
IW-70-SHB310	SHB3/FS	✓	✓	✓	✓	✓	✓	7/30/07	7/30/07	7/31/07	135	105-130	0-80 95-105	80-95 105-130	137	Detailed Log
IW-70-SHB311	SHB3/FS		✓	✓	✓	✓	✓	7/31/07	8/1/07	8/2/07	135	105-130	0-80 95-105	80-95 105-130	132	

TABLE 2.4

SHELL HORIZON BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-SHB312	SHB3/FS		✓	✓	✓	✓	✓	7/25/07	7/25/07	7/25/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB313	SHB3/FS		✓	✓	✓	✓	✓	7/23/07	7/23/07	7/24/07	135	105-130	0-80.5 100.5-110.5	80.5-100.5 110.5-130.5	132	
IW-70-SHB314	SHB3/FS		✓	✓	✓	✓	✓	8/9/07	8/9/07	8/9/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB315	SHB3/FS		✓	✓	✓	✓	✓	8/8/07	8/8/07	8/8/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB316	SHB3/FS		✓	✓	✓	✓	✓	7/18/07	7/19/07	7/19/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB317	SHB3/FS		✓	✓	✓	✓	✓	8/13/07	8/13/07	8/13/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB318	SHB3/FS		✓	✓	✓	✓	✓	8/7/07	8/7/07	8/7/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB319	SHB3/FS		✓	✓	✓	✓	✓	8/1/07	8/1/07	8/2/07	135	105-130	0-80 100-110	80-100 110-130	132	
IW-70-SHB320	SHB3/FS	✓	✓	✓	✓	✓	✓	7/23/07	7/23/07	7/23/07	135	105-130	0-80 100-110	80-100 110-130	137	Detailed Log
MW-70-PMW11A	SHB3/FS		✓	✓	✓	✓	✓	8/14/07	8/14/07	8/14/07	130	115-125	0-85	85-95	97	First Sand Monitoring Well
MW-70-PMW11B	SHB3/FS		✓	✓	✓	L	✓	8/23/07	8/23/07	8/23/07	130	115-125	0-115	115-125	127	
MW-70-PMW12A	SHB3/FS		✓	✓	✓	✓	✓	8/14/07	8/14/07	8/14/07	130	115-125	0-85	85-95	97	First Sand Monitoring Well
MW-70-PMW12B	SHB3/FS		✓	✓	✓	✓	✓	8/10/07	8/10/07	8/10/07	130	115-125	0-115	115-125	127	
MW-70-MNA14	SHB3/FS	✓	✓	✓	✓	✓	✓	7/12/07	7/12/07	7/12/07	130	115-125	0-115	115-125	130	Detailed Log

Notes:
Check mark indicates document complete
App = Appendix
FS = First Sand
ft bgs = feet below ground surface
ID = Identification
IW = Injection Well
L = Photographs lost due to technical difficulties with camera
MNA = Monitored Natural Attenuation
MW = Monitoring Well
PMW = Performance Monitoring Well
SH = Shell Horizon
SHB1 = Shell Horizon Biobarrier 1
SHB2 = Shell Horizon Biobarrier 2
SHB3 = Shell Horizon Biobarrier 3
TD = Total Depth

TABLE 2.5

SECOND SAND BIOBARRIER FIELD DATA SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Zone	Well Boring Log		Well Construction Log		Photographic Record (App C)	Well Development Log (App F)	Date Started	Date Ended	Date Constructed	Proposed Depth (ft bgs)	Proposed Screen Interval (ft bgs)	Blank Screen Interval (ft bgs)	Final Screen Interval (ft bgs)	Final TD (ft bgs)	Notes
		App A	App D	App B	App E											
IW-70-SSB101	SSB1	✓	✓	✓	✓	✓	✓	6/18/07	6/19/07	6/19/07	170	125-165	0-125	125-165	170	Detailed Log
IW-70-SSB102	SSB1		✓	✓	✓	✓	✓	7/12/07	7/13/07	7/13/07	170	125-165	0-125	125-165	167	
IW-70-SSB103	SSB1		✓	✓	✓	✓	✓	7/16/07	7/16/07	7/16/07	170	125-165	0-125	125-165	167	
IW-70-SSB104	SSB1		✓	✓	✓	✓	✓	7/18/07	7/18/07	7/18/07	170	125-165	0-125	125-165	167	
IW-70-SSB105	SSB1		✓	✓	✓	✓	✓	7/19/07	7/19/07	7/19/07	170	125-165	0-125	125-165	167	
IW-70-SSB106	SSB1		✓	✓	✓	✓	✓	8/15/07	8/16/07	8/16/07	170	125-165	0-125	125-165	167	
IW-70-SSB107	SSB1		✓	✓	✓	✓	✓	8/15/07	8/20/07	8/20/07	170	125-165	0-125	125-165	167	
IW-70-SSB108	SSB1		✓	✓	✓	✓	✓	8/21/07	8/21/07	8/21/07	170	125-165	0-125	125-165	167	
IW-70-SSB109	SSB1		✓	✓	✓	✓	✓	8/22/07	8/22/07	8/22-8/23/07	170	125-165	0-125.75	125.75-165.75	167	
IW-70-SSB110	SSB1		✓	✓	✓	✓	✓	8/10/07	8/10/07	8/10/07	170	125-165	0-125	125-165	167	
IW-70-SSB111	SSB1		✓	✓	✓	✓	✓	8/8/07	8/9/07	8/9/07	170	125-165	0-125	125-165	167	
IW-70-SSB112	SSB1	✓	✓	✓	✓	✓	✓	6/20/07	6/20/07	6/20/07	170	125-165	0-125	125-165	170	Detailed Log
IW-70-SSB113	SSB1		✓	✓	✓	✓	✓	8/7/07	8/8/07	8/8/07	170	125-165	0-125	125-165	167	
IW-70-SSB114	SSB1		✓	✓	✓	✓	✓	7/11/07	7/11/07	7/11/07	170	125-165	0-125	125-165	167	
IW-70-SSB115	SSB1		✓	✓	✓	✓	✓	7/10/07	7/10/07	7/10/07	170	125-165	0-125	125-165	167	
IW-70-SSB116	SSB1		✓	✓	✓	✓	✓	6/26/07	6/27/07	6/27/07	170	125-165	0-125	125-165	167	
IW-70-SSB117	SSB1		✓	✓	✓	✓	✓	7/2/07	7/2/07	7/3/07	170	125-165	0-125	125-165	167	
IW-70-SSB118	SSB1		✓	✓	✓	✓	✓	8/13/07	8/13/07	8/13/07	170	125-165	0-125	125-165	167	
IW-70-SSB119	SSB1		✓	✓	✓	✓	✓	8/14/07	8/14/07	8/15/07	170	125-165	0-125	125-165	167	
IW-70-SSB120	SSB1		✓	✓	✓	✓	✓	8/13/07	8/13/07	8/13/07	170	125-165	0-125	125-165	167	
IW-70-SSB121	SSB1		✓	✓	✓	✓	✓	6/25/07	6/26/07	6/26/07	170	125-165	0-125	125-165	167	
IW-70-SSB122	SSB1	✓	✓	✓	✓	✓	✓	6/21/07	6/21/07	6/25/07	170	125-165	0-125	125-165	170	Detailed Log
MW-70-PMW13A	SSB1		✓	✓	✓	✓	✓	8/20/07	8/20/07	8/20/07	145	130-140	0-125	125-135	137	
MW-70-PMW13B	SSB1		✓	✓	✓	✓	✓	8/15/07	8/15/07	8/16/07	165	150-160	0-145	145-155	157	
MW-70-PMW14A	SSB1		✓	✓	✓	L	✓	8/15/07	8/15/07	8/15/07	145	130-140	0-128	128-138	140	Redrilled and reconstructed on 8/22/07 because steel casing broke off in borehole during drilling and could not be recovered.
MW-70-PMW14B	SSB1		✓	✓	✓	✓	✓	8/22/07	8/22/07	8/23/07	165	150-160	0-149	149-159	160	
MW-70-MNA15	SSB1	✓	✓	✓	✓	✓	✓	6/4/07	6/4/07	6/4-6/5/07	155	140-150	0-140	140-150	160	Detailed Log
MW-70-MNA16	SSB1	✓	✓	✓	✓	✓	✓	7/9/07	7/9/07	7/9/07	155	140-150	0-140.5	140.5-150.5	155	Detailed Log
MW-70-MNA17	SSB1	✓	✓	✓	✓	✓	✓	6/5/07	6/6/07	6/6/07	155	140-150	0-140	140-150	167	Detailed Log

Notes:
Check mark indicates document complete
App = Appendix
ft bgs = feet below ground surface
ID = Identification
IW = Injection Well
L = Photographs lost due to technical difficulties with camera
MNA = Monitored Natural Attenuation
MW = Monitoring Well
N/A = Not Applicable
PMW = Performance Monitoring Well
SSB1 = Second Sand Biobarrier 1
TD = Total Depth

TABLE 2.6

SOURCE AREA WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Start Date	End Date	Notes
IW-70-SAT 01	25-55	10	12.50	18.16	5.66	3/26/2007	3/26/2007	
IW-70-SAT 02	25-55	7	12.40	22.42	10.02	4/2/2007	4/2/2007	
IW-70-SAT 03	25-55	7	15.16	22.00	6.84	6/13/2007	6/14/2007	
IW-70-SAT 04	25-55	7	15.00	21.58	6.58	6/13/2007	6/13/2007	
IW-70-SAT 05	25-55	2	13.17	23.25	10.08	5/8/2007	5/9/2007	
IW-70-SAT 06	25-55	7	13.00	21.10	8.10	5/2/2007	5/8/2007	
IW-70-SAT 07	25-55	6	16.60	20.00	3.40	6/20/2007	6/20/2007	
IW-70-SAT 08	25-55	11	12.58	22.50	9.92	4/3/2007	4/3/2007	
IW-70-SAT 09	25-55	4	14.08	21.16	7.08	5/8/2007	5/9/2007	
IW-70-SAT 10	25-55	5	13.00	20.58	7.58	5/8/2007	5/8/2007	
IW-70-SAT 11	25-55	4	16.92	23.16	6.24	6/14/2007	6/20/2007	
IW-70-SAT 12	25-55	7	15.08	22.33	7.25	6/14/2007	6/14/2007	
IW-70-SAT 13	25-55	6	14.90	23.50	8.60	6/11/2007	6/11/2007	
IW-70-SAT 14	25-55	5	15.00	22.33	7.33	6/11/2007	6/11/2007	
IW-70-SAT 15	25-55	6	15.84	19.40	3.56	6/12/2007	6/12/2007	
IW-70-SAT 16	25-55	6	16.67	21.33	4.66	6/12/2007	6/12/2007	
IW-70-SAT 17	25-55	10	11.83	16.42	4.59	3/15/2007	3/15/2007	
IW-70-SAT 18	25-55	10	11.42	15.42	4.00	3/14/2007	3/14/2007	
IW-70-SAT 19	25-55	6	12.00	24.33	12.33	3/28/2007	3/28/2007	
IW-70-SAT 20	25-55	10	11.75	17.83	6.08	3/28/2007	3/28/2007	
IW-70-SAT 21	25-55	10	11.58	14.00	2.42	3/22/2007	3/26/2007	
IW-70-SAT 22	25-55	5	11.75	14.11	2.36	3/21/2007	3/22/2007	
IW-70-SAT 23	25-55	10	11.40	17.50	6.10	3/27/2007	3/27/07	
IW-70-SAT 24	25-55	10	11.08	14.75	3.67	3/20/2007	3/21/2007	
IW-70-SAT 25	25-55	10	11.00	13.11	2.11	3/20/2007	3/20/2007	
IW-70-SAT 26	25-55	10	11.16	20.33	9.17	3/27/2007	3/27/2007	
IW-70-SAT 27	25-55	5	10.66	16.08	5.42	3/12/2007	3/12/2007	
IW-70-SAT 28	25-55	15	11.90	14.00	2.10	4/4/2007	4/5/2007	
IW-70-SAT 29	25-55	10	10.83	13.42	2.59	3/13/2007	3/14/2007	
IW-70-SAT 30	25-55	10	10.58	18.58	8.00	3/12/2007	3/12/2007	
IW-70-SAT 31	25-55	10	8.16	15.83	7.67	3/13/2007	3/13/2007	
IW-70-SAT 32	25-55	4	11.80	20.75	8.95	3/8/2007	3/8/2007	Redeveloped due to low production rates.
IW-70-SAT 33	25-55	6	11.11	21.11	10.00	3/7/2007	3/8/2007	Redeveloped due to low production rates.
IW-70-SAT 34	25-55	6	10.92	19.08	8.16	3/6/2007	3/7/2007	Redeveloped due to low production rates.
IW-70-SAB 01	60-80	15	10.50	14.60	4.10	2/5/2007	2/6/2007	

TABLE 2.6

SOURCE AREA WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Start Date	End Date	Notes
IW-70-SAB 02	65-105	14	10.40	16.83	6.43	2/6/2007	2/6/2007	
IW-70-SAB 03	65-105	20	10.90	14.20	3.30	2/21/2007	2/23/2007	
IW-70-SAB 04	60-80 85-100	14	11.40	12.90	1.50	2/7/2007	2/7/2007	
IW-70-SAB 05	65-105	19	10.50	17.90	7.40	2/22/2007	2/23/2007	
IW-70-SAB 06	65-80 85-105	19	10.42	12.90	2.48	2/23/2007	2/27/2007	
IW-70-SAB 07	65-105	19	10.50	12.83	2.33	2/27/2007	2/28/2007	
IW-70-SAB 08	65-105	14	11.58	42.92	31.34	2/19/2007	2/21/2007	
IW-70-SAB 09	65-105	14	11.66	23.83	12.17	2/19/2007	2/19/2007	
IW-70-SAB 10	67-87 92-107	14	10.83	11.50	0.67	2/14/2007	2/15/2007	
IW-70-SAB 11	65-105	14	10.92	15.70	4.78	2/15/2007	2/15/2007	
IW-70-SAB 12	65-105	20	11.80	16.50	4.70	4/4/2007	4/4/2007	
IW-70-SAB 13	65-105	17	12.83	56.75	43.92	5/7/2007	5/7/2007	
IW-70-SAB 14	60-105	14	11.80	29.92	18.12	2/8/2007	2/8/2007	
MW-70-PMW 01A	25-35	3	11.00	22.50	11.50	3/19/2007	3/19/2007	
MW-70-PMW 01B	45-55	7	11.00	14.16	3.16	3/19/2007	3/19/2007	
MW-70-PMW 02A	70.5-80.5	3	8.83	64.25	55.42	3/1/2007	3/1/2007	
MW-70-PMW 02B	90-100	6	10.08	14.58	4.50	3/5/2007	3/5/2007	
MW-70-PMW 03A	70-80	7	10.30	12.83	2.53	2/28/2007	2/28/2007	
MW-70-PMW 03B	90-100	7	6.08	21.25	15.17	3/5/2007	2/28/2007	
MW-70-MNA 01	40-50	5	11.50	30.00	18.50	3/15/2007	3/15/2007	
MW-70-MNA 02	35-45	3.5	7.25	17.50	10.25	3/6/2007	3/6/2007	
MW-70-MNA 03	35-45	1	11.25	34.50	23.25	3/5/2007	3/6/2007	
MW-70-MNA 04	35-45	3	10.83	15.00	4.17	3/5/2007	3/5/2007	
MW-70-MNA 05	70-80	1.5	13.80	60.83	47.03	2/7/2007	2/7/2007	

Notes:
DTW = Depth to Water
ft bgs = feet below ground surface
GPM = Gallons Per Minute
ID = Identification
IW = Injection Well
MNA = Monitored Natural Attenuation
MW = Monitoring Well
PMW = Performance Monitoring Wells
SAB = Source Area Biobarrier
SAT = Source Area Treatment

TABLE 2.7

DISSOLVED PHASE PLUME WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Drawdown at Adjacent Wells (Feet)	Start Date	End Date	Notes
IW-70-FSB 101	60.5-105.5	20	9.05	12.10	3.05	0.15	5/8/2007	5/8/2007	
IW-70-FSB 102	61-106	20	8.69	9.70	1.01	0.3, 0	5/8/2007	5/8/2007	
IW-70-FSB 103	60-105	20	8.95	10.90	1.95	0.42, 0.25	5/7/2007	5/7/2007	
IW-70-FSB 104	60-105	20	8.80	11.95	3.15	0.5, 0.84	NR	NR	
IW-70-FSB 105	60-105	20	8.95	10.05	1.10	0.5, (1.7)	5/2/2007	5/2/2007	
IW-70-FSB 106	60-105	20	9.10	14.15	5.05	NR	5/2/2007	5/2/2007	
IW-70-FSB 107	60-105	20	9.40	11.80	2.40	0.2, 0.2	5/1/2007	5/2/2007	
IW-70-FSB 108	60-105	20	9.25	10.80	1.55	0.1, 0.2	5/1/2007	5/1/2007	
IW-70-FSB 109	60-105	30	9.50	15.40	5.90	(0.4), (1.2)	4/30/2007	4/30/2007	
IW-70-FSB 110	59-104	20	9.05	13.20	4.15	NR	4/25/2007	4/26/2007	
IW-70-FSB 111	60.7-105.7	20	8.40	10.90	2.50	NR	4/25/2007	4/25/2007	
IW-70-FSB 112	60-105	20	8.80	10.30	1.50	NR	4/24/2007	4/24/2007	
IW-70-FSB 113	60-105	21	9.00	10.65	1.65	NR	4/23/2007	4/24/2007	
IW-70-FSB 114	60-105	21	8.60	11.34	2.74	NR	4/19/2007	4/23/2007	
IW-70-FSB 115	60-105	16	9.40	40.40	31.00	NR	5/16/2007	5/16/2007	
IW-70-FSB 116	60-105	20	9.20	21.40	12.20	0.2, 0.2	5/16/2007	5/17/2007	
IW-70-FSB 117	60-105	5	9.00	43.60	34.60	NR	5/15/2007	5/16/2007	
IW-70-FSB 118	60-105	20	8.55	11.60	3.05	0.45, 0.4	5/14/2007	5/15/2007	
IW-70-FSB 119	60-105	20	9.60	15.50	5.90	0.2, 0.2	5/15/2007	5/15/2007	
IW-70-FSB 120	60-105	20	9.10	12.00	2.90	0.5, 0.5	5/14/2007	5/15/2007	
IW-70-FSB 121	60-105	19	10.00	32.60	22.60	NR	5/14/2007	5/14/2007	
IW-70-FSB 122	60-105	20	9.40	16.30	6.90	1.6, 0.9	5/14/2007	5/14/2007	
IW-70-FSB 123	60-105	20	8.60	11.58	2.98	1.3	5/10/2007	5/10/2007	
IW-70-FSB 124	60-105	20	9.35	11.55	2.20	0.35, 0.5	5/9/2007	5/9/2007	
IW-70-FSB 125	60-105	20	9.60	11.50	1.90	0.2	5/10/2007	5/10/2007	
IW-70-FSB 126	60-105	8.75	9.50	26.00	16.50	0.5, 0.55	5/8/2007	5/8/2007	
IW-70-FSB 127	60-105	20	8.50	32.50	24.00	NR	4/26/2007	4/26/2007	
IW-70-FSB 128	60-105	20	10.70	12.20	1.50	NR	5/16/2007	5/17/2007	
IW-70-FSB 129	60-105	20	9.70	11.70	2.00	NR	4/25/2007	4/25/2007	
IW-70-FSB 130	60-105	20	9.40	13.20	3.80	NR	4/23/2007	4/24/2007	
IW-70-FSB 131	60-105	20	9.60	11.20	1.60	NR	4/23/2007	4/23/2007	
IW-70-FSB 132	60-105	20	9.60	10.60	1.00	NR	4/19/2007	4/19/2007	
MW-70-PMW 04A	70-80	20	9.60	13.40	3.80	NR	5/21/2007	5/21/2007	
MW-70-PMW 04B	90-100	7.5	9.00	53.70	44.70	NR	5/21/2007	5/22/2007	
MW-70-PMW 05A	70-80	10	16.65	29.50	12.85	NR	5/22/2007	5/22/2007	Redeveloped after reconstruction.
MW-70-PMW 05B	90-100	18	9.30	31.00	21.70	NR	5/23/2007	5/23/2007	
MW-70-PMW 06A	69.5-79.5	16	9.07	42.20	33.13	NR	5/21/2007	5/21/2007	
MW-70-PMW 06B	91-101	20	9.40	41.75	32.35	NR	5/17/2007	5/17/2007	
MW-70-MNA 06	80-90	0.375	9.50	62.20	52.70	NR	5/8/2007	5/8/2007	

TABLE 2.7

DISSOLVED PHASE PLUME WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Drawdown at Adjacent Wells (Feet)	Start Date	End Date	Notes
MW-70-MNA 07	90-100	20	9.20	39.50	30.30	NR	5/17/2007	5/17/2007	
MW-70-MNA 08	80-90	7	12.70	75.60	62.90	NR	4/19/2007	4/19/2007	
MW-70-MNA 11	80-90	20	13.90	15.40	1.50	NR	4/18/2007	4/18/2007	
IW-70-FSB 201	65-100	20	13.60	19.50	5.90	NR	4/16/2007	4/17/2007	
IW-70-FSB 202	65-100	20	14.05	18.70	4.65	NR	4/16/2007	4/16/2007	
IW-70-FSB 203	65-100	20	13.80	50.20	36.40	NR	4/16/2007	4/17/2007	
IW-70-FSB 204	65-100	20	11.50	19.31	7.81	NR	4/12/2007	4/12/2007	
IW-70-FSB 205	65-100	20	12.50	19.90	7.40	NR	4/16/2007	4/16/2007	
IW-70-FSB 206	65-100	20	12.00	17.00	5.00	NR	4/11/2007	4/12/2007	
IW-70-FSB 207	65-100	20	12.50	13.35	0.85	NR	4/12/2007	4/12/2007	
IW-70-FSB 208	65-100	20	13.60	15.50	1.90	0.1, 0.1	4/11/2007	4/11/2007	
IW-70-FSB 209	65-100	18	14.90	14.00	(0.90)	NR	4/10/2007	4/11/2007	
IW-70-FSB 210	65-100	20	13.91	16.50	2.59	0.7, 0.1	4/9/2007	4/10/2007	
IW-70-FSB 211	65-100	20	14.70	17.30	2.60	NR	4/10/2007	4/11/2007	
IW-70-FSB 212	65-100	20	14.50	27.50	13.00	0.5, 1.0	4/9/2007	4/9/2007	
IW-70-FSB 213	65-100	20	13.90	19.30	5.40	1.2, 0.4	4/10/2007	4/10/2007	
IW-70-FSB 214	65-100	20	14.22	38.17	23.95	0.7, 0.1	4/9/2007	4/9/2007	
IW-70-FSB 215	65-100	10	13.20	16.40	3.20	0.4, 0.1	4/5/2007	4/5/2007	
IW-70-FSB 216	65-100	20	13.70	31.20	17.50	NR	4/5/2007	4/9/2007	
IW-70-FSB 217	65-100	10	8.50	16.40	7.90	NR	4/3/2007	4/4/2007	
IW-70-FSB 218	65-100	10	12.90	24.50	11.60	NR	4/4/2007	4/4/2007	
IW-70-FSB 219	65.5-100.5	10	12.60	13.80	1.20	NR	4/3/2007	4/3/2007	
IW-70-FSB 220	65-100	10	11.40	13.30	1.90	NR	3/29/2007	4/2/2007	
IW-70-FSB 221	65-100	6	12.20	38.80	26.60	NR	4/2/2007	4/3/2007	
IW-70-FSB 222	65-100	8	12.00	29.00	17.00	NR	3/29/2007	3/29/2007	Redeveloped due to low production rates.
IW-70-FSB 223	65-100	10	11.78	15.29	3.51	NR	3/28/2007	3/28/2007	
IW-70-FSB 224	65-100	10	11.45	16.20	4.75	NR	3/29/2007	3/29/2007	
IW-70-FSB 225	65-100	10	11.25	15.50	4.25	NR	3/28/2007	3/28/2007	
IW-70-FSB 226	65-100	10	11.40	12.71	1.31	NR	3/27/2007	3/28/2007	
IW-70-FSB 227	65-100	10	10.70	36.08	25.38	NR	3/26/2007	3/27/2007	
IW-70-FSB 228	65-100	10	11.30	16.20	4.90	NR	3/27/2007	3/28/2007	
IW-70-FSB 229	65-100	10	13.65	13.16	(0.49)	NR	3/26/2007	3/27/2007	
MW-70-PMW 07A	65-75	10	12.30	14.30	2.00	NR	4/4/2007	4/4/2007	
MW-70-PMW 07B	85-95	10	11.70	22.20	10.50	NR	4/4/2007	4/4/2007	
MW-70-PMW 08A	65-75	10	12.00	22.41	10.41	NR	4/4/2007	4/5/2007	
MW-70-PMW 08B	85-95	7	14.85	39.80	24.95	NR	4/5/2007	4/9/2007	
MW-70-MNA 09	64.25-74.25	20	12.20	15.40	3.20	NR	4/18/2007	4/18/2007	
MW-70-MNA 10	74.5-84.5	20	13.30	29.60	16.30	NR	4/17/2007	4/18/2007	
MW-70-MNA 12	75-85	20	10.80	29.75	18.95	NR	4/17/2007	4/18/2007	

TABLE 2.7

DISSOLVED PHASE PLUME WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Drawdown at Adjacent Wells (Feet)	Start Date	End Date	Notes
RDO-1	65.1-105.1	20	17.70	19.40	1.70	0.4, 0.4	8/28/2007	8/28/2007	
RDO-2	65.1-105.1	20	17.40	20.50	3.10	0.65, 0.65	8/29/2007	8/29/2007	
RDO-3B	65-105	25	18.20	19.70	1.50	NR	9/6/2007	9/6/2007	
RDO-4	65-105	25	17.90	19.50	1.60	NR	9/7/2007	9/7/2007	
IW-70-SHB101	105-130	20	20.90	26.00	5.10	NR	6/28/2007	6/28/2007	
IW-70-SHB102	105-130	33	21.85	29.40	7.55	NR	7/31/2007	7/31/2007	
IW-70-SHB103	105-130	30	24.48	35.65	11.17	NR	8/8/2007	8/8/2007	
IW-70-SHB104	105-130	32	23.90	32.20	8.30	NR	8/2/2007	8/2/2007	
IW-70-SHB105	105-130	30	23.95	60.20	36.25	NR	8/8/2007	8/8/2007	
IW-70-SHB106	105-130	30	21.70	35.05	13.35	NR	8/1/2007	8/2/2007	
IW-70-SHB107	105-130	20	19.70	36.84	17.14	NR	7/3/2007	7/3/2007	
IW-70-SHB108	105-110 115-130	21	19.90	29.15	9.25	0.15, 0.29	7/9/2007	7/10/2007	
IW-70-SHB109	100-110 115-130	20	19.45	34.40	14.95	(2.1), (0.35)	7/10/2007	7/11/2007	
IW-70-SHB110	105-130	30	27.31	34.30	6.99	NR	7/31/2007	7/31/2007	
IW-70-SHB111	100-110 120-130	30	28.10	37.25	9.15	NR	7/30/2007	7/30/2007	
IW-70-SHB112	100-110 115-130	20	22.50	25.90	3.40	0.3, 0	7/10/2007	7/11/2007	
IW-70-SHB113	105-130	20	14.75	33.60	18.85	NR	5/24/2007	5/24/2007	Redeveloped after reconstruction.
IW-70-SHB114	105-130	18	12.10	22.10	10.00	NR	5/23/2007	5/23/2007	
IW-70-SHB115	105-130	20	19.80	60.80	41.00	NR	6/25/2007	6/26/2007	
IW-70-SHB116	105-110 115-130	20	16.10	29.25	13.15	(0.6), (0.6)	6/27/2007	6/27/2007	
IW-70-SHB117	105.5-110.5 115.5-130.5	20	18.80	29.30	10.50	NR	7/9/2007	7/9/2007	
IW-70-SHB118	100-110 115-130	20	17.60	34.44	16.84	NR	7/2/2007	7/2/2007	
IW-70-SHB119	100-110 115-130	20	17.40	30.40	13.00	0.3, 0.3	6/28/2007	6/28/2007	
IW-70-SHB120	100-110 120-130	20	18.50	53.10	34.60	0.9, 1.5	6/27/2007	6/28/2007	
IW-70-SHB121	100-110 120-130	20	18.70	28.50	9.80	1.3, (0.7)	6/26/2007	6/27/2007	
IW-70-SHB122	100-110 120-130	20	18.50	29.90	11.40	NR	6/25/2007	6/26/2007	
IW-70-SHB123	100-110 120-130	20	17.50	34.45	16.95	NR	6/25/2007	6/26/2007	Redeveloped after reconstruction.

TABLE 2.7

DISSOLVED PHASE PLUME WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Drawdown at Adjacent Wells (Feet)	Start Date	End Date	Notes
IW-70-SHB124	105-110 115-130	20	9.20	28.00	18.80	NR	6/19/2007	6/19/2007	
IW-70-SHB125	105-130	20	16.10	26.80	10.70	NR	6/20/2007	6/20/2007	
IW-70-SHB126	105-110 115-130	16	18.10	35.50	17.40	NR	6/20/2007	6/21/2007	
IW-70-SHB127	103.5-128.5	16.7	18.70	21.40	2.70	NR	5/24/2007	5/24/2007	Redeveloped due to low production rates.
IW-70-SHB128	105-130	17	14.00	31.85	17.85	NR	5/21/2007	5/23/2007	
IW-70-SHB129	100-110 120-130	30	22.10	67.40	45.30	NR	7/31/2007	8/1/2007	
IW-70-SHB130	100-110 120-130	30	23.15	42.30	19.15	NR	8/1/2007	8/1/2007	
IW-70-SHB131	100-110 120-130	30	21.60	33.00	11.40	(0.03)	7/31/2007	8/1/2007	
IW-70-SHB132	105-110 115-130	20	19.20	37.77	18.57	NR	6/21/2007	6/25/2007	
IW-70-SHB133	100-110 120-130	17.5	20.20	25.50	5.30	NR	6/20/2007	6/20/2007	
IW-70-SHB134	105-115 120-130	17.5	17.80	22.15	4.35	NR	6/19/2007	6/20/2007	
IW-70-SHB135	105-110 120-130	20	21.65	69.40	47.75	NR	7/11/2007	7/11/2007	
IW-70-SHB136	105-110 120-130	20	23.50	40.75	17.25	NR	7/11/2007	7/11/2007	
IW-70-SHB137	105-115 120-130	16.5	17.93	28.70	10.77	NR	6/19/2007	6/19/2007	
MW-70-PMW 09	120-130	20	21.30	34.50	13.20	0.6	7/9/2007	7/10/2007	
MW-70-PMW 10	120-130	20	12.80	57.00	44.20	0.8	7/9/2007	7/9/2007	
MW-70-MNA 13	115-125	13	21.70	82.70	61.00	NR	7/30/2007	7/30/2007	
IW-70-SHB301	80-95 105-130	30	24.65	28.20	3.55	NR	8/7/2007	8/8/2007	
IW-70-SHB302	80-95 105-130	30	24.40	35.20	10.80	NR	8/8/2007	8/8/2007	
IW-70-SHB303	80-95 105-130	30	24.80	52.90	28.10	NR	8/9/2007	8/9/2007	
IW-70-SHB304	82-97 107-127	30	25.10	30.30	5.20	NR	8/9/2007	8/10/2007	
IW-70-SHB305	80.5-95.5 105.5-130.5	30	26.30	58.91	32.61	NR	8/13/2007	8/13/2007	

TABLE 2.7

DISSOLVED PHASE PLUME WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Drawdown at Adjacent Wells (Feet)	Start Date	End Date	Notes
IW-70-SHB306	80-95 105-130	30	26.35	37.99	11.64	NR	8/15/2007	8/15/2007	
IW-70-SHB307	80-95 105-130	30	26.20	50.00	23.80	NR	8/22/2007	8/22/2007	
IW-70-SHB308	80-95 105-130	30	26.15	33.90	7.75	NR	8/16/2007	8/16/2007	
IW-70-SHB309	80-95 105-130	30	26.85	32.70	5.85	NR	8/23/2007	8/23/2007	
IW-70-SHB310	80-95 105-130	30	27.00	60.90	33.90	0.6, (0.15)	8/23/2007	8/27/2007	
IW-70-SHB311	80-95 105-130	30	25.30	32.81	7.51	NR	8/13/2007	8/14/2007	
IW-70-SHB312	80-100 110-130	30	26.00	39.00	13.00	NR	8/13/2007	8/13/2007	
IW-70-SHB313	80.5-100.5 110.5-130.5	30	26.10	69.80	43.70	NR	8/10/2007	8/10/2007	
IW-70-SHB314	80-100 110-130	30	25.04	88.40	63.36	NR	8/20/2007	8/20/2007	
IW-70-SHB315	80-100 110-130	30	26.35	47.00	20.65	NR	8/21/2007	8/21/2007	
IW-70-SHB316	80-100 110-130	33	25.20	36.90	11.70	NR	8/2/2007	8/7/2007	
IW-70-SHB317	80-100 110-130	30	24.05	45.55	21.50	NR	8/15/2007	8/16/2007	
IW-70-SHB318	80-100 110-130	30	25.25	30.85	5.60	NR	8/20/2007	8/21/2007	
IW-70-SHB319	80-100 110-130	30	25.20	28.70	3.50	NR	8/21/2007	8/22/2007	
IW-70-SHB320	80-100 110-130	30	25.40	28.80	3.40	NR	8/20/2007	8/20/2007	
MW-70-PMW11A	85-95	9	27.25	69.60	42.35	0.35	9/6/2007	9/7/2007	
MW-70-PMW11B	115-125	20	27.30	73.90	46.60	0.4	9/6/2007	9/6/2007	
MW-70-PMW 12A	85-95	3.5	27.05	77.50	50.45	1	9/5/2007	9/5/2007	
MW-70-PMW12B	115-125	10	33.10	59.50	26.40	NR	8/21/2007	8/22/2007	
MW-70-MNA 14	115-125	8	26.15	120.55	94.40	NR	7/26/2007	7/30/2007	
IW-70-SSB101	125-165	30	23.70	25.80	2.10	NR	7/19/2007	7/24/2007	
IW-70-SSB102	125-165	30	24.10	28.50	4.40	(0.4), (0.3)	7/25/2007	7/25/2007	
IW-70-SSB103	125-165	30	24.15	30.00	5.85	NR	7/26/2007	7/26/2007	
IW-70-SSB104	125-165	30	24.30	26.90	2.60	NR	7/23/2007	7/24/2007	
IW-70-SSB105	125-165	30	24.20	32.70	8.50	0.3	7/25/2007	7/25/2007	

TABLE 2.7

DISSOLVED PHASE PLUME WELL DEVELOPMENT SUMMARY TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Screen Interval (ft bgs)	Sustained Development Rate (GPM)	Initial DTW (Feet)	Final DTW (Feet)	Drawdown at Sustained Rate (Feet)	Drawdown at Adjacent Wells (Feet)	Start Date	End Date	Notes
IW-70-SSB106	125-165	30	26.55	30.60	4.05	0.1, 0.05	8/28/2007	8/28/2007	
IW-70-SSB107	125-165	30	26.60	35.00	8.40	0.3	8/28/2007	8/29/2007	
IW-70-SSB108	125-165	30	26.50	93.10	66.60	0.3	8/29/2007	8/30/2007	
IW-70-SSB109	125.75-165.75	30	26.85	67.00	40.15	0.1, 0.25	8/30/2007	8/30/2007	
IW-70-SSB110	125-165	30	27.40	32.50	5.10	0.15, 0.2	8/29/2007	8/29/2007	
IW-70-SSB111	125-165	30	25.40	44.65	19.25	NR	8/14/2007	8/14/2007	
IW-70-SSB112	125-165	20	23.50	26.87	3.37	1.05	7/12/2007	7/16/2007	
IW-70-SSB113	125-165	30	26.45	47.99	21.54	NR	8/14/2007	8/15/2007	
IW-70-SSB114	125-165	25	24.80	34.75	9.95	NR	7/19/2007	7/19/2007	
IW-70-SSB115	125-165	25	24.86	54.25	29.39	NR	7/18/2007	7/18/2007	
IW-70-SSB116	125-165	20	24.95	42.55	17.60	NR	7/12/2007	7/17/2007	
IW-70-SSB117	125-165	20	24.25	27.15	2.90	0.07, 0.2	7/17/2007	7/18/2007	
IW-70-SSB118	125-165	30	24.43	30.60	6.17	1.2, 0.5	8/28/2007	8/28/2007	
IW-70-SSB119	125-165	30	35.25	37.13	1.88	1.4, 1.1	8/27/2007	8/27/2007	
IW-70-SSB120	125-165	30	27.30	45.00	17.70	NR	8/22/2007	8/23/2007	
IW-70-SSB121	125-165	25	23.90	49.50	25.60	NR	7/18/2007	7/19/2007	
IW-70-SSB122	125-165	20	23.90	32.20	8.30	0.7, 0.4	7/17/2007	7/18/2007	
MW-70-PMW13A	125-135	13	22.28	92.60	70.32	NR	9/5/2007	9/6/2007	
MW-70-PMW13B	145-155	20	22.10	71.00	48.90	0.3	9/5/2007	9/5/2007	
MW-70-PMW14A	128-138	18	26.11	119.40	93.29	0.3	9/4/2007	9/5/2007	
MW-70-PMW14B	149-159	20	26.25	109.10	82.85	0.3	9/4/2007	9/4/2007	
MW-70-MNA 15	140-150	16.5	17.05	31.50	14.45	(0.40)	6/18/2007	6/18/2007	
MW-70-MNA 16	140.5-150.5	23	25.20	40.20	15.00	NR	7/25/2007	7/26/2007	
MW-70-MNA 17	140-150	20	17.00	33.30	16.30	NR	6/18/2007	6/19/2007	

Notes:
DTW = Depth to Water
ft bgs = feet below ground surface
FSB = First Sand Biobarrier
GPM = Gallons Per Minute
MNA = Monitored Natural Attenuation
NR = Not Recorded
PMW = Performance Monitoring Wells
RDO = Remedial Design Optimization
SHB = Shell Horizon Biobarrier
SSB = Second Sand Biobarrier

FINAL SURVEY DATA TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation
IW-70-SAT 01	2224308.0728	6005882.8112	13.29	13.06
IW-70-SAT 02	2224286.7966	6005883.1453	13.30	13.04
IW-70-SAT 03	2224286.8281	6005948.1770	13.15	13.01
IW-70-SAT 04	2224281.6297	6005958.8236	13.01	12.86
IW-70-SAT 05	2224283.8732	6005900.7872	13.45	13.24
IW-70-SAT 06	2224279.1741	6005925.7497	13.21	12.99
IW-70-SAT 07	2224271.7010	6005956.1983	13.00	12.74
IW-70-SAT 08	2224266.7893	6005871.2855	13.16	12.85
IW-70-SAT 09	2224269.3780	6005896.8819	13.29	13.03
IW-70-SAT 10	2224267.0171	6005934.8148	13.27	13.11
IW-70-SAT 11	2224260.4213	6005960.0069	13.08	12.80
IW-70-SAT 12	2224266.9553	6005945.7924	13.26	13.09
IW-70-SAT 13	2224220.1625	6005941.8255	13.14	12.95
IW-70-SAT 14	2224216.8108	6005949.9047	13.17	13.05
IW-70-SAT 15	2224218.6744	6005973.6155	13.15	12.97
IW-70-SAT 16	2224206.6599	6005943.2445	13.03	12.78
IW-70-SAT 17	2224206.6359	6005963.2686	13.08	12.91
IW-70-SAT 18	2224206.5903	6005983.3236	12.66	12.46
IW-70-SAT 19	2224199.7638	6005923.2045	12.72	12.51
IW-70-SAT 20	2224186.4116	6005878.2265	12.71	12.48
IW-70-SAT 21	2224189.3586	6005933.5640	12.68	12.50
IW-70-SAT 22	2224189.3750	6005953.3925	12.75	12.54
IW-70-SAT 23	2224166.9302	6005881.4713	12.49	12.35
IW-70-SAT 24	2224166.7461	6005949.7029	12.41	12.15
IW-70-SAT 25	2224166.6920	6005963.2001	12.42	12.19
IW-70-SAT 26	2224147.4281	6005877.1139	12.19	11.95
IW-70-SAT 27	2224128.8997	6005902.0761	12.07	11.83
IW-70-SAT 28	2224146.5546	6005933.3428	12.15	11.98
IW-70-SAT 29	2224146.6766	6005953.1345	12.17	12.09
IW-70-SAT 30	2224131.3654	6005923.4066	12.03	12.07
IW-70-SAT 31	2224130.4204	6005942.9064	11.92	12.03
IW-70-SAT 32	2224097.5714	6005993.1758	12.62	12.38
IW-70-SAT 33	2224100.5328	6006013.4381	12.61	12.41
IW-70-SAT 34	2224100.6756	6006034.3510	12.77	12.50
IW-70-SAB 01	2223802.9809	6005831.2175	11.56	11.40
IW-70-SAB 02	2223817.5828	6005849.4765	11.63	11.43
IW-70-SAB 03	2223836.6342	6005867.0331	12.21	11.96
IW-70-SAB 04	2223846.5005	6005889.0168	12.18	11.99
IW-70-SAB 05	2223861.0261	6005908.2497	11.92	11.68
IW-70-SAB 06	2223875.3741	6005927.2777	12.10	11.92
IW-70-SAB 07	2223889.5715	6005946.5315	12.32	12.03
IW-70-SAB 08	2223904.4231	6005965.5798	12.45	12.21
IW-70-SAB 09	2223918.5768	6005984.7390	12.60	12.31
IW-70-SAB 10	2223927.9765	6006003.8769	11.94	11.90
IW-70-SAB 11	2223947.4015	6006023.1644	12.04	11.87
IW-70-SAB 12	2223961.7634	6006042.5239	12.19	12.04

FINAL SURVEY DATA TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation
IW-70-SAB 13	2223976.1889	6006061.4175	12.70	12.39
IW-70-SAB 14	2223999.6857	6006072.3750	12.87	12.66
MW-70-PMW 01A	2224162.7014	6005948.2959	12.36	12.08
MW-70-PMW 01B	2224163.3442	6005952.7188	12.34	12.06
MW-70-PMW 02A	2223909.8302	6005902.2998	12.41	12.20
MW-70-PMW 02B	2223912.0803	6005905.7292	12.42	12.23
MW-70-PMW 03A	2223867.8236	6005930.0753	12.06	11.79
MW-70-PMW 03B	2223870.3375	6005933.3895	12.06	11.73
MW-70-MNA 01	2224281.8922	6006003.2219	12.61	12.21
MW-70-MNA 02	2224020.6558	6006052.9066	12.63	12.36
MW-70-MNA 03	2224096.4765	6006104.8104	13.32	13.03
MW-70-MNA 04	2224052.5541	6005800.6285	12.50	12.24
MW-70-MNA 05	2224052.6710	6005796.7175	12.52	12.31
IW-70-FSB 101	2223378.3012	6005796.4708	8.40	8.34
IW-70-FSB 102	2223377.5970	6005819.4614	8.30	8.23
IW-70-FSB 103	2223377.7857	6005842.1704	8.20	8.16
IW-70-FSB 104	2223378.1873	6005864.4012	8.30	8.20
IW-70-FSB 105	2223377.4498	6005886.7820	8.60	8.36
IW-70-FSB 106	2223377.4915	6005910.2836	8.40	8.33
IW-70-FSB 107	2223376.7461	6005933.2403	8.50	8.24
IW-70-FSB 108	2223375.3202	6005955.7085	8.70	8.49
IW-70-FSB 109	2223375.3972	6005978.8209	8.70	8.57
IW-70-FSB 110	2223374.3192	6006001.8077	8.50	8.31
IW-70-FSB 111	2223374.2616	6006024.7719	8.10	7.93
IW-70-FSB 112	2223393.4761	6006037.3136	8.00	7.89
IW-70-FSB 113	2223413.1900	6006049.4318	8.30	8.11
IW-70-FSB 114	2223432.6326	6006061.3876	8.30	8.17
IW-70-FSB 115	2223476.0481	6006085.1658	8.20	8.06
IW-70-FSB 116	2223492.9778	6006094.2265	8.20	7.98
IW-70-FSB 117	2223514.0628	6006104.4052	8.20	7.94
IW-70-FSB 118	2223552.3952	6006128.6844	8.40	8.27
IW-70-FSB 119	2223569.9883	6006142.2101	8.50	8.29
IW-70-FSB 120	2223588.2955	6006155.5562	8.60	8.51
IW-70-FSB 121	2223606.0605	6006169.2824	8.60	8.53
IW-70-FSB 122	2223648.8308	6006186.9226	8.80	8.71
IW-70-FSB 123	2223664.0512	6006207.3589	9.00	8.81
IW-70-FSB 124	2223683.3470	6006219.5515	9.10	9.10
IW-70-FSB 125	2223703.2492	6006232.2084	9.20	9.06
IW-70-FSB 126	2223722.4948	6006244.7968	8.80	8.81
IW-70-FSB 127	2223741.9989	6006257.7791	9.20	8.99
IW-70-FSB 128	2223762.6634	6006265.4186	10.10	9.83
IW-70-FSB 129	2223780.3900	6006283.1531	9.80	9.80
IW-70-FSB 130	2223818.1962	6006309.0638	9.30	9.36
IW-70-FSB 131	2223835.7291	6006324.0547	9.30	9.24
IW-70-FSB 132	2223854.6081	6006338.0794	9.40	9.32
MW-70-PMW 04A	2223422.4691	6005948.0062	8.80	8.37

FINAL SURVEY DATA TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation
MW-70-PMW 04B	2223422.4402	6005942.7757	8.80	8.38
MW-70-PMW 05A	2223356.4321	6005957.4072	8.40	8.06
MW-70-PMW 05B	2223355.6784	6005965.6356	8.70	8.19
MW-70-PMW 06A	2223555.9629	6006088.2992	8.40	7.99
MW-70-PMW 06B	2223550.5963	6006086.3442	8.40	8.01
MW-70-MNA 06	2223223.9355	6005822.0100	8.10	7.80
MW-70-MNA 07	2223353.5253	6006032.6773	8.90	8.50
MW-70-MNA 08	2223428.5245	6006211.9139	11.80	11.51
MW-70-MNA 11	2223538.7839	6006673.8661	12.60	12.15
IW-70-FSB 201	2222968.0134	6006154.5378	12.30	12.09
IW-70-FSB 202	2222994.6918	6006169.0210	12.80	12.60
IW-70-FSB 203	2223008.0130	6006188.9030	11.70	11.63
IW-70-FSB 204	2223020.9071	6006210.0466	10.50	10.35
IW-70-FSB 205	2223033.9836	6006229.8912	9.80	9.60
IW-70-FSB 206	2223045.6867	6006249.0856	10.00	9.79
IW-70-FSB 207	2223059.1914	6006269.7114	10.00	10.12
IW-70-FSB 208	2223071.3103	6006292.0997	10.90	11.15
IW-70-FSB 209	2223084.8916	6006310.8734	12.00	11.66
IW-70-FSB 210	2223107.5650	6006328.1228	12.20	11.86
IW-70-FSB 211	2223111.0122	6006352.0212	12.98	12.69
IW-70-FSB 212	2223124.0577	6006371.9277	12.88	12.57
IW-70-FSB 213	2223135.8954	6006391.8877	12.73	12.54
IW-70-FSB 214	2223148.9760	6006411.7024	12.81	12.60
IW-70-FSB 215	2223162.0919	6006433.1635	12.40	12.38
IW-70-FSB 216	2223174.7197	6006453.0737	12.40	12.19
IW-70-FSB 217	2223187.7597	6006472.9351	12.30	12.18
IW-70-FSB 218	2223202.1864	6006493.5498	12.30	12.24
IW-70-FSB 219	2223213.0475	6006514.0464	12.10	11.99
IW-70-FSB 220	2223236.2788	6006523.7049	11.60	11.55
IW-70-FSB 221	2223239.0152	6006554.3138	11.40	11.28
IW-70-FSB 222	2223251.8981	6006575.0717	11.40	11.32
IW-70-FSB 223	2223263.9023	6006595.3917	11.50	11.33
IW-70-FSB 224	2223274.2845	6006617.7803	11.20	11.22
IW-70-FSB 225	2223283.9819	6006640.1338	10.80	10.94
IW-70-FSB 226	2223292.0633	6006663.0885	11.10	11.07
IW-70-FSB 227	2223293.2911	6006693.5255	10.80	10.76
IW-70-FSB 228	2223321.9195	6006698.5365	10.70	10.79
IW-70-FSB 229	2223341.1869	6006714.7014	10.90	10.68
MW-70-PMW 07A	2223191.9207	6006440.3825	11.90	11.74
MW-70-PMW 07B	2223194.3275	6006445.2439	11.80	11.37
MW-70-PMW 08A	2223146.8158	6006447.7764	13.00	12.89
MW-70-PMW 08B	2223144.4225	6006442.6936	13.00	12.93
MW-70-MNA 09	2222951.7061	6006103.5527	10.90	10.67
MW-70-MNA 10	2223077.8665	6006534.0153	11.20	10.86
MW-70-MNA 12	2222721.1895	6006633.8983	9.80	9.81
RDO-1	2223799.5261	6006296.0437	9.20	9.06

FINAL SURVEY DATA TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation
RDO-2	2223624.5336	6006182.6071	8.50	8.47
RDO-3B	2223534.5633	6006114.8293	8.20	10.81
RDO-4	2223452.0512	6006074.3517	8.00	7.98
IW-70-SHB101	2223111.2343	6006007.7583	11.80	11.62
IW-70-SHB102	2223127.2484	6006021.8749	12.30	11.95
IW-70-SHB103	2223136.2711	6006040.0105	12.71	12.50
IW-70-SHB104	2223144.9637	6006057.9556	12.88	12.68
IW-70-SHB105	2223154.2228	6006076.1159	12.67	12.52
IW-70-SHB106	2223163.1047	6006093.8585	12.74	12.21
IW-70-SHB107	2223172.9607	6006113.1053	12.30	12.25
IW-70-SHB108	2223181.3848	6006129.3196	12.50	12.43
IW-70-SHB109	2223190.1759	6006146.8032	12.30	12.05
IW-70-SHB110	2223200.3624	6006164.7895	12.30	12.35
IW-70-SHB111	2223228.3999	6006171.3756	12.40	12.16
IW-70-SHB112	2223218.7946	6006200.9840	12.10	12.06
IW-70-SHB113	2223226.4029	6006218.0690	11.40	11.34
IW-70-SHB114	2223236.0939	6006235.5415	10.70	10.57
IW-70-SHB115	2223244.7906	6006254.0980	10.40	10.18
IW-70-SHB116	2223254.1956	6006271.9273	10.40	10.26
IW-70-SHB117	2223262.6104	6006290.1189	10.50	10.33
IW-70-SHB118	2223279.2303	6006304.0642	10.40	10.16
IW-70-SHB119	2223288.2729	6006320.2419	11.10	10.85
IW-70-SHB120	2223289.7124	6006342.8788	11.90	11.68
IW-70-SHB121	2223298.0065	6006360.9420	12.60	12.42
IW-70-SHB122	2223303.8168	6006380.9701	12.20	12.00
IW-70-SHB123	2223302.1614	6006405.5517	10.40	10.31
IW-70-SHB124	2223337.3473	6006409.8371	11.50	11.43
IW-70-SHB125	2223336.1408	6006431.7691	10.50	10.38
IW-70-SHB126	2223345.2486	6006449.6822	10.50	10.42
IW-70-SHB127	2223353.9121	6006467.8863	10.70	10.64
IW-70-SHB128	2223362.8319	6006485.6311	11.60	11.46
IW-70-SHB129	2223371.3274	6006504.0880	12.60	12.43
IW-70-SHB130	2223380.7360	6006521.0350	13.01	12.86
IW-70-SHB131	2223389.9204	6006538.8974	13.04	12.91
IW-70-SHB132	2223398.7565	6006557.3022	12.50	12.42
IW-70-SHB133	2223407.6441	6006574.9494	12.40	12.19
IW-70-SHB134	2223416.7188	6006593.0759	13.00	12.86
IW-70-SHB135	2223426.0333	6006610.9747	13.13	13.02
IW-70-SHB136	2223436.1552	6006627.9134	13.09	12.97
IW-70-SHB137	2223444.8784	6006646.0280	12.99	12.87
MW-70-PMW 09	2223253.8724	6006226.3473	10.80	10.67
MW-70-PMW 10	2223215.7667	6006247.2416	10.80	10.45
MW-70-MNA 13	2222951.3119	6006096.8891	10.70	10.49
IW-70-SHB201	2222510.0109	6006405.4977	11.30	11.48
IW-70-SHB217	2222624.8873	6006709.5069	12.50	12.52
IW-70-SHB232	2222844.2032	6006893.6918	11.70	11.78

FINAL SURVEY DATA TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation
IW-70-SHB301	2222266.6382	6006863.0088	12.08	11.81
IW-70-SHB302	2222286.4700	6006875.7924	12.23	11.92
IW-70-SHB303	2222306.9853	6006888.8746	12.63	12.31
IW-70-SHB304	2222330.8635	6006904.2260	12.92	12.52
IW-70-SHB305	2222347.4546	6006915.0788	13.00	12.73
IW-70-SHB306	2222367.4162	6006928.3326	12.96	12.76
IW-70-SHB307	2222387.5548	6006941.1949	12.98	12.55
IW-70-SHB308	2222407.9174	6006954.2147	12.92	12.74
IW-70-SHB309	2222427.8836	6006967.2455	12.94	12.74
IW-70-SHB310	2222447.9720	6006980.4995	12.96	12.58
IW-70-SHB311	2222466.3830	6006996.0334	12.91	12.63
IW-70-SHB312	2222488.3478	6007006.8188	12.63	12.52
IW-70-SHB313	2222508.4418	6007019.6900	12.31	12.11
IW-70-SHB314	2222527.7551	6007033.4785	11.90	11.73
IW-70-SHB315	2222544.3338	6007043.6339	12.10	11.91
IW-70-SHB316	2222561.5737	6007056.5394	12.80	12.62
IW-70-SHB317	2222587.7203	6007073.0179	12.80	12.60
IW-70-SHB318	2222611.8153	6007089.3412	11.70	11.61
IW-70-SHB319	2222631.0595	6007100.6103	11.70	11.39
IW-70-SHB320	2222648.1010	6007112.6695	12.00	11.63
MW-70-PMW11A	2222552.1799	6007014.9870	12.20	11.98
MW-70-PMW11B	2222545.7994	6007013.6030	12.10	11.80
MW-70-PMW 12A	2222526.8250	6007058.0981	12.00	11.71
MW-70-PMW12B	2222518.1011	6007051.3770	12.10	11.94
MW-70-MNA 14	2222157.2816	6007254.7394	13.07	12.71
IW-70-SSB101	2222076.9869	6007048.0618	11.70	11.62
IW-70-SSB102	2222093.1542	6007066.7165	11.70	11.67
IW-70-SSB103	2222111.0767	6007083.6119	11.50	11.54
IW-70-SSB104	2222131.4254	6007097.2942	11.50	11.39
IW-70-SSB105	2222151.1055	6007109.7334	11.60	11.36
IW-70-SSB106	2222171.0140	6007123.0461	11.90	11.89
IW-70-SSB107	2222191.2428	6007136.1059	11.80	11.78
IW-70-SSB108	2222207.4660	6007147.7430	11.90	11.87
IW-70-SSB109	2222230.8556	6007162.7545	11.90	11.81
IW-70-SSB110	2222256.0315	6007179.3558	12.90	12.75
IW-70-SSB111	2222270.5696	6007189.2771	12.90	12.75
IW-70-SSB112	2222290.3724	6007202.9964	11.90	11.72
IW-70-SSB113	2222310.4356	6007215.9744	11.70	11.69
IW-70-SSB114	2222330.3131	6007229.3286	11.70	11.53
IW-70-SSB115	2222350.6647	6007242.0751	11.90	11.83
IW-70-SSB116	2222370.0009	6007255.7928	12.30	12.27
IW-70-SSB117	2222389.7610	6007268.1340	12.40	12.30
IW-70-SSB118	2222409.2336	6007281.3170	12.60	12.39
IW-70-SSB119	2222429.6440	6007294.6791	13.19	12.91
IW-70-SSB120	2222452.3316	6007308.5823	12.60	12.09
IW-70-SSB121	2222469.9080	6007320.4156	12.40	12.19

FINAL SURVEY DATA TABLE
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Well ID	Northing	Easting	Ground Surface Elevation	Measuring Point Elevation
IW-70-SSB122	2222487.2165	6007331.7855	12.30	12.05
MW-70-PMW13A	2222293.7823	6007163.1912	8.40	11.32
MW-70-PMW13B	2222303.1037	6007169.2491	8.50	11.33
MW-70-PMW14A	2222253.6681	6007203.4913	11.80	11.49
MW-70-PMW14B	2222270.9395	6007216.2715	12.00	11.77
MW-70-MNA 15	2222706.1802	6006650.4865	9.90	9.70
MW-70-MNA 16	2222145.2632	6007245.6479	13.07	12.50
MW-70-MNA 17	2222026.2380	6007015.4267	10.80	10.65

Notes:
FSB = First Sand Biobarrier
ID = Identification
IW = Injection Well
MNA = Monitored Natural Attenuation
MW = Monitoring Well
PMW = Performance Monitoring Well
RDO = Remedial Design Optimization
SHB = Shell Horizon Biobarrier
SSB = Second Sand Biobarrier
Vertical datum = NGVD29
Horizontal coordinate system = California StatePlane NAD83 Zone VI feet

TABLE 2.9

DISPOSITION OF INVESTIGATON DERIVED WASTE - SOLIDS
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Container Type	Container #	Status	Piping	Asphalt	Soil / PPE	Paint Chips	Date on-site	Transported Offsite	ECC Manifest Tracking #
20 cy rolloff	DB480	Removed			✓		NR	2/21/2007	Site 70-01-001
20 cy rolloff	DB700	Removed			✓		NR	2/22/2007	Site 70-01-002
20 cy rolloff	DB921	Removed			✓		NR	2/22/2007	Site 70-01-003
20 cy rolloff	DB409	Removed			✓		NR	2/22/2007	Site 70-01-004
20 cy rolloff	DB443	Removed		✓	✓		NR	2/23/2007	Site 70-01-005
20 cy rolloff	DB934	Removed			✓		NR	3/8/2007	Site 70-01-006
20 cy rolloff	DB939	Removed			✓		NR	3/8/2007	Site 70-01-007
20 cy rolloff	DB921	Removed		✓	✓		NR	3/9/2007	Site 70-01-008
20 cy rolloff	DB409	Removed			✓		NR	3/20/2007	Site 70-01-009
20 cy rolloff	DB921	Removed			✓		3/20/2007	3/26/2007	Site 70-01-010
20 cy rolloff	DB939	Removed			✓		3/9/2007	3/26/2007	Site 70-01-011
20 cy rolloff	DB497	Removed			✓		2/28/2007	4/4/2007	Site 70-01-012
20 cy rolloff	DB776	Removed			✓		3/13/2007	4/4/2007	Site 70-01-013
20 cy rolloff	DB934	Removed			✓		3/8/2007	4/9/2007	Site 70-01-014
20 cy rolloff	DB939	Removed			✓		3/26/2007	4/12/2007	Site 70-01-015
20 cy rolloff	DB764	Removed			✓		3/26/2007	4/16/2007	Site 70-01-016
20 cy rolloff	DB681	Removed			✓		3/8/2007	4/23/2007	Site 70-01-017
20 cy rolloff	DB447	Removed			✓		4/12/2007	4/25/2007	Site 70-01-018
20 cy rolloff	DB412	Removed			✓		4/23/2007	4/26/2007	Site 70-01-019
20 cy rolloff	DB722	Removed			✓		3/8/2007	4/30/2007	Site 70-01-020
20 cy rolloff	DB497	Removed			✓		4/4/2007	4/30/2007	Site 70-01-021
20 cy rolloff	DB686	Removed			✓		4/4/2007	4/30/2007	Site 70-01-022
20 cy rolloff	DB741	Removed			✓		4/4/2007	4/30/2007	Site 70-01-023
20 cy rolloff	DB701	Removed			✓		4/16/2007	5/1/2007	Site 70-01-024
20 cy rolloff	DB483	Removed			✓		4/25/2007	5/21/2007	Site 70-01-025
20 cy rolloff	DB722	Removed			✓		4/30/2007	5/22/2007	Site 70-01-026
20 cy rolloff	DB497	Removed			✓		4/30/2007	5/22/2007	Site 70-01-027
20 cy rolloff	DB433	Removed			✓		4/30/2007	5/30/2007	Site 70-01-028
20 cy rolloff	DB741	Removed			✓		4/9/2007	5/31/2007	Site 70-01-029

TABLE 2.9

DISPOSITION OF INVESTIGATON DERIVED WASTE - SOLIDS
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

20 cy rolloff	DB489	Removed			✓		5/1/2007	5/31/2007	Site 70-01-030
20 cy rolloff	DB484	Removed			✓		4/26/2007	5/31/2007	Site 70-01-031
20 cy rolloff	DB686	Removed			✓		5/1/2007	6/1/2007	Site 70-01-032
20 cy rolloff	DB480	Removed			✓		5/21/2007	6/1/2007	Site 70-01-033
20 cy rolloff	DB 483	Removed			✓		5/21/2007	6/1/2007	Site-70-01-034
20 cy rolloff	DB 722	Removed			✓		5/22/2007	6/4/2007	Site-70-01-035
20 cy rolloff	DB480	Removed			✓		6/1/2007	6/5/2007	Site-70-01-036
20 cy rolloff	DB483	Removed			✓		6/4/2007	6/7/2007	Site-70-01-037
20 cy rolloff	DB423	Removed			✓		6/7/2007	6/13/2007	Site-70-01-038
20 cy rolloff	DB403	Removed			✓		6/5/2007	6/20/2007	Site-70-01-039
20 cy rolloff	DB668	Removed			✓		6/13/2007	6/20/2007	Site-70-01-040
20 cy rolloff	DB507	Removed			✓		6/20/2007	6/26/2007	Site-70-01-041
20 cy rolloff	DB423	Removed			✓		6/20/2007	6/27/2007	Site-70-01-042
20 cy rolloff	DB762	Removed			✓		6/26/2007	6/29/2007	Site-70-01-043
20 cy rolloff	DB 507	Removed			✓		6/27/2007	7/2/2007	Site-70-01-044
20 cy rolloff	DB 482	Removed			✓		6/29/2007	7/9/2007	Site-70-01-045
20 cy rolloff	DB 415	Removed			✓		7/2/2007	7/9/2007	Site-70-01-046
20 cy rolloff	DB443	Removed			✓		7/9/2007	7/12/2007	Site-70-01-047
20 cy rolloff	DB421	Removed			✓		7/12/2007	7/17/2007	Site-70-01-048
20 cy rolloff	DB482	Removed			✓		7/9/2007	7/17/2007	Site-70-01-049
20 cy rolloff	DB443	Removed			✓		7/13/2007	7/19/2007	Site-70-01-050
20 cy rolloff	DB421	Removed			✓		7/17/2007	7/24/2007	Site-70-01-051
20 cy rolloff	DB431	Removed			✓		7/19/2007	7/24/2007	Site-70-01-052
20 cy rolloff	DB421	Removed			✓		7/24/2007	7/30/2007	Site-70-01-053
20 cy rolloff	DB400	Removed			✓		7/24/2007	7/30/2007	Site-70-01-054
20 cy rolloff	DB421	Removed			✓		7/30/2007	8/2/2007	Site-70-01-055
20 cy rolloff	DB443	Removed			✓		7/30/2007	8/8/2007	Site-70-01-056
20 cy rolloff	DB604	Removed			✓		8/2/2007	8/8/2007	Site-70-01-057
20 cy rolloff	DB942	Removed			✓		8/8/2007	8/10/2007	Site-70-01-058
20 cy rolloff	DB400	Removed			✓		8/8/2007	8/10/2007	Site-70-01-059
20 cy rolloff	DB408	Removed			✓		8/10/2007	8/16/2007	Site-70-01-060

TABLE 2.9

DISPOSITION OF INVESTIGATON DERIVED WASTE - SOLIDS
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

20 cy rolloff	DB942	Removed			✓		8/10/2007	8/20/2007	Site-70-01-061
20 cy rolloff	DB451	Removed			✓		8/16/2007	8/28/2007	Site-70-01-062
20 cy rolloff	DB408	Removed			✓		8/16/2007	9/6/2007	Site-70-01-063
20 cy rolloff	DB678	Removed			✓		8/20/2007	9/6/2007	Site-70-01-064
Baker Dewatering Box		Removed					8/1/2007	9/7/2007	Site-70-01-065
Drum	01	1/4 Full				✓	4/9/2007	7/3/2007	000784869 FLE
40 cy rolloff	Supplied by Navy	Full	✓				1/15/2007	4/10/2007	NA

Acronyms/Abbreviations

- number
cy - cubic yard
ECC - Environmental Chemical Corporation
NA - not applicable
NR - not recorded
PPE - personal protective equipment

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TABLE 2.10

DISPOSITION OF INVESTIGATON DERIVED WASTE - LIQUIDS
IR Site 70, Naval Weapons Station Seal Beach
Seal Beach, California

Container Type	Batch #	Container #	Content	Location	Fill Start date	Sample Date	Sample ID	TCE Sample Results	Air Sparge Date	Aditional sample	TCE Sample Results	Discharge Date	Discharge Area	Comments
21,000 gallon Baker Tank	1	1238	ground water	Phase One	1/16/2007	2/23/2007	FT-01-01-01	650ppb	4/12/2007	FT-01-02-01	Below detection limits	5/1/2007	A	Orginal Contents emptied into closed top tank 1585EA
21,000 gallon Baker Tank	1*	1585EA	ground water	Phase One	*transferred*									Contents of Tank 1. Discharged into Phase II open field.
21,000 gallon Baker Tank	2	S1569EA	ground water	Phase One	2/15/2007	3/13/2007	FT-02-01-01	1700ppb	4/17/2007	FT-02-02-01	Below detection limits	5/28/2007	A	Removed due to bulge. Contents emptied into 422NEA
21,000 gallon Baker Tank	2*	422NEA	ground water	Phase One	*transferred*									Contents of Tank 2. Discharged into Phase II open field.
21,000 gallon Baker Tank	3	2622EA	ground water	Phase One	3/8/2007	4/18/2007	na	na	6/4&6/5	na	na	6/25/2007	A	Phase 2 staging Area
21,000 gallon Baker Tank	4	S1114EA	ground water	Phase One	3/26/2007	3/26/2007	na	na	5/10/2007	na	na	5/15/2007	A	Discharged into Phase II open field.
21,000 gallon Baker Tank	5	18REA	ground water	Phase One	3/14/2007	na	na	na	4/24/2007	na	na	6/5/2007	A	Source Area Development Water
21,000 gallon Baker Tank	10	1585EA	ground water	Phase One	4/2/2007	5/9/2007	FT-10-01-02	430ppb	5/30&6/1	FT-06-02-02	1.9ppb	6/4/2007	A	Discharged into Phase II open field.
21,000 gallon Baker Tank	11	1585EA	ground water	Phase One	6/11/2007	6/28/2007	FT-12-01-01	430ppb	6/29/2007	na	na	7/11/2007	A	Discharged into Phase II open field. Tank offsite 8/7
21,000 gallon Baker Tank	6	1238	ground water	Phase Two	4/5/2007	na	na	na	na	na	na	6/7/2007	C	moved from phase one
21,000 gallon Baker Tank	7	S38NEA	ground water	Phase Two	4/10/2007	na	na	na	6/6&6/7	na	na	6/18/2007	C	
21,000 gallon Baker Tank	8	S1569EA	ground water	Phase Two	4/23/2007	na	na	na	6/12&6/13	na	na	6/14/2007	C	
21,000 gallon Baker Tank	9	907MEA	ground water	Phase Two	5/7/2007	5/9/2007	FT-09-01-02	250ppb	5/31/2007	na	na	6/1/2007	B	Leaky tank, transferred to T-1878EA
21,000 gallon Baker Tank	9*	1878EA	ground water	Phase Two	*transferred*									Contents of T-907mea
21,000 gallon Baker Tank	12	1238	ground water	Phase Two	6/19/2007	7/3/2007	FT-013-02-01	420ppb	7/11 & 7/12	na	na	7/18/2007	C	
21,000 gallon Baker Tank	13	S38NEA	ground water	Phase Two	6/28/2007	7/23/2007	FT-11-02-01	100 ppb	7/26 & 7/30	na	na	8/1/2007	C	
21,000 gallon Baker Tank	14	2622EA	ground water	Phase Two	7/11/2007	7/31/2007	FT-14-02-01	50ppb	7/31 & 8/1	na	na	8/9/2007	C	
21,000 gallon Baker Tank	15	1238	ground water	Phase Two	7/26/2007	8/7/2007	FT-15-02-01	220ppb	8/7 & 8/8	na	na	8/15/2007	C	
21,000 gallon Baker Tank	16	S38NEA	ground water	Phase Two	8/2/2007	8/15/2007	FT-16-02-01	160ppb	8/15/& 8/16	na	na	8/21/2007	C	
21,000 gallon Baker Tank	17	2622EA	ground water	Phase Two	8/10/2007	8/20/2007	FT-17-02-01	180ppb	8/20&8/21	na	na	9/7/2007	C	
21,000 gallon Baker Tank	18	1238	ground water	Phase Two	8/16/2007	8/27/2007	FT-18-02-01	67ppb	8/29&8/30	na	na	9/24/2007	C	
21,000 gallon Baker Tank	19	S38NEA	ground water	Phase Two	8/27/2007	9/10/2007	FT-19-02-01	99ppb	9/10&9/11	na	na	9/25/2007	C	

Acronyms/Abbreviations

- number
ID - Identification
NA - not applicable
ppb - parts per billion
TCE - Trichloroethene
Investigation derived waste (IDW) liquid discharge areas presented on Figure 2.1

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FIGURES

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Figure 1.1
Site Location Map

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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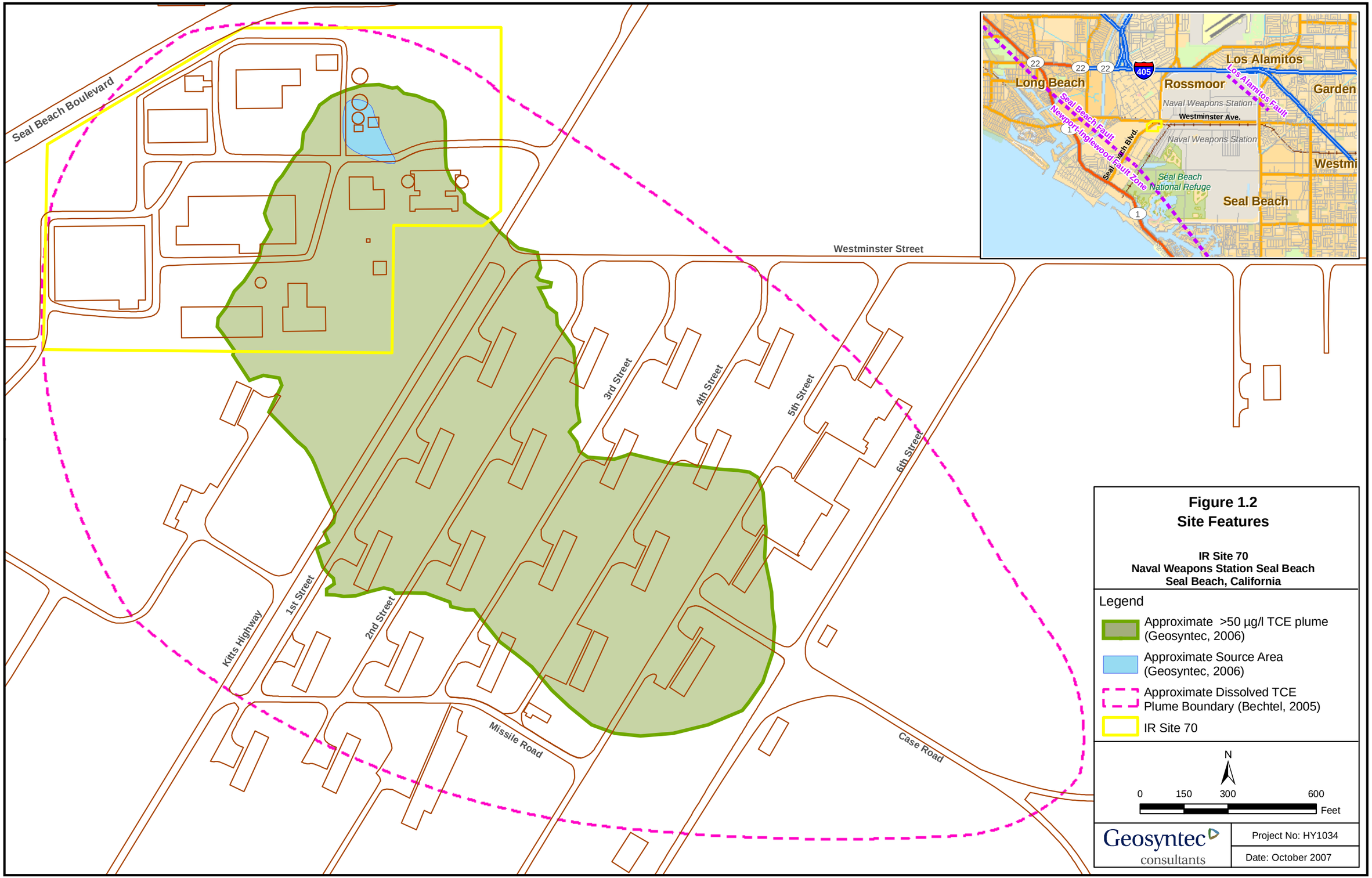

Figure 1.2
Site Features

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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Figures 1.3 to 1.6

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

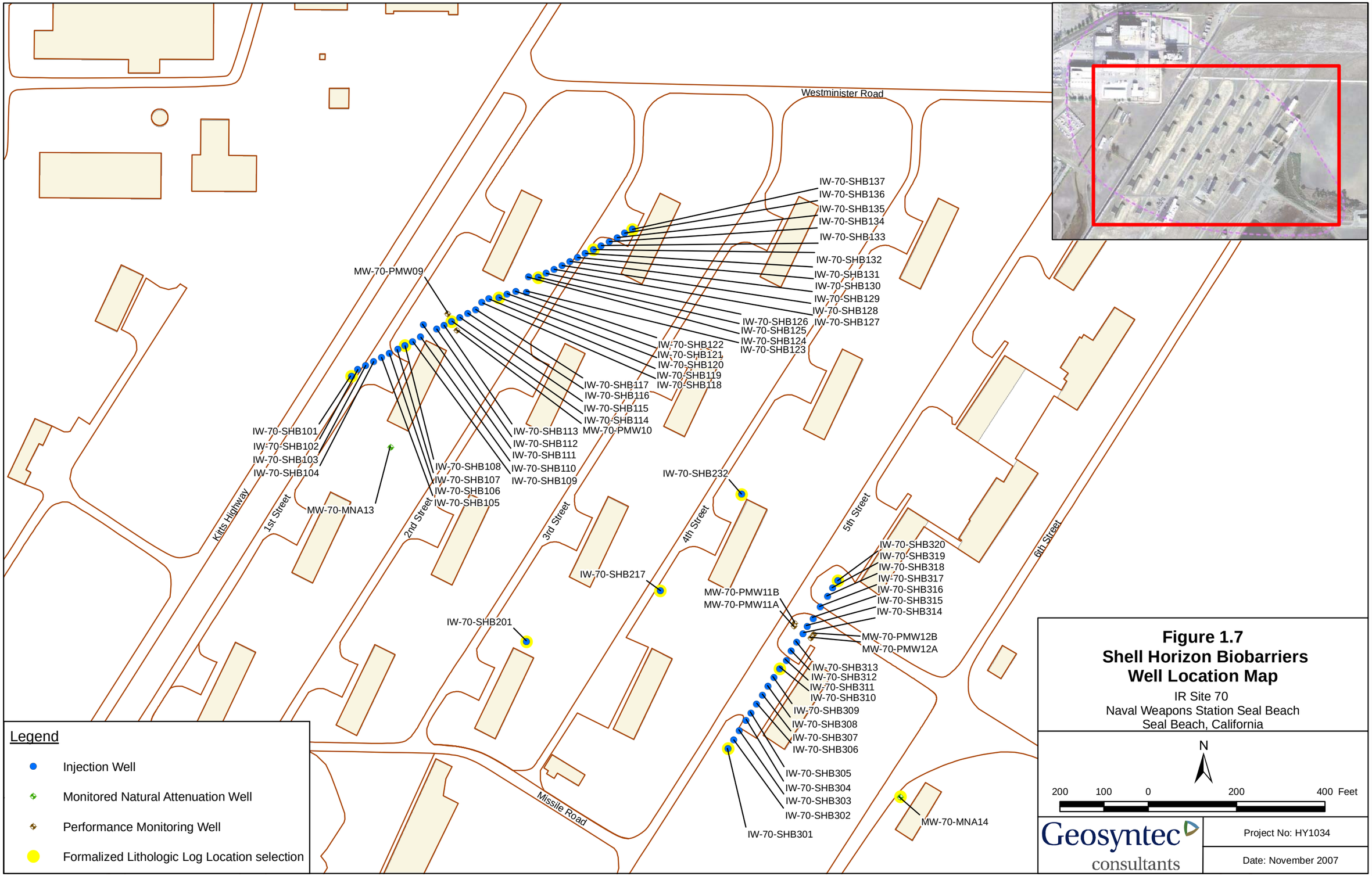

Figure 1.7
Shell Horizon Biobarriers
Well Location Map

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

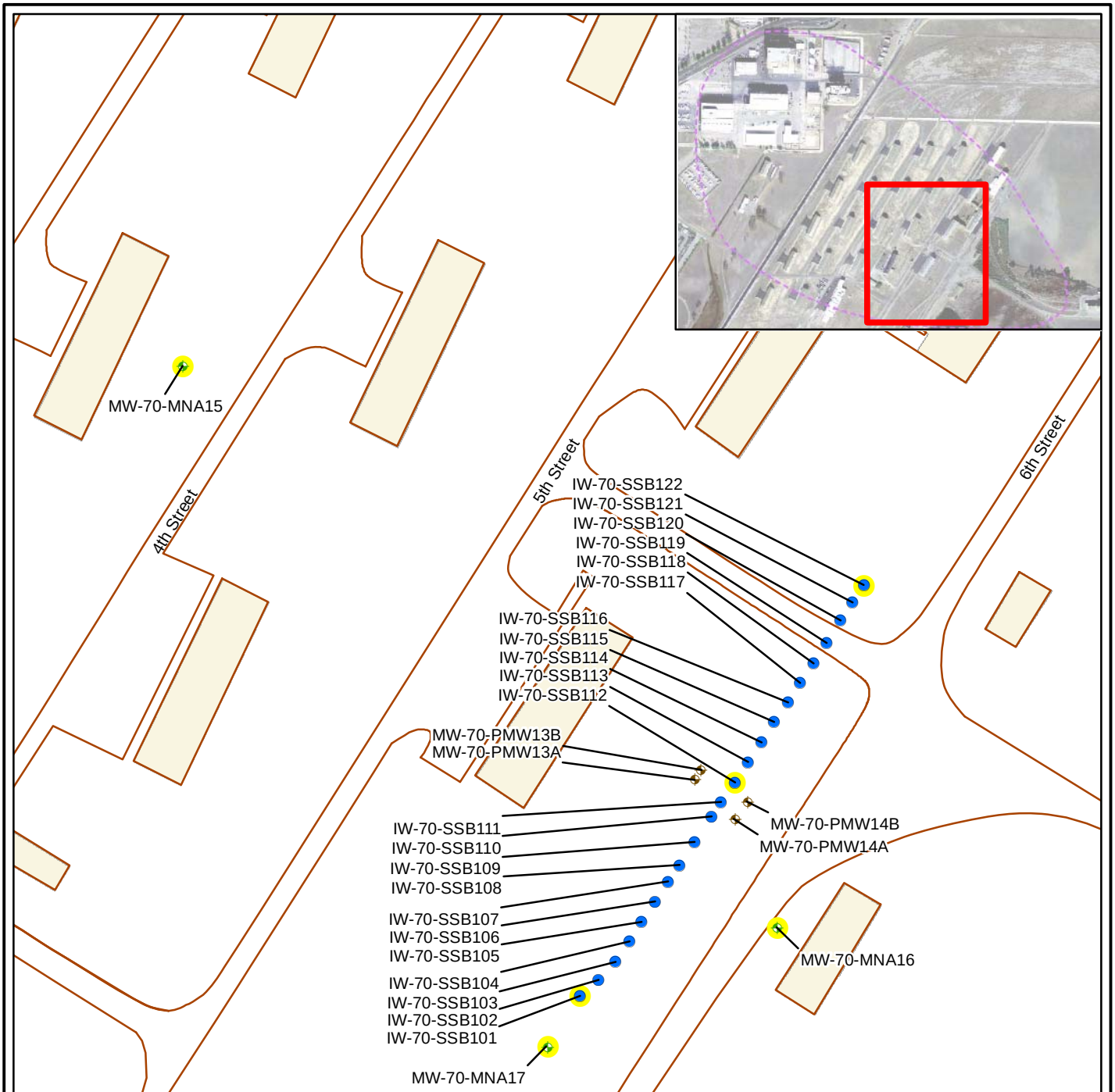

Figure 1.8
Second Sand Biobarrier
Well Location Map

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

N

150 75 0 150 300 Feet

Geosyntec consultants

Project No: HY1034

Date: November 2007

Legend

- Injection Well
- Monitored Natural Attenuation Well
- Performance Monitoring Well
- Formalized Lithologic Log Location

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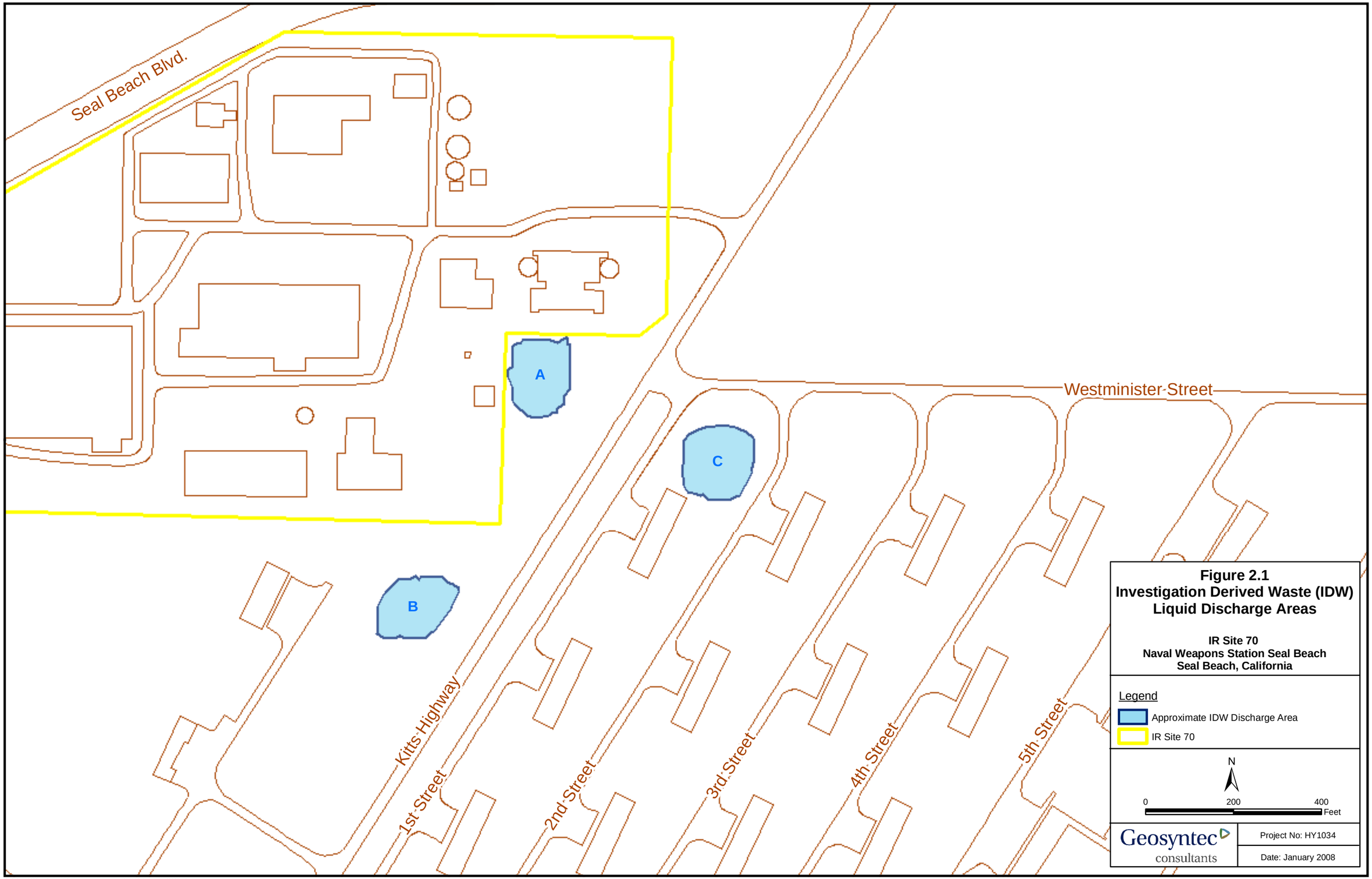

Figure 2.1
Investigation Derived Waste (IDW) Liquid Discharge Areas

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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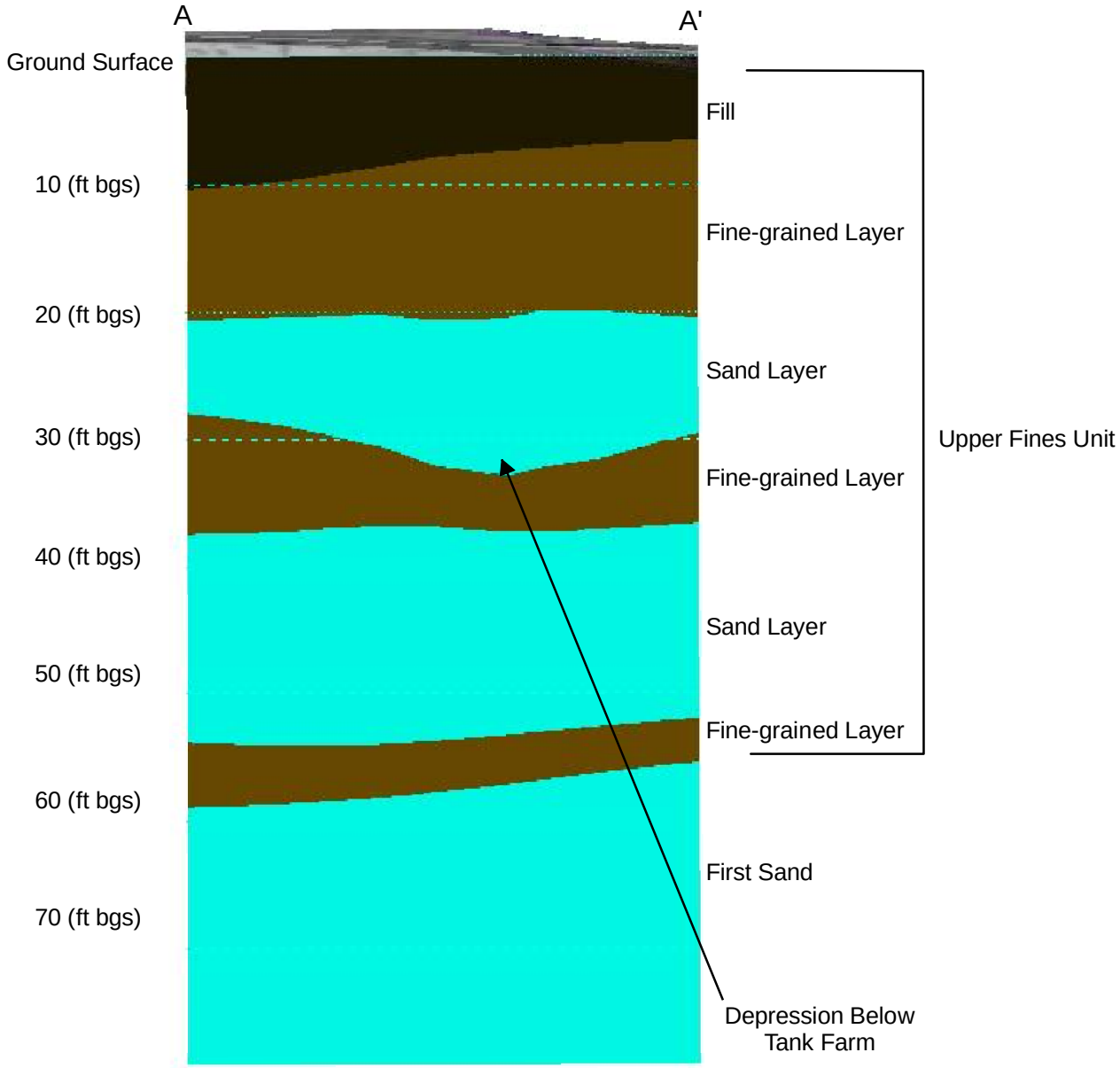

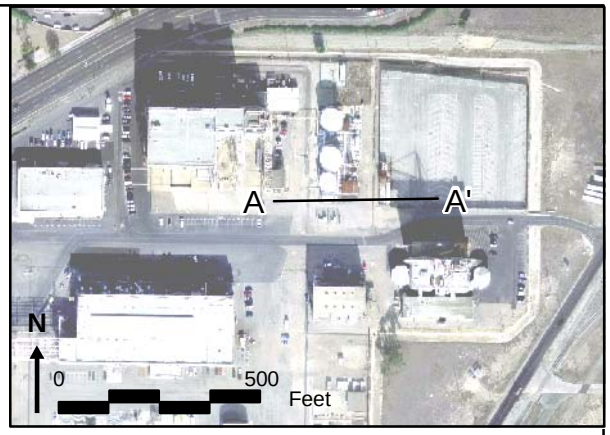

Figure 3.1
Conceptual Site Model
West-East Cross Section

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

Lower Conductivity Unit

Higher Conductivity Unit

ft bgs Feet Below Ground Surface

N

0 100 200 Feet

Approximate Horizontal Scale
10:1 Vertical Exaggeration

Geosyntec consultants

Project No: HY1034

Date: January 2008

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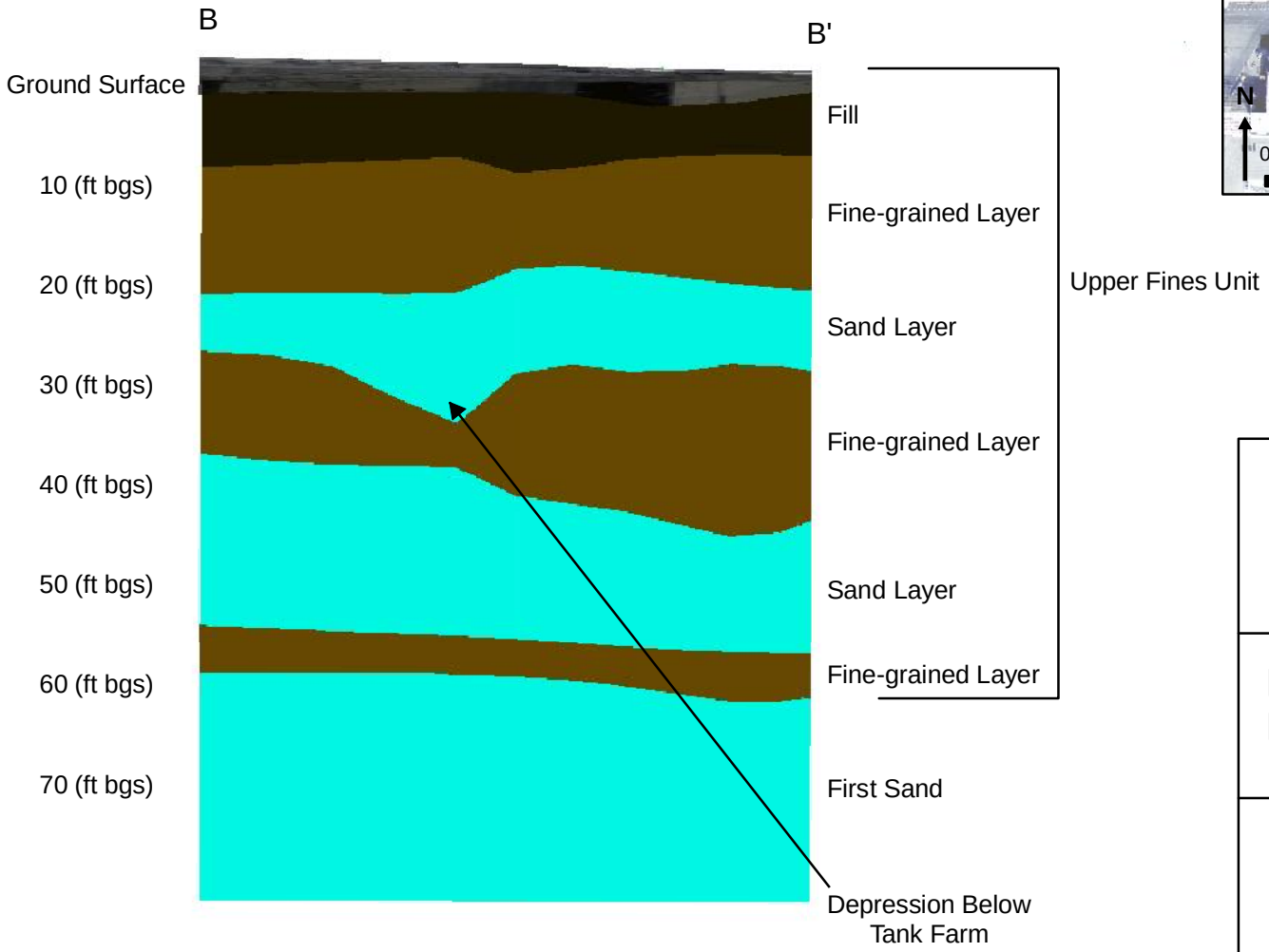

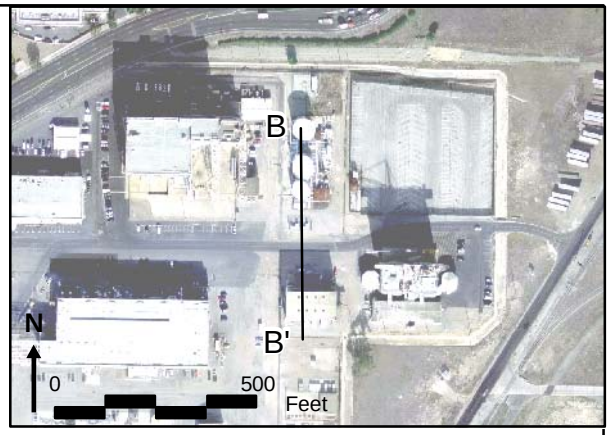

Figure 3.2
Conceptual Site Model
North-South Cross Section

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

Lower Conductivity Unit

Higher Conductivity Unit

ft bgs Feet Below Ground Surface

N

0 100 200 Feet

Approximate Horizontal Scale
10:1 Vertical Exaggeration

Geosyntec consultants

Project No: HY1034

Date: January 2008

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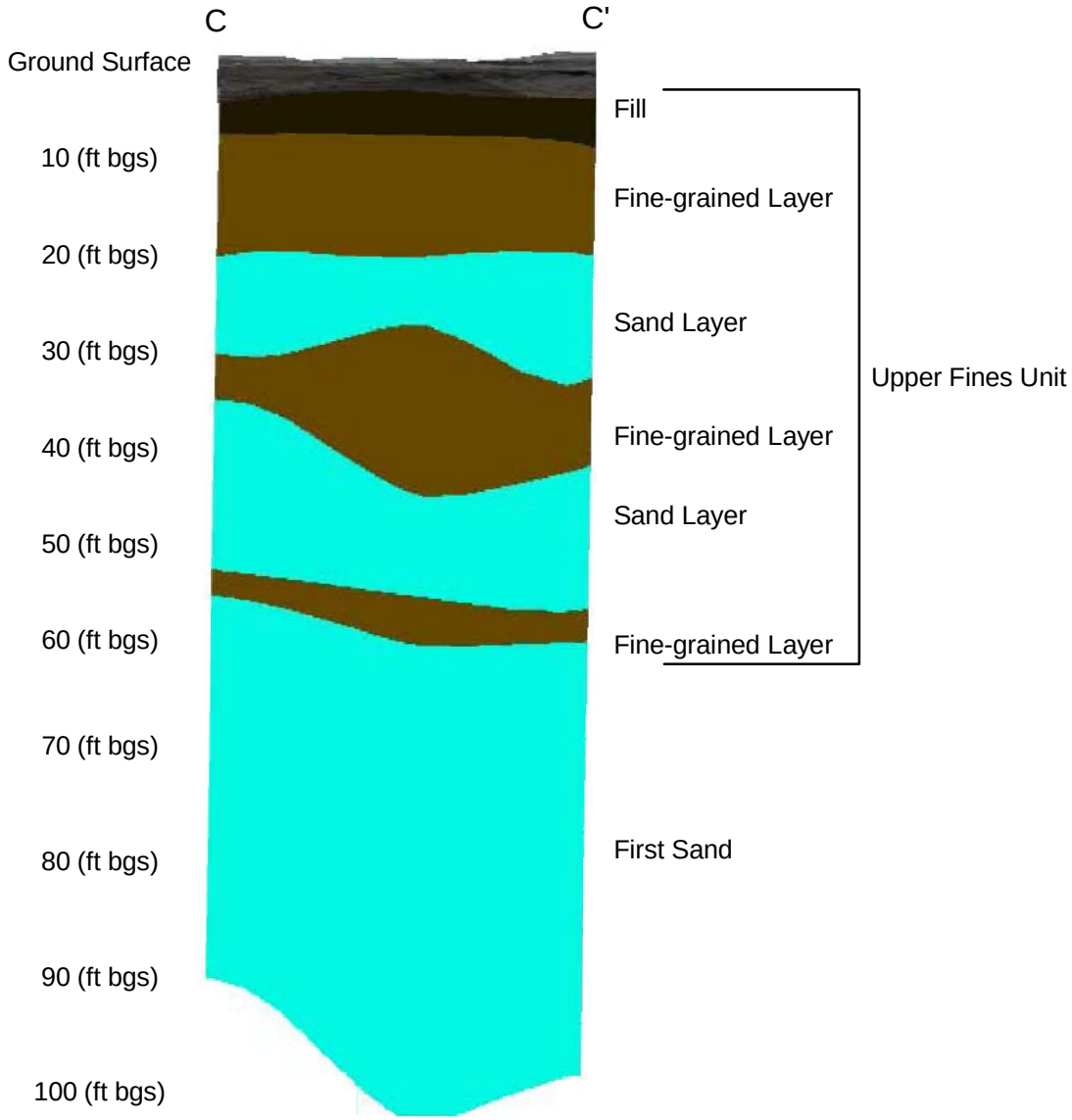

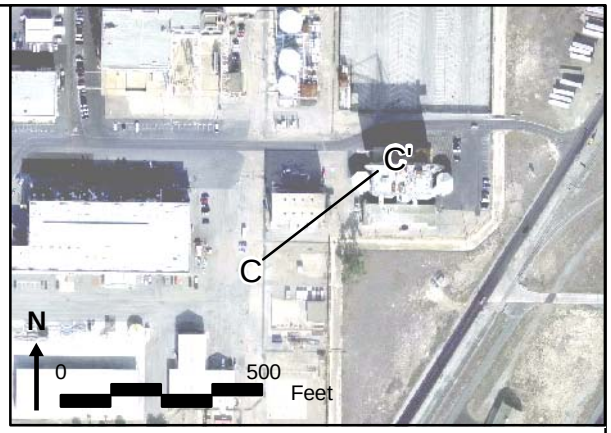

Figure 3.3
Conceptual Site Model
Southwest-Northeast Cross Section

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

Lower Conductivity Unit

Higher Conductivity Unit

ft bgs Feet Below Ground Surface

N

0 100 200 Feet

Approximate Horizontal Scale
10:1 Vertical Exaggeration

Geosyntec consultants

Project No: HY1034

Date: January 2008

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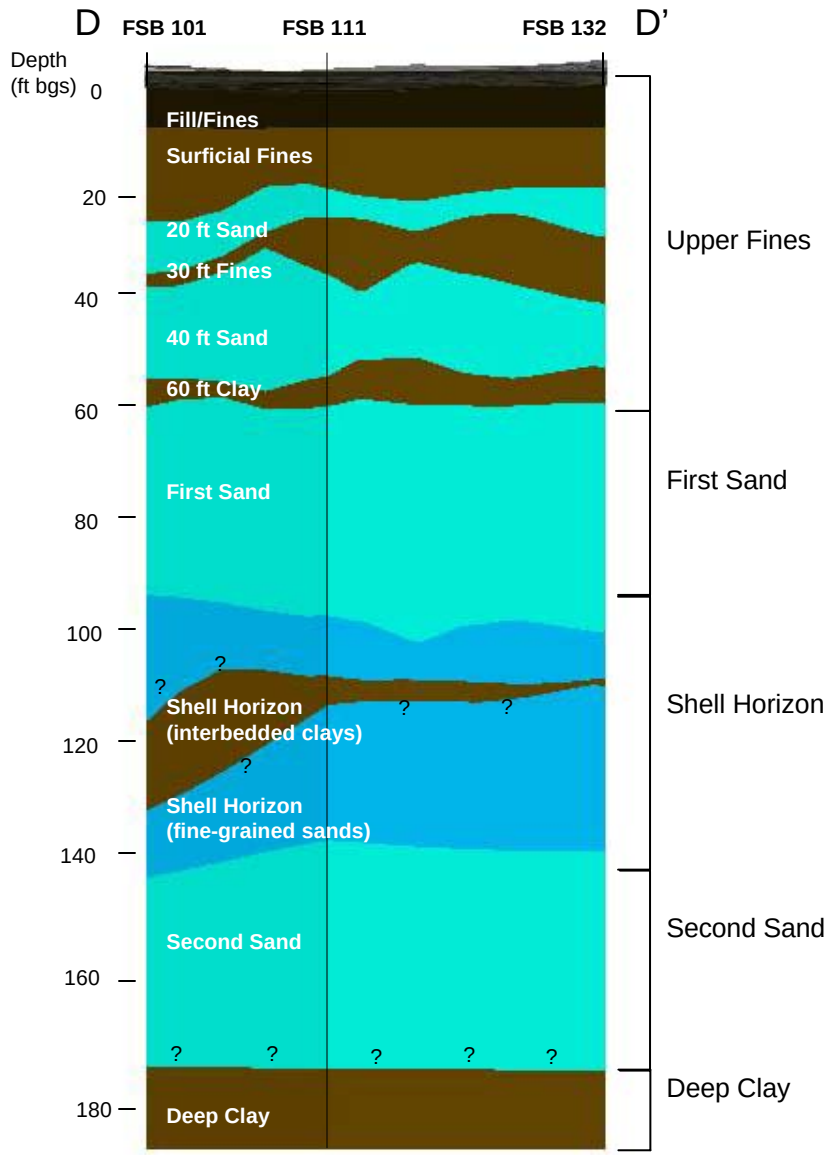


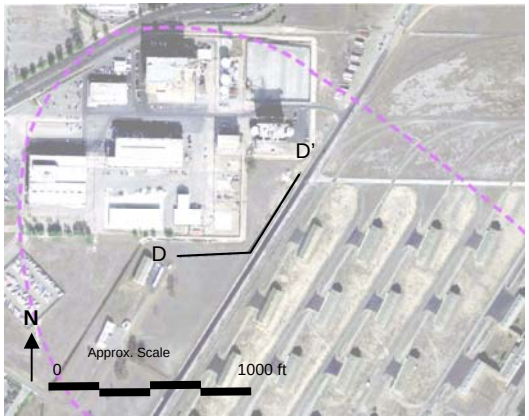


Figure 3.4
First Sand Biobarrier 1
Cross-Section D-D'

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

Lower Conductivity Unit

Higher Conductivity Unit

Shell Horizon Higher Conductivity Unit

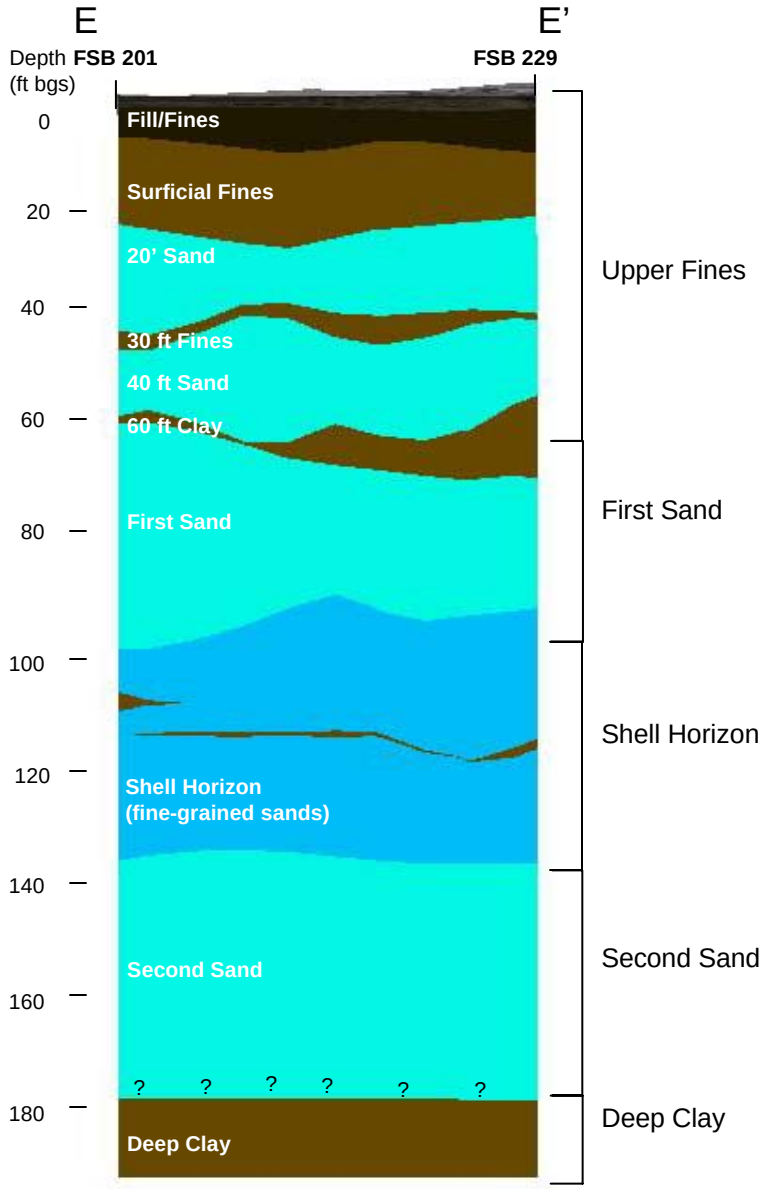
Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Notes
? = Inferred Contact
ft bgs = Feet Below Ground Surface

Geosyntec consultants

Project No: HY1034

Date: November 2007



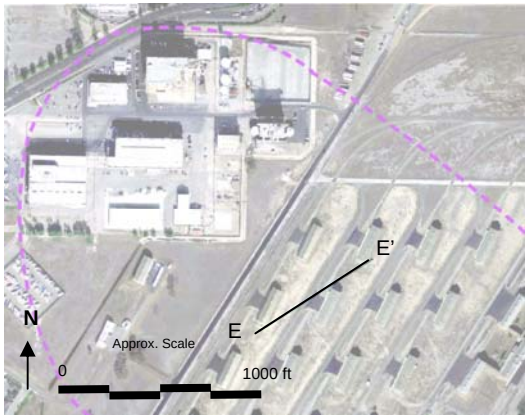


Figure 3.5
First Sand Biobarrier 2
Cross-Section E-E'

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

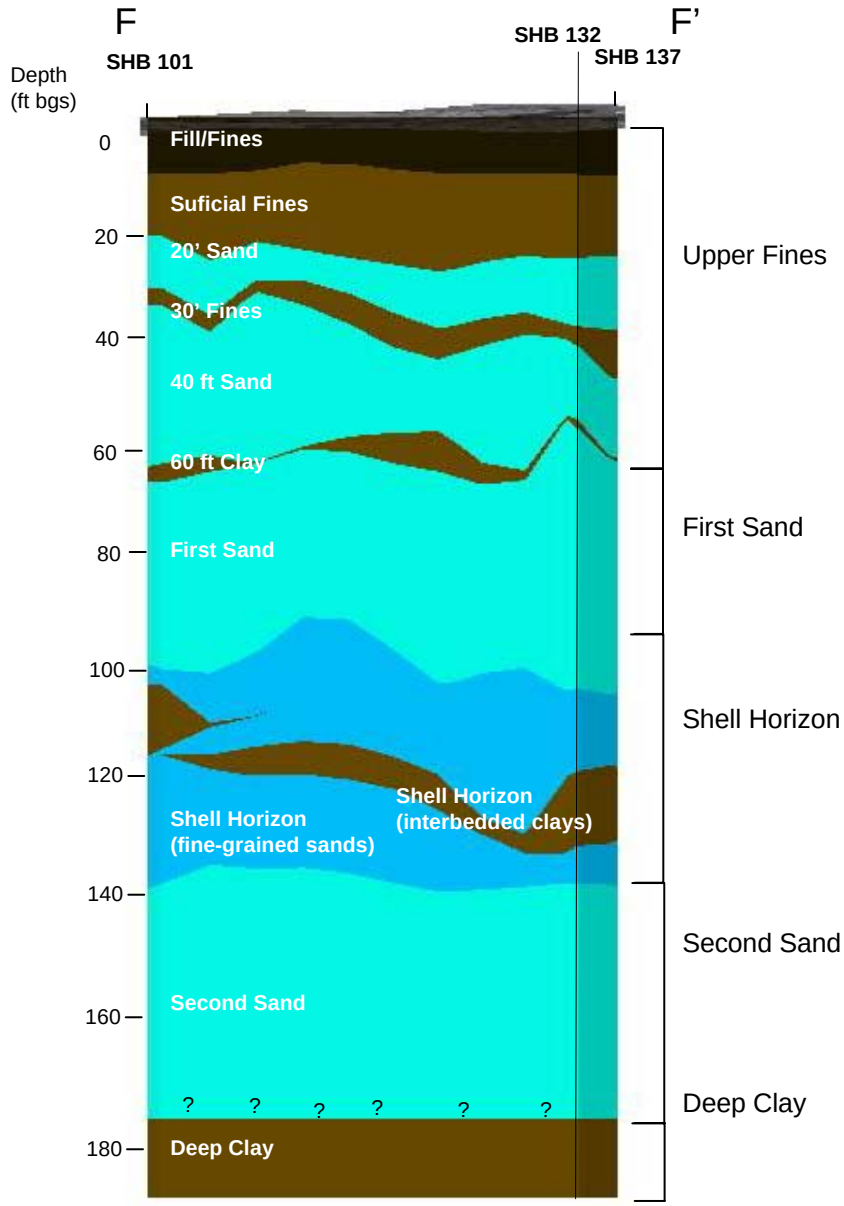
- Lower Conductivity Unit
- Higher Conductivity Unit
- Shell Horizon Higher Conductivity Unit
- Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Notes
? = Inferred Contact
ft bgs = Feet Below Ground Surface

Geosyntec consultants

Project No: HY1034

Date: January 2008



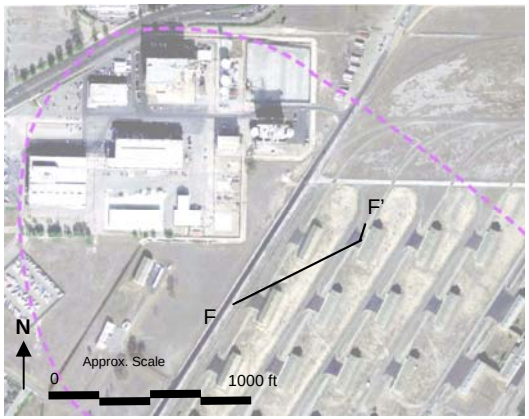


Figure 3.6
Shell Horizon Biobarrier 1
Cross-Section F-F'

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

Lower Conductivity Unit

Higher Conductivity Unit

Shell Horizon Higher Conductivity Unit

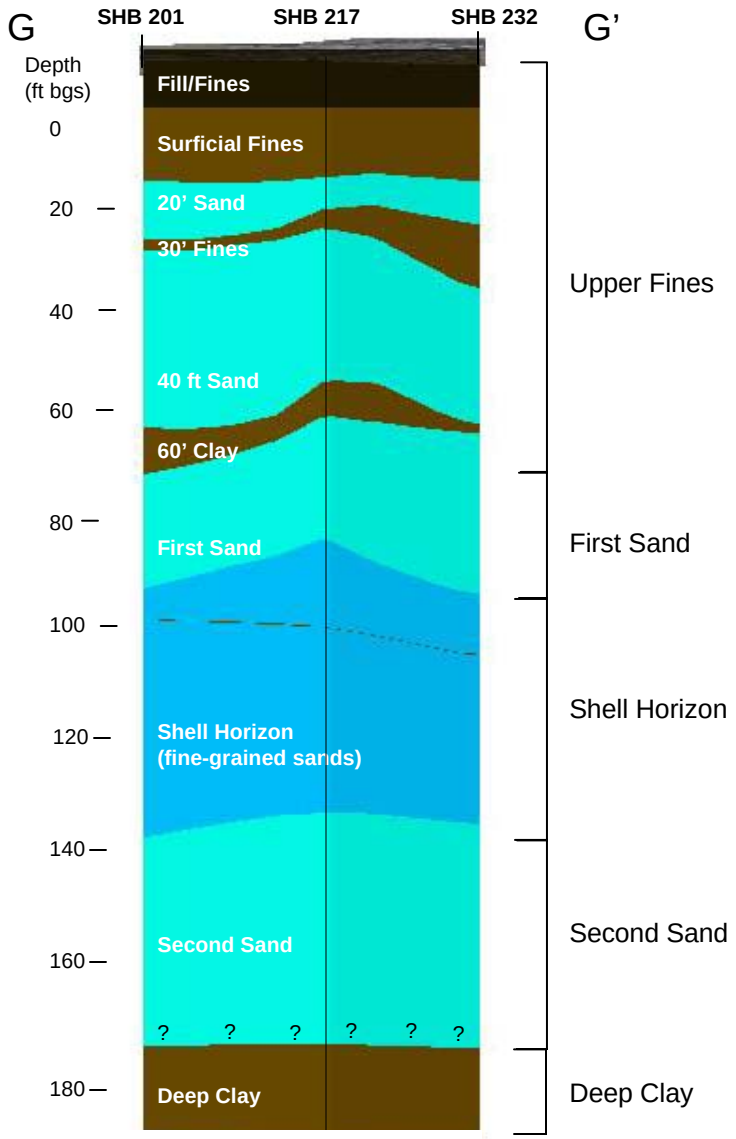
Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Notes
? = Inferred Contact
ft bgs = Feet Below Ground Surface

Geosyntec consultants

Project No: HY1034

Date: January 2008



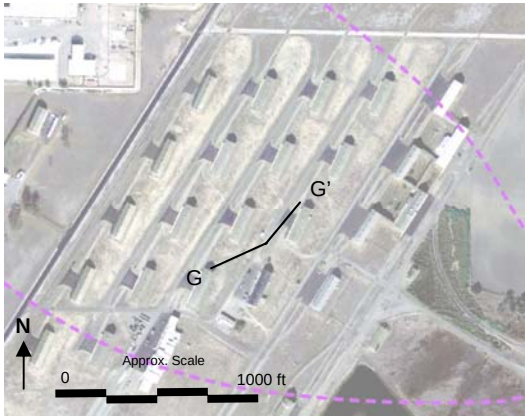


Figure 3.7
Shell Horizon Biobarrier 2
Cross-Section G-G'

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

Lower Conductivity Unit

Higher Conductivity Unit

Shell Horizon Higher Conductivity Unit

Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Notes
? = Inferred Contact
ft bgs = Feet Below Ground Surface

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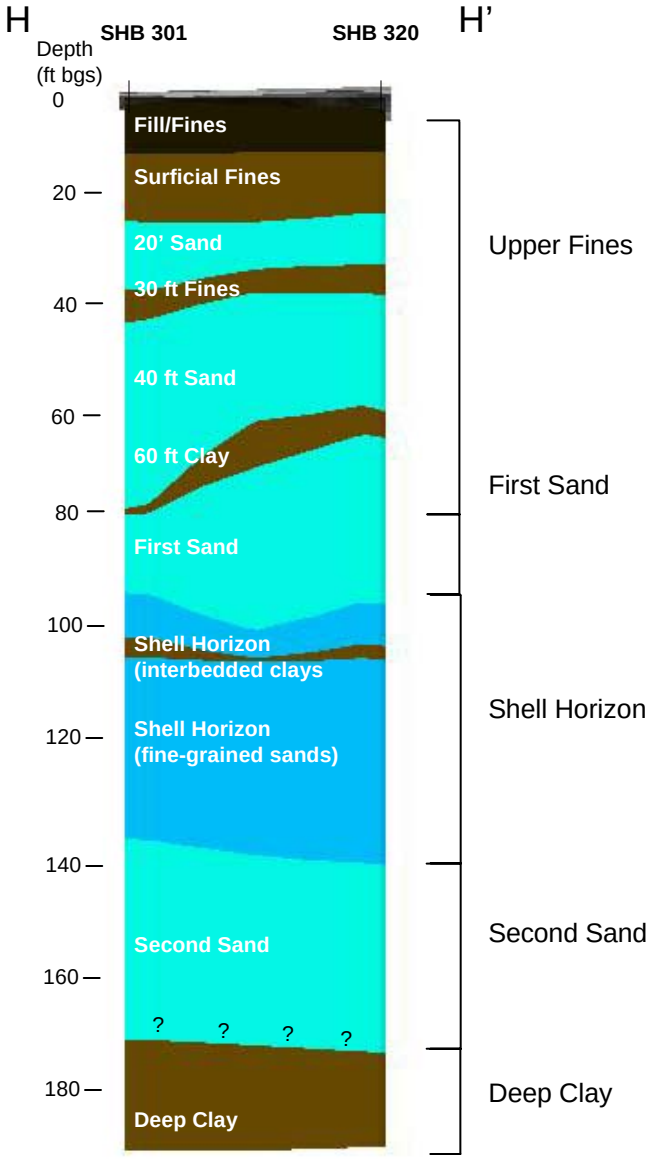
Project No: HY1034

Date: January 2008



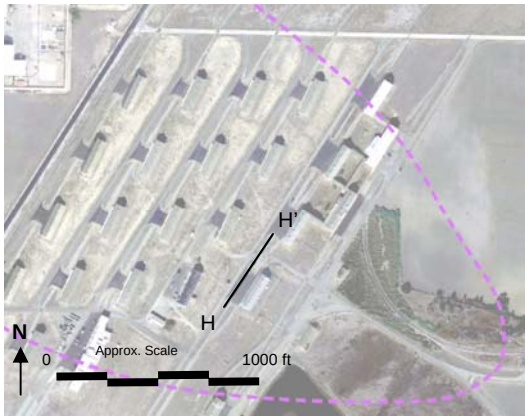


Figure 3.8
Shell Horizon Biobarrier 3
Cross-Section H-H'

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

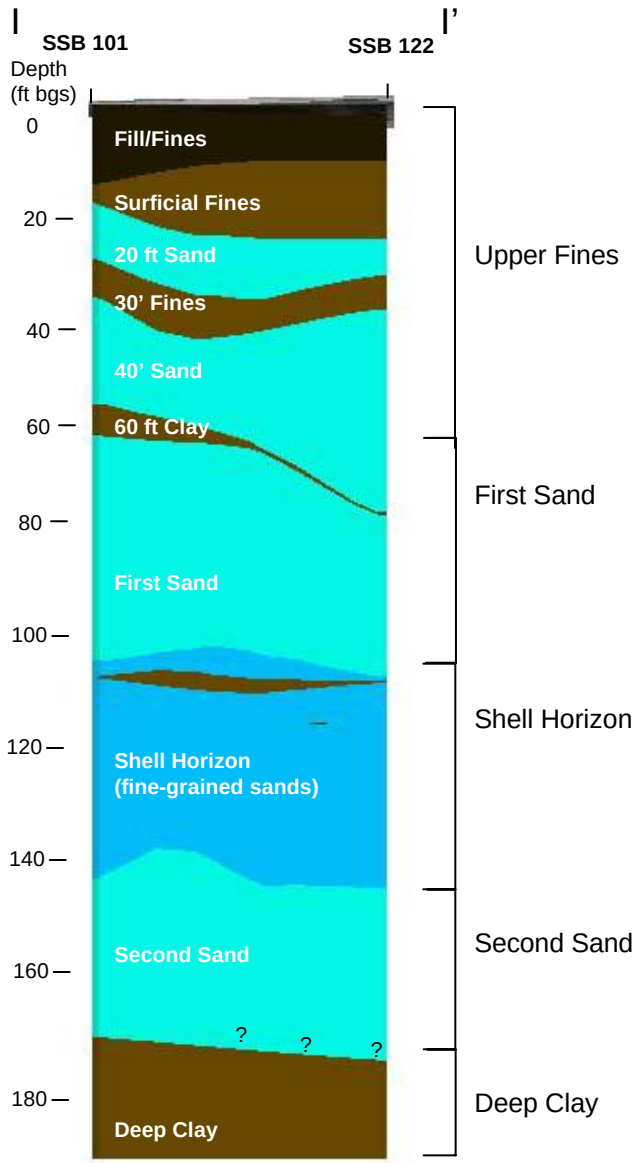
- Lower Conductivity Unit
- Higher Conductivity Unit
- Shell Horizon Higher Conductivity Unit
- Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Notes
? = Inferred Contact
ft bgs = Feet Below Ground Surface

Geosyntec consultants

Project No: HY1034

Date: January 2008



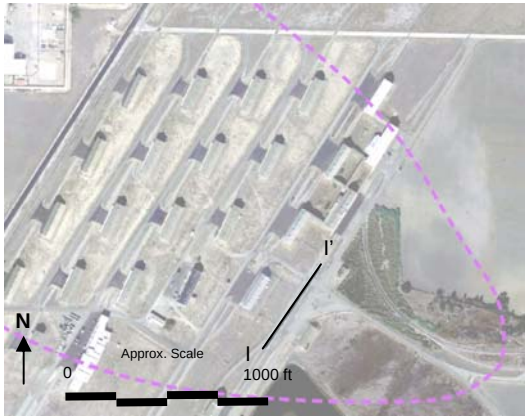


Figure 3.9
Second Sand Biobarrier 1
Cross-Section I-I'

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

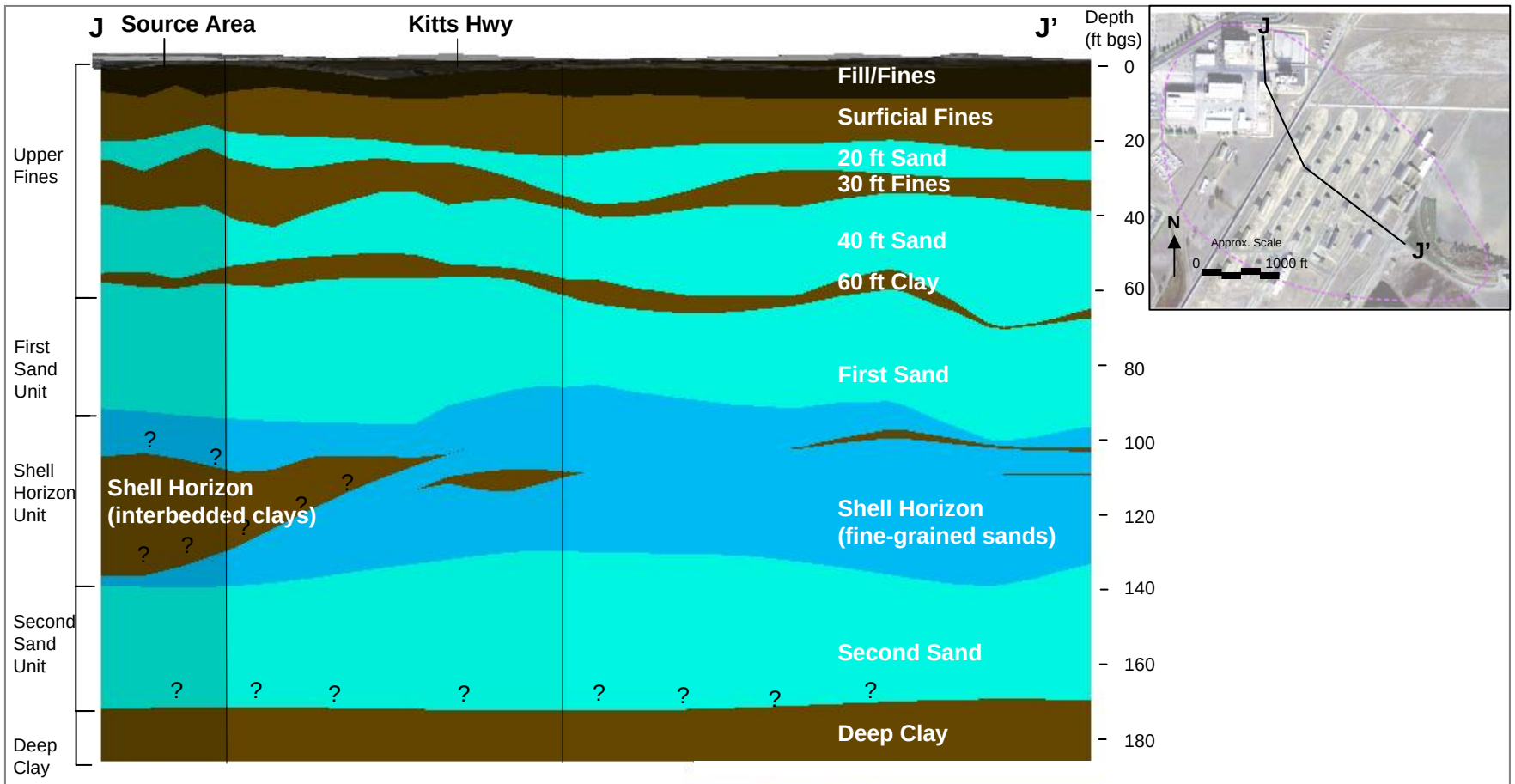
- Lower Conductivity Unit
- Higher Conductivity Unit
- Shell Horizon Higher Conductivity Unit
- Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Notes
? = Inferred Contact
ft bgs = Feet Below Ground Surface

Geosyntec consultants

Project No: HY1034

Date: January 2008



Notes:

ft bgs = Feet Below Ground Surface

? = Inferred Contact

Approx. = Approximate

TCE = Trichloroethene

Lower Conductivity Unit

Higher Conductivity Unit

Shell Horizon Higher Conductivity Unit

Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Figure 3.10
Conceptual Site Model
Northwest to Southeast Cross-Section

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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Date: January 2008

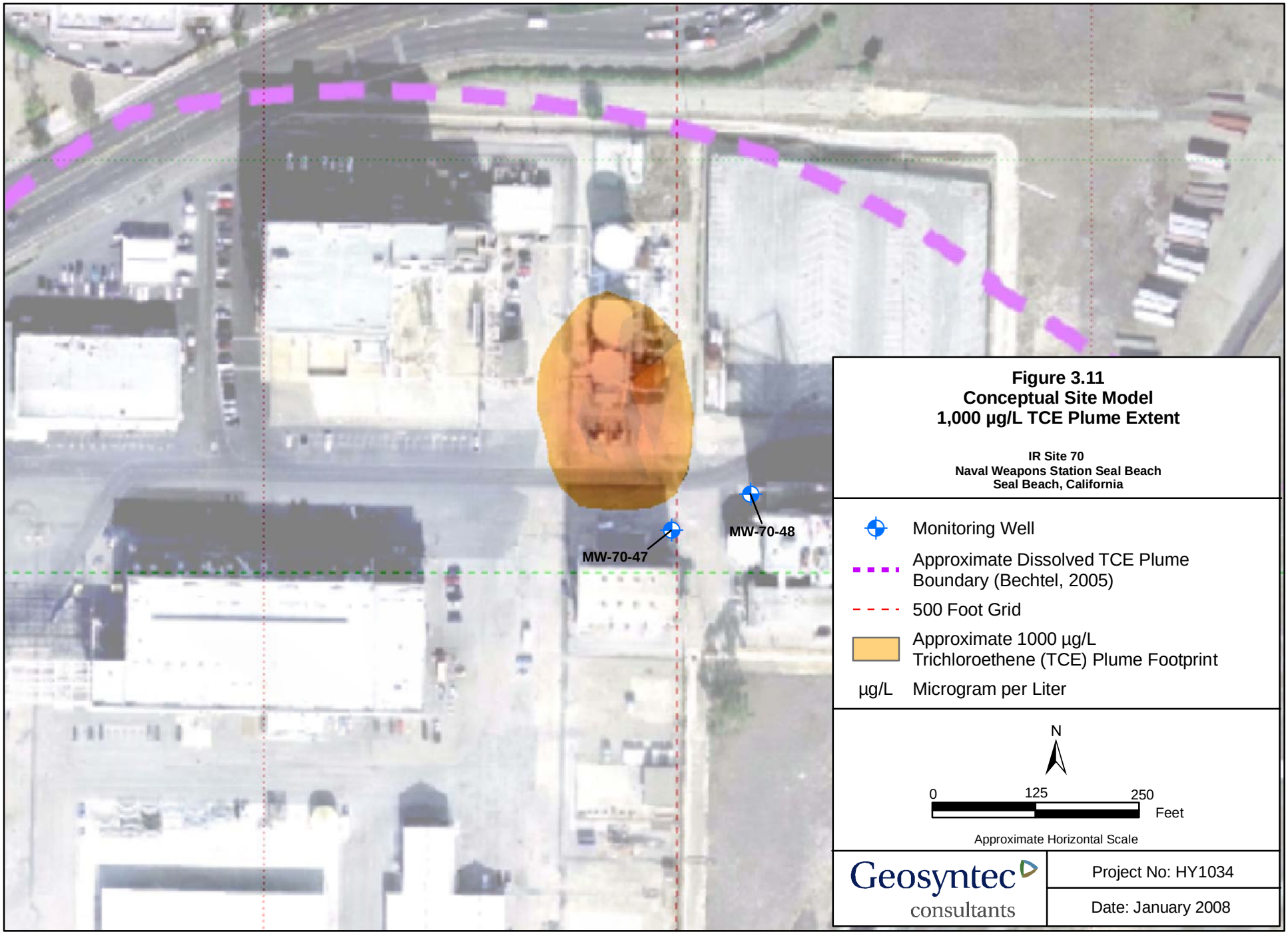

Figure 3.11
Conceptual Site Model
1,000 µg/L TCE Plume Extent

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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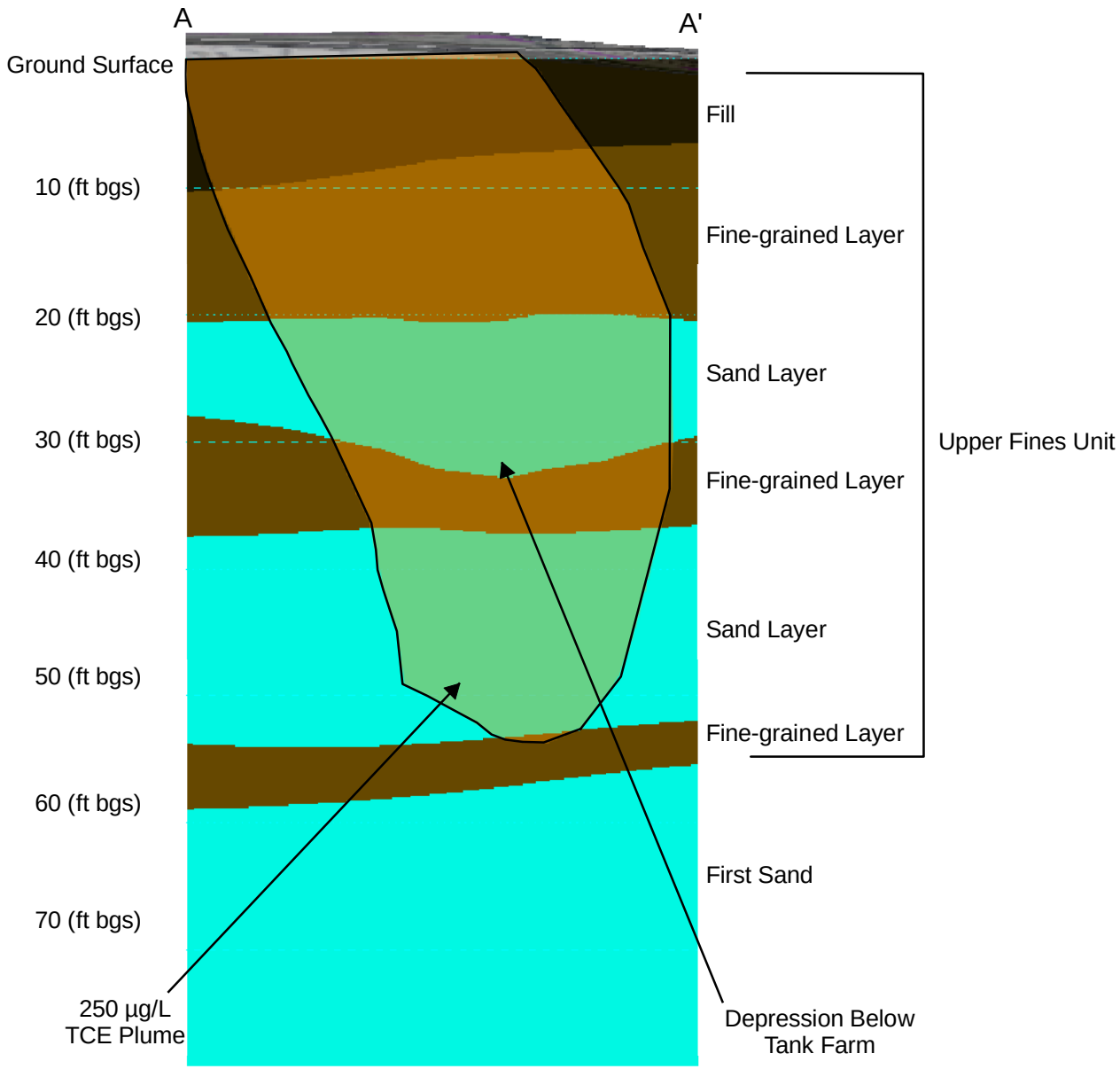

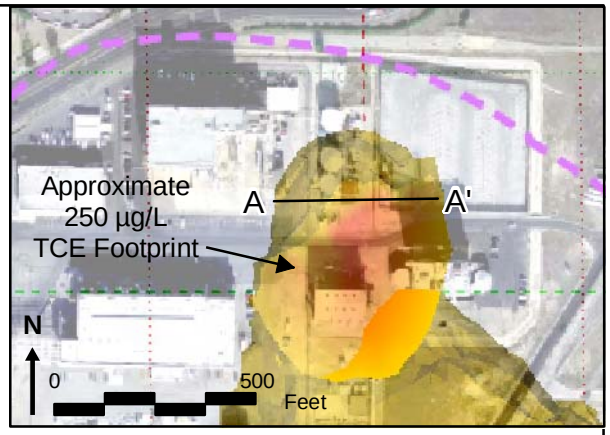

Figure 3.12
Conceptual Site Model
West-East Cross Section
With 250 µg/L TCE Plume

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

	250 µg/L Trichloroethene (TCE) Plume
	Lower Conductivity Unit
	Higher Conductivity Unit
ft bgs	Feet Below Ground Surface
µg/L	Microgram Per Liter

N

0 100 200 Feet

Approximate Horizontal Scale
10:1 Vertical Exaggeration

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Project No: HY1034

Date: January 2008

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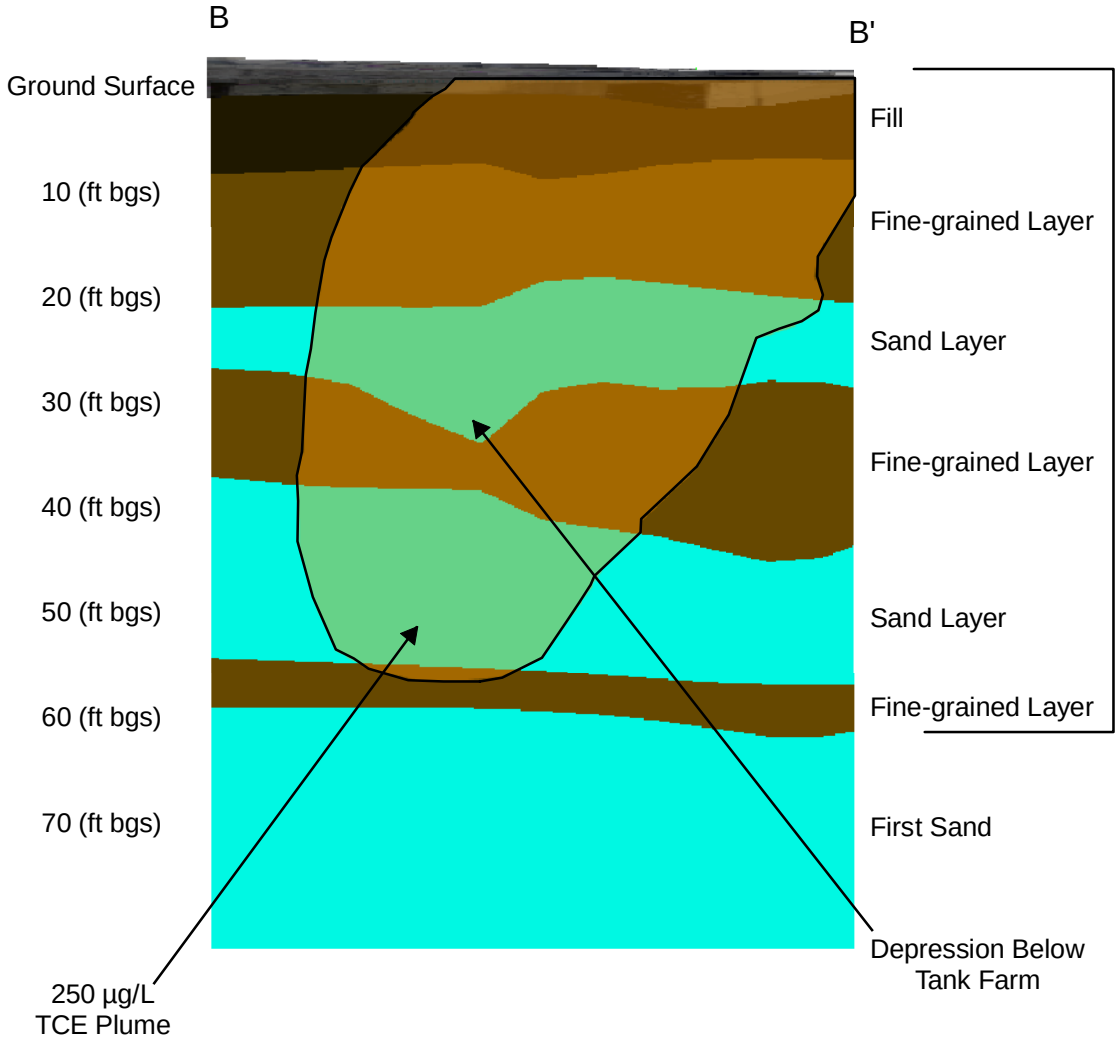

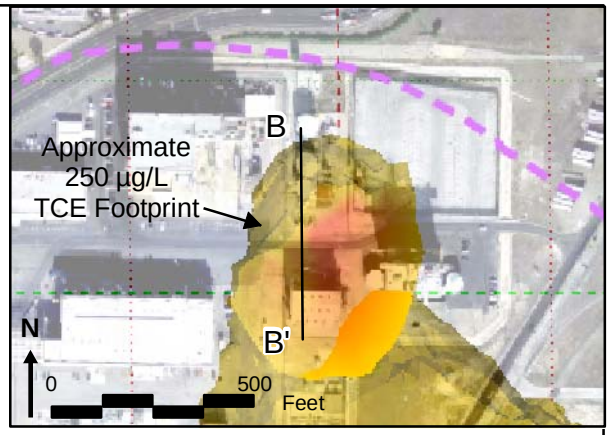

Figure 3.13
Conceptual Site Model
North-South Cross Section
With 250 µg/L TCE Plume

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

	250 µg/L Trichloroethene (TCE) Plume
	Lower Conductivity Unit
	Higher Conductivity Unit
ft bgs	Feet Below Ground Surface
µg/L	Microgram Per Liter

N

0 100 200 Feet

Approximate Horizontal Scale
10:1 Vertical Exaggeration

Geosyntec consultants

Project No: HY1034

Date: January 2008

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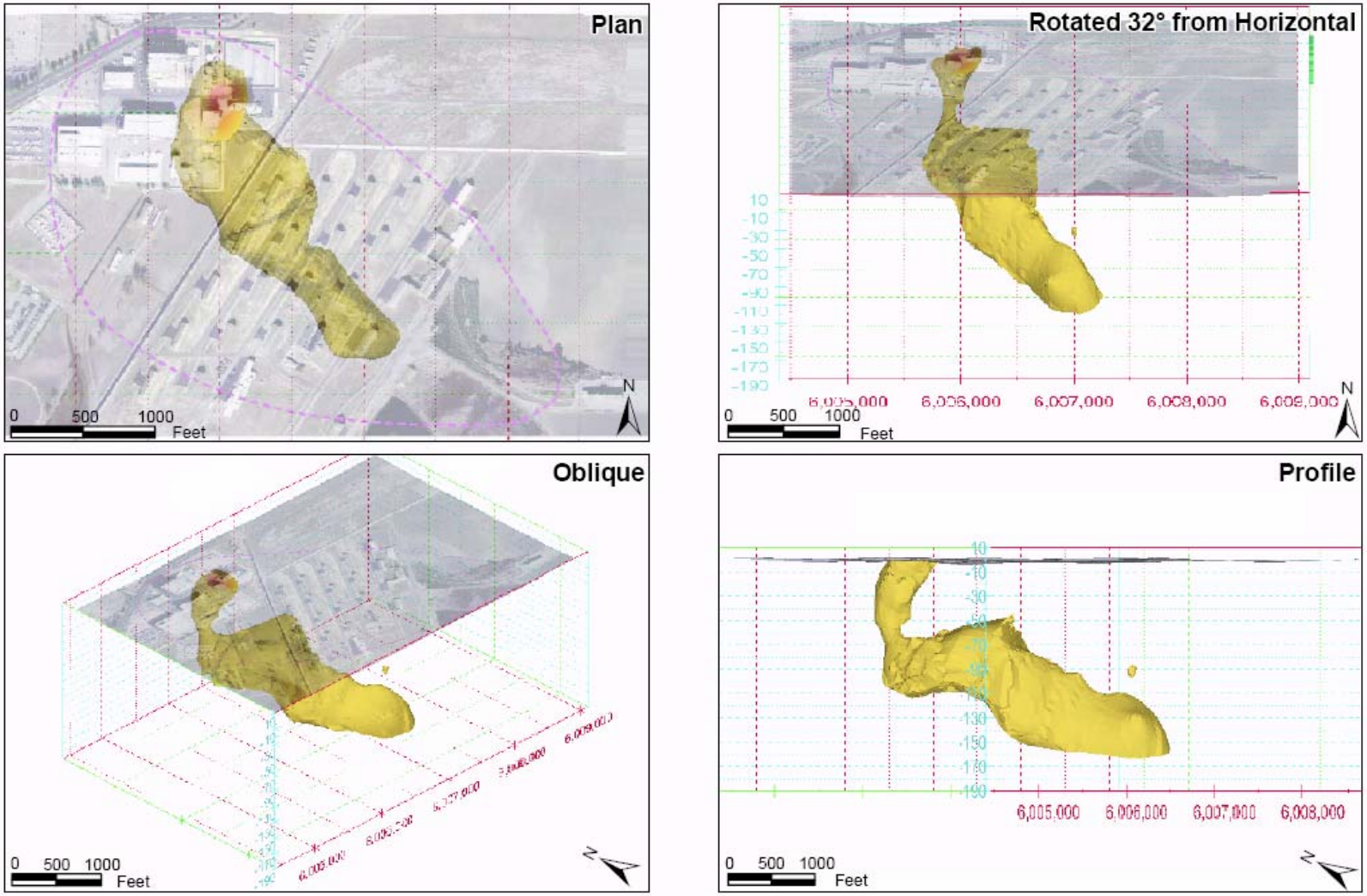

Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

500 Foot Grid

Approximate 250 µg/L Trichloroethene (TCE) Plume

Note: µg/L = Micrograms per Liter
TCE = Trichloroethene

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Date: January 2008

Figure 3.14
Conceptual Site Model
Oblique Views 250 µg/L TCE Plume

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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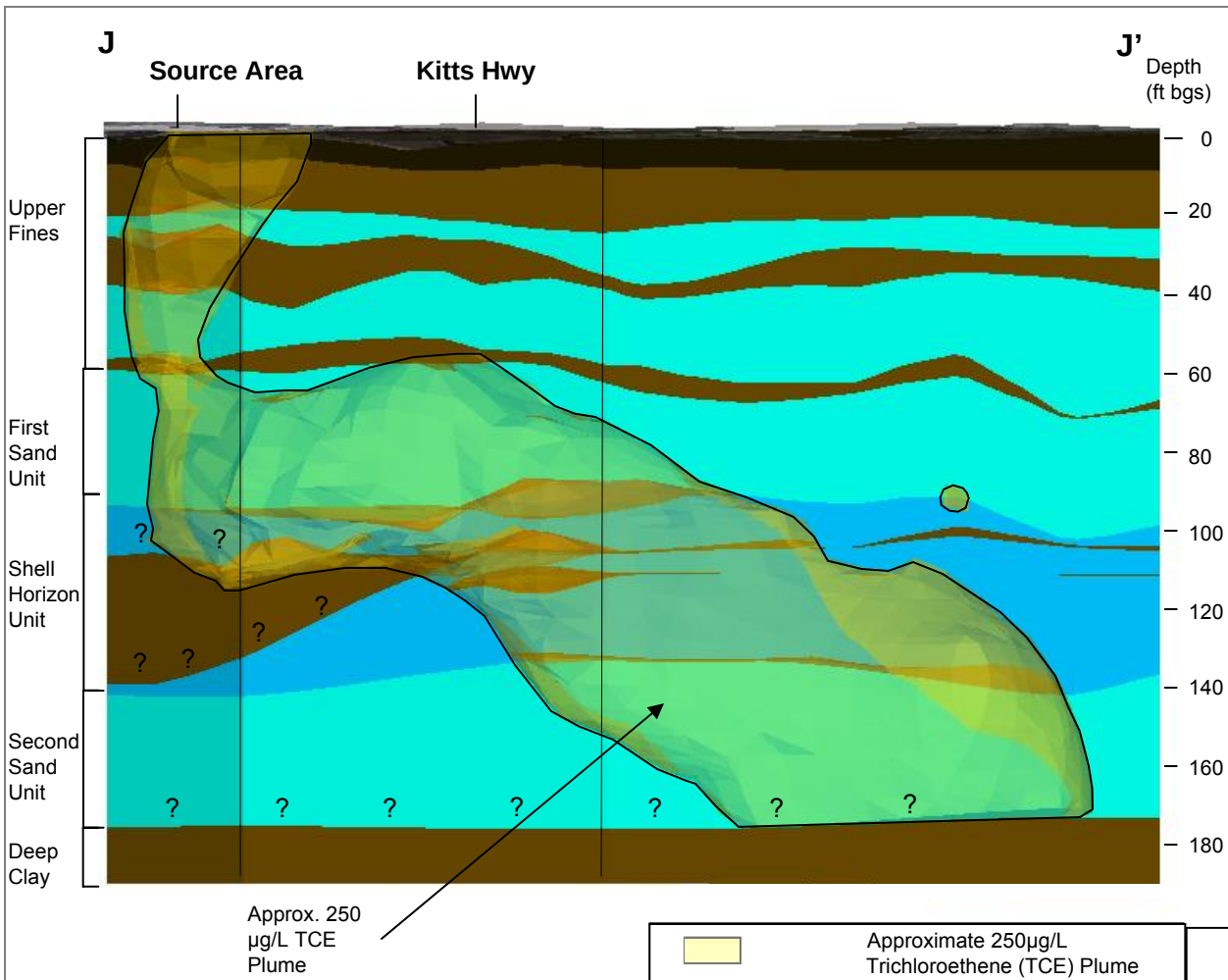

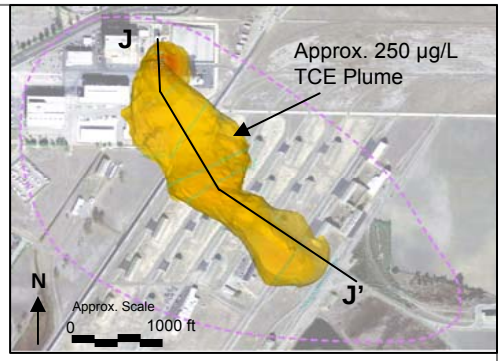

Notes:

ft bgs = Feet Below Ground Surface

? = Inferred Contact

Approx. = Approximate

TCE = Trichloroethene

µg/L= Microgram Per Liter

	Approximate 250µg/L Trichloroethene (TCE) Plume
	Lower Conductivity Unit
	Higher Conductivity Unit
	Shell Horizon Higher Conductivity Unit
- - - - -	Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Figure 3.15
Conceptual Site Model Northwest to Southeast Cross-Section with Plume

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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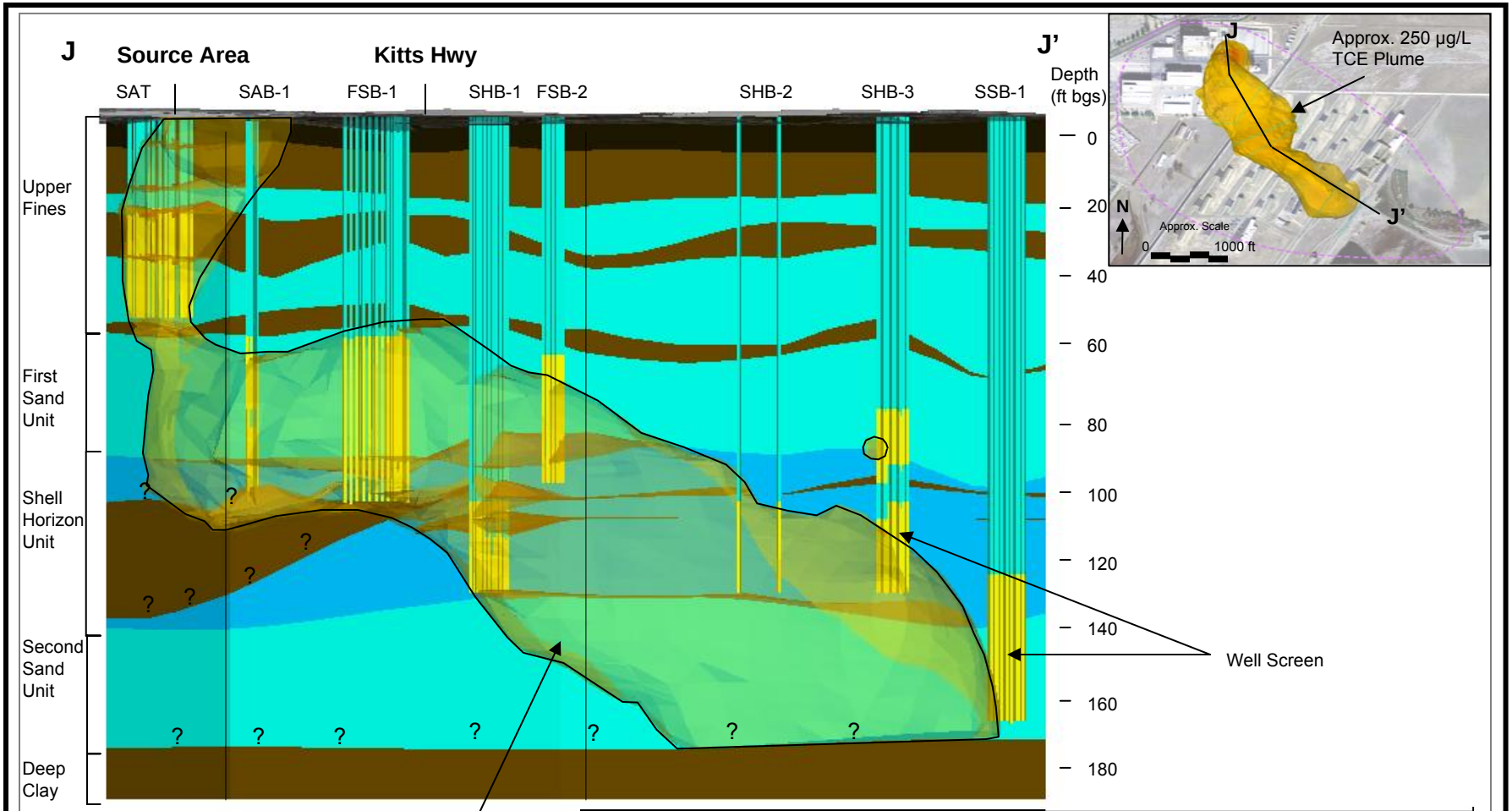
Project No: HY1034

Date: January 2008



Notes:

ft bgs = Feet Below Ground Surface

? = Inferred Contact

Approx. = Approximate

TCE = Trichloroethene

µg/L= Microgram Per Liter

Approximate 250µg/L Trichloroethene (TCE) Plume

Lower Conductivity Unit

Higher Conductivity Unit

Shell Horizon Higher Conductivity Unit

Approximate Dissolved TCE Plume Boundary (Bechtel, 2005)

Figure 3.16
Conceptual Site Model
Complete Injection System Cross-Section

IR Site 70
Naval Weapons Station Seal Beach
Seal Beach, California

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Project No: HY1034

Date: January 2008

Geosyntec consultants

APPENDICES

NOTE: The Appendices for this document contain several gigabytes of data and are too large to post online. For access to this information please contact the Installation Restoration Program manager at (562) 626-7897.

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