CDM

Pre-Remediation Workplan

Boeing Realty Corporation
Former C-6 Facility
19503 South Normandie Avenue
Los Angeles, California

February 14, 2006

Prepared for:

Boeing Realty Corporation
4900 Conant Street
Building 1, M/C D001-0097
Long Beach, CA 90846

Prepared by:

CDM
18581 Teller Avenue, Suite 200
Irvine, California 92612

Project No. 27355-47930. T1C.PRE-REM

CDM

18581 Teller Avenue, Suite 200
Irvine, California 92612
tel: 949 752-5452
fax: 949 752-1307

February 14, 2006 CDM Project File: 27355-47930, 5.2

Ms. Ana Townsend
California Regional Water Quality Control Board - Los Angeles Region
320 W. 4th Street, Suite 200
Los Angeles, California 90013

Subject: **Pre-Remediation Workplan**
Boeing Realty Corporation, Former C-6 Facility
19503 South Normandie Avenue
Los Angeles, California,

Dear Ms. Townsend:

On behalf of Boeing Realty Corporation (BRC), Camp Dresser & McKee Inc. (CDM) is submitting the above-referenced document for your review.

If you have any questions or concerns regarding this document, please call the undersigned at (949) 752-5452 or Joe Weidmann at (805) 563-8600.

Very truly yours,

Ravi Subramanian

Ravi Subramanian, P.E
Senior Project Manager

Enclosure

Cc: Brian Mossman, BRC
Stephanie Sibbett-Brutocao, BRC
Joe Weidmann, Haley & Aldrich

Pre-Remediation Workplan

Boeing Realty Corporation
Former C-6 Facility
19503 South Normandie Avenue
Los Angeles, California

February 14, 2006

Prepared for:

Boeing Realty Corporation
4900 Conant Street
Building 1, M/C D001-0097
Long Beach, CA 90846

Prepared by:

CDM
18581 Teller Avenue, Suite 200
Irvine, California 92612

Project No. 27355-47930. T1C.PRE-REM

The information contained in the document titled "Pre-Remediation Workplan" for site "Boeing Realty Corporation Former C-6 Facility, Los Angeles, California ", dated February 14, 2006, has received appropriate technical review and approval. The conclusions and recommendations presented represent professional judgments and are based upon findings from the investigations and sampling identified in the report and the interpretation of such data based on our experience and background. This acknowledgement is made in lieu of all warranties, either expressed or implied. The activities outlined in this report were performed under the supervision of a California Registered Professional Engineer.

Reviewed and Approved by:

Patrick J. Evans, Ph.D.
Senior Technical Specialist

Ravi Subramanian, P.E.
Senior Project Manager

Contents

Section 1 Introduction 1-1
1.1 Project Background 1-1
1.2 Work Plan Organization 1-1
Section 2 Evaluation of Existing Amendment Wells 2-1
2.1 Evaluation of Available Data 2-1
2.2 Field Testing Activities 2-1
2.3 Data Evaluation and Reporting 2-2
Section 3 Test Well Installation, Aquifer Testing and Groundwater Modeling 3-1
3.1 Well Installation and Development Procedures 3-1
3.1.1 Well Installation 3-1
3.1.2 Well Development 3-3
3.2 Aquifer Testing Procedures 3-3
3.3 Modeling Protocols 3-5
3.4 Data Evaluation and Reporting 3-5
Section 4 Treatability Testing and Electron Donor Evaluation 4-1
4.1 Background Data Evaluation 4-1
Section 5 Electron Donor Injection Test 5-1
5.1 Purpose 5-1
Section 6 Project Schedule 6-1
Section 7 Health and Safety 7-1
Section 8 References 8-1

Appendices

Appendix A Standard Operating Procedures

List of Figures

Figure 1 Site Vicinity Map 1-3
Figure 2 Location of Existing Amendment and Monitoring Wells 1-4
Figure 3 Proposed Test Wells 3-7
Figure 4 Proposed Project Schedule 6-2

Section 1
Introduction

This work plan has been prepared for implementing pre-remediation activities at the Boeing Realty Corporation's (BRC) Former C-6 Facility (Site) in Los Angeles, California (Figure 1). The purpose of this workplan is to perform certain pre-remediation activities that would assist in the implementation of bioremediation to reduce volatile organic compound (VOC) concentrations and mass within the Bellflower Aquitard beneath the Site.

1.1 Project Background

Two primary source areas have been identified at the Site (Former Buildings 2 and 1/36). The California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) has previously approved In-situ Enhanced Bioremediation (ISEB) Pilot Test Work Plans for the treatment of the Building 2 and 1/36 source-area groundwater VOC impacts in the Bellflower Aquitard. The LARWQCB has issued a General Waste Discharge Requirement (General WDR) permit for the Site. Infrastructure including injection (or amendment) wells and piping have been installed. Figure 2 shows the existing amendment wells and groundwater monitoring wells at the site. In general, the injection well networks were designed to treat VOC concentrations in excess of 5 milligrams per liter (mg/l) in groundwater beneath the source areas. The primary VOCs in the Building 2 and Building 1/36 areas vary slightly. The Building 2 primary VOCs include trichloroethene (TCE), 1,1-dichloroethene (1,1,-DCE), and chloroform. The Building 1/36 primary VOCs include TCE, 1,1-DCE, methyl ethyl ketone (MEK [2-butanone]), toluene, and 1,1,1-trichloroethane (1,1,1-TCA). Other VOCs are present in both areas but at lower concentrations. Remediation injections were initiated in the Building 2 area in 2004; however, technical difficulties prompted a review of the selected amendment and injection methods.

Based on CDM's evaluation of available data, the bioremediation/ bioaugmentation strategy for the Site is expected to be in-situ enhanced bioremediation (ISEB) with recirculation. This will involve injection of electron donor by regularly amending the water that is being recirculated using a pulsing injection system. In order to further evaluate this approach and develop conceptual and final designs, CDM has prepared this workplan to determine the condition of the existing wells and infrastructure and the usability of the same, verify aquifer properties, and determine the optimum electron donor (s) for implementing the ISEB with recirculation.

1.2 Work Plan Organization

The rest of the work plan is organized as follows:

- Existing well and associated infrastructure testing (Section 2): This section provides details on the pre-field and field activities for existing well reconnaissance and testing including water injection.

- Aquifer testing and modeling (Section 3): The aquifer test portion of the work plan will include a site plan showing the proposed location of the well and a drawing showing well construction details. This portion of the work plan will include procedures for drilling, groundwater and soil sample collection (for use in the treatability study), well installation, and well development. This work plan will summarize groundwater modeling plan and procedures that will be used in analyzing the data from the aquifer test.

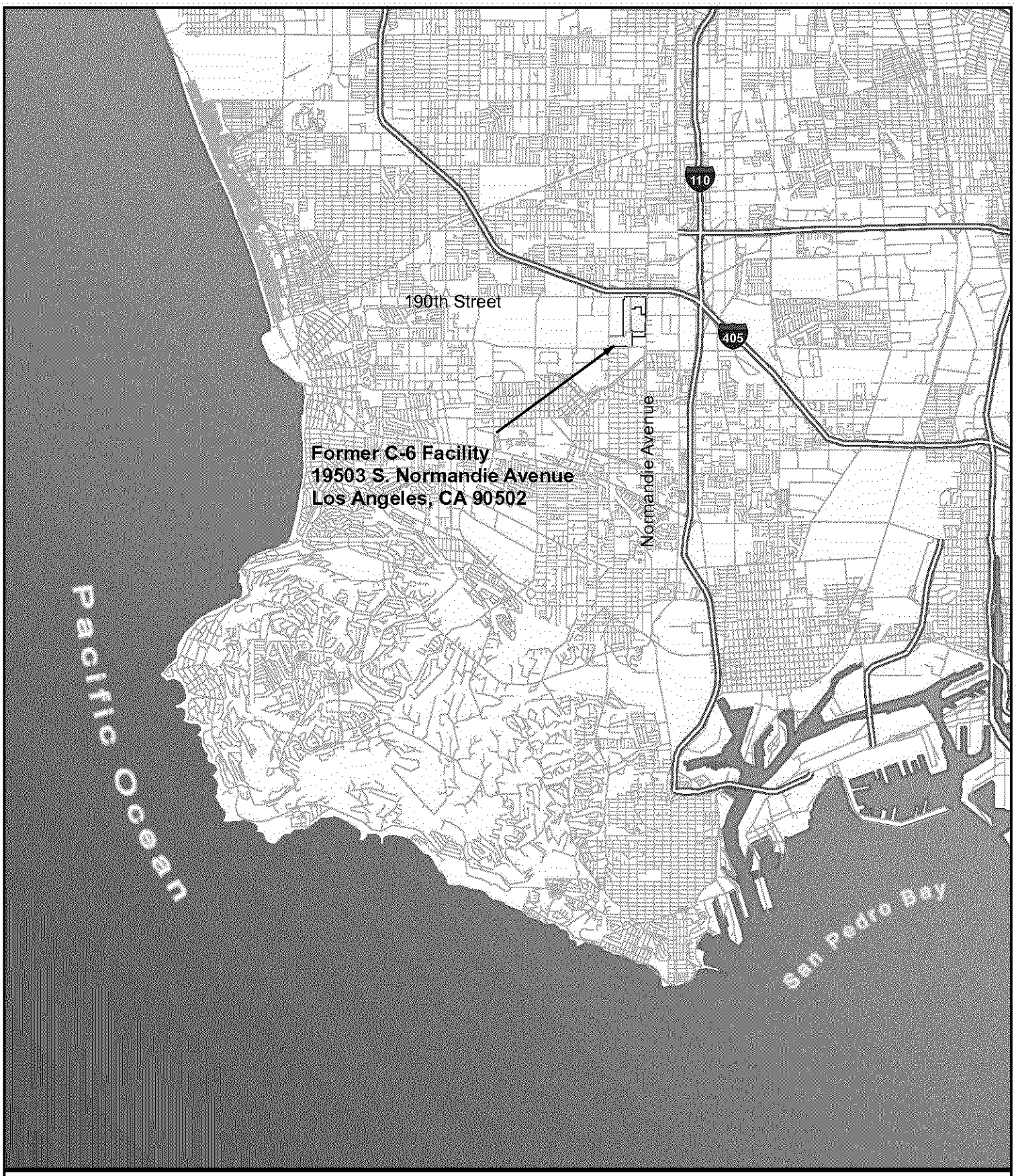
- Treatability study and electron donor evaluation (Section 4): The treatability study portion of the work plan includes plans for study set-up, sampling, and analysis and presentation and interpretation of the results.

- Electron donor injection test (Section 5): This section provides details on the pre-field and field activities for existing well testing with the injection of electron donor(s) to be selected from the treatability study described in Section 4.

- An estimated project schedule for the proposed activities is presented in Section 6.

- Health and Safety requirements are discussed in Section 7.

- References used in the preparation of the work plan are listed in Section 8.



2 0 2
Miles

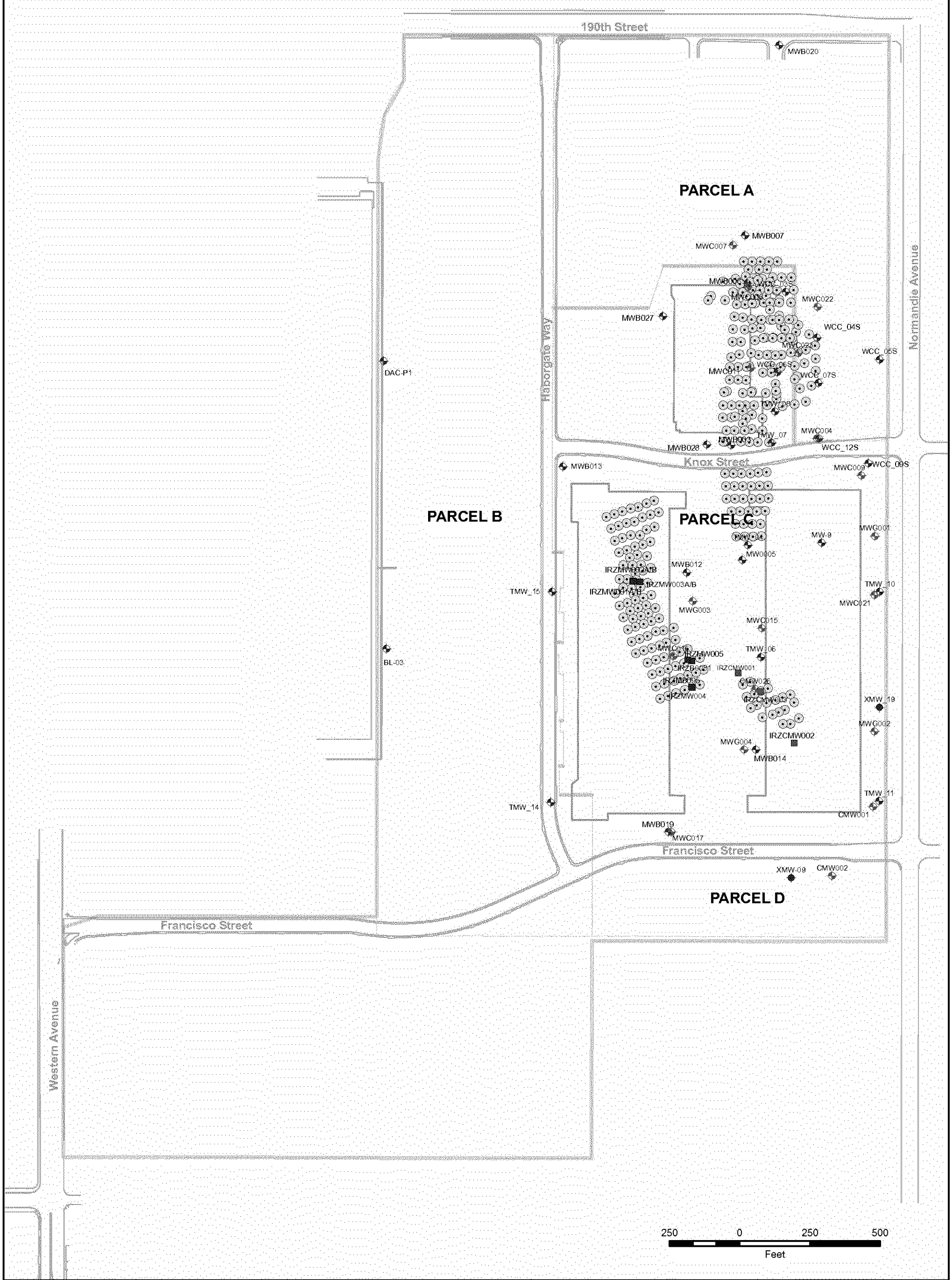
N

Figure 1

Boeing Realty Corporation
Former C-6 Facility

Site Vicinity Map

CDM



January 31, 2006

CDM

Legend

- Property Boundary
- Parcel Boundary
- B-Sand IRZ Bioremediation Monitoring Well
- C-Sand IRZ Bioremediation Monitoring Well
- Montrose Monitoring Well
- B-Sand Monitoring Well
- C-Sand Monitoring Well
- Gage Monitoring Well
- Amendment Well

N

Figure 2

Boeing Realty Corporation
Former C-6 Facility

Existing Amendment and Groundwater Monitoring Wells

Section 2
Evaluation of Existing Amendment Wells

2.1 Evaluation of Available Data

A detailed evaluation of the existing remediation infrastructure was performed to determine its usability for further remediation at the site. To this end, the existing documents and data generated by Arcadis G&M, Inc. (Arcadis), including the summary of pre-injection test data report (Arcadis, 2005) and water injection test data report (Arcadis, 2004a) were reviewed. Acceptability assessment of 169 wells associated with the former Building 2 area was based on flow rates, injection volumes, injection pressures, and field personnel observations during injection. Results of this initial evaluation indicate that 69 wells are acceptable for use, 19 wells are unacceptable for use, and up to 81 wells may be useable but may require additional testing. This additional testing is primarily to evaluate well responses since the molasses injection. Approximately 30 of the 81 wells which are located in the northeastern portion of the Building 2 area (Vault 5) just south of Knox street, were not injected with molasses and are likely useable. However up to six of these wells may also need to be tested because water injection testing demonstrated inconsistent results. In addition, 173 wells in the Building 1/36 area were installed using hollow stem auger techniques. Water injection testing conducted on a subset of these wells by Haley & Aldrich in 2004 and 2005 indicated that these wells would be useable. Prior to field testing, additional evaluations of these data will be conducted to further characterize the existing wells to the extent possible using well installation data, well abandonment and maintenance records, and existing water/amendment injection data. It should be noted that the condition of a significant percentage of the wells is likely to be uncertain following this additional evaluation and field testing would likely be required to positively verify the current conditions.

2.2 Field Testing Activities

Water injection tests on a subset of existing wells, which were deemed as potentially useable, will be conducted to establish baseline operability. These tests will involve continuous injection of clean water into each of these wells and monitoring flow and pressure. The following procedure is planned for these tests:

- Water will be obtained from a fire hydrant, filtered using portable bag filters (if necessary), and stored in Baker tanks or other suitable containers. It is anticipated to pump water into each amendment well at a flow rate of about 0.5 gallons per minute (gpm) to up to 10 gpm for a period of time to be determined based on individual well conditions. Due to the large quantity of wells, it is anticipated that several wells will be tested concurrently. The actual number of wells, flowrates, and duration of the testing will be adjusted in the field as appropriate to account for well-specific conditions.

- During each test, wells will be temporarily instrumented with positive displacement flow meters and pressure gauges at the existing cam-lock fitting.

This will be performed using a mobile manifold system. An operator will manually record flow and pressure data at 1-hour or other suitable intervals at each well during the study.

2.3 Data Evaluation and Reporting

A summary of field testing activities, including copies of field logs and data sheets, and conclusions on the condition and usability of the existing infrastructure will be presented in a Remedial Action Plan (RAP) anticipated to be submitted to the RWQCB by end of 2005. The data from the evaluation of existing data and field testing will be presented with the goal of identifying which existing amendment wells are useable under the proposed remediation plan.

Section 3
Test Well Installation, Aquifer Testing and Groundwater Modeling

The purpose of this task is to determine aquifer hydraulic characteristics, assess leakage between the two aquifer zones (B-Sand and C-sand) and utilize site data to develop a groundwater flow and transport model suitable for supporting the design of the site remediation systems. This task will include installation of two extraction wells to facilitate aquifer testing in locations that are suitable for incorporation into the remedial design. Aquifer testing will be conducted at these wells, using available Site groundwater monitoring wells as observation wells. Results of the aquifer testing will be used to refine the existing reconnaissance level groundwater model for the Site. Modifications to the scope proposed herein may be done based on further evaluation of existing well testing data. For detailed information about groundwater conditions at the Site, please refer to previous site investigation and groundwater monitoring reports (Kennedy/Jenks Consultants, 2000a, England Geosystem/Haley and Aldrich, Inc., 2001, and Haley and Aldrich 2002b). Descriptions of the activities associated with this task are provided in the following sections.

3.1 Well Installation and Development Procedures

3.1.1 Well Installation

The two groundwater extraction wells will be installed using fluid-rotary drilling techniques in preparation for aquifer performance tests (APTs) to be conducted under Task 3.2 . The extraction wells will be constructed using V-shaped wire stainless steel screen and a PVC casing in order to allow efficient redevelopment. The casing and screen will be sized for the anticipated flow rates from the aquifer, including provisions for use of a pump shroud, if needed.

Where applicable, the work will be performed in accordance with the standard operating procedures (SOPs) for drilling, soil sampling, well installation, well development, and related activities (Haley & Aldrich, 2004). Copies of the SOPs are included in Appendix A. Additional details and any deviations from the SOPs are provided below

The general locations of the proposed wells are shown in Figure 3 included at the end of this section. Actual well locations will be adjusted in the field to be near the existing infrastructure (header lines, electrical conduits, etc.), as appropriate, to minimize surface disturbance. The following bullets provide a description of the key activities:

- Prior to any intrusive work, CDM will review utility information, including maps of the recently installed buildings and remediation infrastructure and conduct a Site visit to locate utilities, mark well locations, and determine Site clearing needs for drill rig access. Underground Service Alert will be notified a minimum of two working days in advance to allow adequate time for marking the locations of

subsurface utilities. A geophysical survey will also be conducted at the locations for further utility clearance.

CDM will also coordinate with BRC to minimize disruptions to Site activities. Currently, the Site buildings are vacant.

- Prior to drilling, CDM will obtain the necessary well installation permits from the Los Angeles County Department of Health Services.

- The wells will be installed using mud rotary techniques in order to minimize the potential for developing an interconnection between the B and C-Sand aquifers. For the C-Sand well, a 12-inch borehole will be drilled to the design total depth. A 6-inch V-shaped stainless steel screen and mild steel casing assembly will be placed to the design depth. A gravel pack will be placed in the screen zone and the well cemented to the ground surface with an expansive grout. A similar method will used for constructing the B-Sand well.

  If necessary, the C-Sand extraction well may be drilled using the double-cased hole method to prevent communication between the B- and C-Sand aquifers. The upper portion of the hole will be drilled to the confining unit separating the B and C-Sand aquifers (Middle Bellflower Mud [MBFM]) using mud rotary techniques. A 10-inch ID casing will be installed and cemented in place through the MBFM. This upper casing will be installed in a borehole of sufficient diameter to allow cementing of the 10-inch casing in place by use of tremmie placement within the annulus between the drilled borehole and the casing. A drillable plug will be placed in the lower section of the 10-inch casing. After this cement grout is set, drilling of the borehole will continue into the C-Sand aquifer using drilling fluids that are designed to minimize formation plugging. The well will be completed using a 6-inch V-slot stainless steel screen through the C-Sand aquifer, with 6-inch blank casing installed to the ground surface. The screen will be gravel-packed, then sealed into the 10-inch casing using an expansive cement grout. No protective casing will be required for the B-Sand well.

  The well construction details for the extraction wells will be recorded on field forms.

- Soil cuttings will be separated from the drilling mud using a baffled "shaker" and collected in a "hopper" bin. The cuttings will be transferred periodically from the hopper into roll-off bins placed near the borings and moved to a BRC-approved on-site location.

- No soil samples for chemical analysis are anticipated to be taken from the borings for the wells.

- CDM's drilling subcontractor will develop the new wells to remove particulates and condition the filter pack.

- Each well will be surveyed for location and elevation. Well locations and well-head elevations will be surveyed to the nearest 0.5 feet and 0.01 foot, respectively, at a marked reference point on each well casing. Horizontal coordinates and vertical elevations will be established using North American Datum of 1983 (NAD 83) and North American Vertical Datum of 1988 (NAVD 88), respectively.

- The drilling subcontractor will submit well completion forms to Los Angeles County Department of Health Services.

- Investigation derived waste (IDW) (e.g., drill cuttings, development water) will be containerized, labeled, characterized, and properly stored pending laboratory analyses and disposal determination. The IDW will be properly manifested and disposed by CDM following receipt of laboratory results.

3.1.2 Well Development

Development of wells will consist of initial development (pre-development) during construction of the well, to settle the filter pack, and development of the well a minimum of 72 hours following placement of the surface seal to remove drilling fluids and fines from within the screen zone and increase hydraulic communication with the formation of the water bearing units. This task will consist of the following activities:

- Before development, static groundwater levels will be measured in the extraction wells and the surrounding observation wells.

- Well development will consist of mechanical surging or jetting followed by bailing and pumping of the well. The purpose of this development is to remove drilling fluids and fines from within the aquifer adjacent to the screen zone. Bailing and pumping methods will be used in combination to remove water containing suspended fine-grained material and to induce groundwater flow through the filter pack into the well.

- Investigation-derived waste (IDW) including drill cuttings, development water, etc., will be stored in properly labeled Baker tanks or other approved-containers and stored on-Site at a location selected by BRC pending laboratory analyses and disposal determination. The IDW will be properly manifested and disposed of by CDM following receipt of laboratory results.

3.2 Aquifer Testing Procedures

Aquifer performance tests (APTs) involve the extraction of groundwater from a well at a measured rate. Water levels are monitored in the test well and at nearby locations. The change in head (difference between static water level and water levels during pumping) over the period of the test provides the basis for evaluating aquifer characteristics.

The following tasks will be performed for each of the APTs for the two wells:

- Data loggers will be installed in the extraction well and adjacent existing monitoring wells. Manual water level measurements will be taken in available surrounding monitoring and observation wells.

- Water levels will be measured electronically at all measuring points using In-situ Mini-Troll transducers/data loggers. Back-up measurements will be collected manually using an electric well sounder throughout the test.

- For each test, an electric submersible pump will be installed in the test wells. The pump intake will be set near the top of screen. Discharge will be measured using a calibrated inline flow meter. Discharge rates will be controlled using a ball or globe valve installed downstream of the flow meter.

- Groundwater parameters consisting of pH, temperature, conductivity and turbidity will be measured on a regular frequency during the APTs.

- Samples for analysis of volatile organic compounds (VOCs) by EPA Method 8260B will be collected after 15 minutes of pumping and at the end of 24 hours of pumping. Samples will be stored on ice in a cooler and transported by courier to a California-certified analytical laboratory for analysis under proper chain-of-custody. Chain of custody forms will be maintained throughout sample collection and transport.

- A step drawdown test will first be performed in the extraction wells to determine the appropriate pumping rate for the subsequent constant rate APT.

- For the constant rate test, each extraction well will be pumped at a continuous rate for 24 hours at a projected rate of 15 gpm in each of the B- and C-sand zones.

- For the constant rate test, groundwater levels will be monitored in the piezometers (existing monitoring wells) and extraction well over an estimated 3-day period (1 day of background to establish static water levels, 1 day during performance of the APT, and 1 day of recovery).

- IDW (e.g., APT water) will be stored in properly labeled Baker tanks or other approved-containers and stored on-Site at a location selected by BRC pending laboratory analyses and disposal determination. The IDW will be properly manifested and disposed of by CDM following receipt of laboratory results

- The results of the APTs will be analyzed using standard groundwater analytical techniques to determine the estimates of horizontal hydraulic conductivity, transmissivity, specific capacity, and well efficiency.

3.3 Modeling Protocols

An existing reconnaissance level groundwater model will be refined and calibrated to site data, including results from the aquifer tests. Existing boring logs at the Site will be analyzed to refine the characteristics of the potentially discontinuous confining layer separating the B-Sand and C-Sand aquifer zones. The results of the aquifer test in the C-Sand will be assessed to determine if extension of the model to the Gage Aquifer is necessary for the flow model. The model will extend a sufficient distance upgradient and downgradient of the Site to minimize the impact of boundary conditions on the Site simulations. To the extent that data is available, the downgradient extent of the model will consider the location of remediation systems under design at adjacent sites, especially the Del Amo and Montrose facilities.

The groundwater flow model will consist of 3 layers representing: the B-Sand; the MBFM which is a fine-grained silt and clay layer locally separating the B and C-Sands; and the C-Sand. If the Gage Aquifer is modeled, then an additional two layers will be added to model the Lower Bellflower Aquitard (LBF) and the Gage aquifer. The model will be configured in a grid-independent manner to facilitate design evaluations that may require grid refinements to assess donor solution delivery. The model framework will be configured based on analysis of Site and area boring logs. Initial estimates of hydraulic characteristics will be configured based on aquifer test results from the Site and adjacent areas. Upgradient and downgradient boundaries will be defined as general head boundaries. Calibration of the model will be accomplished by varying sensitive parameters that have the greatest uncertainty in their field values. The calibration will be assessed by comparing simulated and observed water levels at the Site under steady-state conditions, and flow directions are consistent with the distribution of contaminants at the site. If time variant stresses, such as seasonal pumping at nearby production wells are identified, then calibration to these transient conditions will be undertaken. The calibration will attempt to match water levels within less than 0.5 feet at 70 percent of the wells.

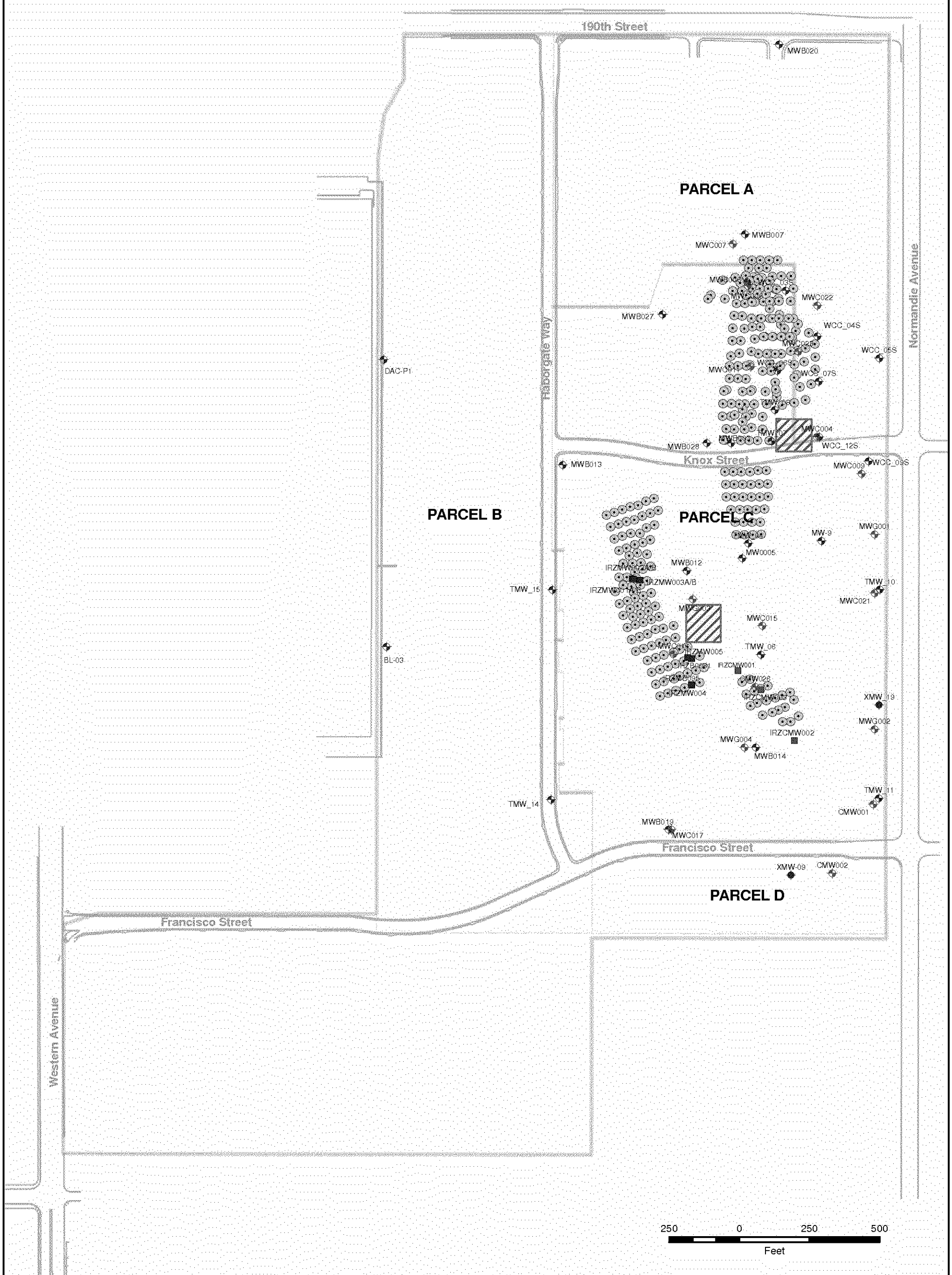
After refinement of the site model, it will be used to assess optimal designs for donor solution delivery, timing of recirculation operations, and placement of additional wells for the proposed recirculation system.

3.4 Data Evaluation and Reporting

The results of the aquifer testing and groundwater modeling will be submitted in the RAP and will include the following key items:

- Summary of field activities, including copies of boring logs and well completion diagrams, results of survey, monitoring results during the aquifer testing program and analysis of aquifer test results.
- The modeling portions will describe the site conceptual model and its implementation in the numerical model. This section will include descriptions of the site hydrogeology, aquifer characteristics, fate and transport characteristics

and boundary conditions used in the model. The basis for selection of each parameter will also be provided. The model calibration will be described and will include description of uncertainties, and a sensitivity analysis for significant parameters. The final results for each remediation scenario that is evaluated will be provided in the RAP.



February 10, 2006

Legend

- Property Boundary
- Proposed Extraction Well
- Montrose Monitoring Well
- B-Sand Monitoring Well
- C-Sand Monitoring Well
- B-Sand IRZ Bioremediation Monitoring Well
- C-Sand IRZ Bioremediation Monitoring Well
- Gage Monitoring Well
- Amendment Well

CDM

N

Figure 3

Boeing Realty Corporation
Former C-6 Facility

Proposed Extraction Wells in B-Sand and C-Sand

Section 4
Treatability Testing and Electron Donor Evaluation

An electron donor evaluation will be conducted to identify the most suitable electron donor compound(s) for use under the proposed remediation at the Site. Various cost-effective electron donors including ethanol, isopropanol, citric acid, whey, lactose, lactate, high fructose corn syrup, glucose syrup, and molasses are being considered for use at the Site. Additionally, proprietary electron donor blends developed by JRW Bioremediation may be tested. In addition, the evaluation will identify potentially necessary design, operations, and maintenance requirements associated with injection of the electron donor(s). In order to appropriately consider the factors that affect electron donor selection, the evaluation will be conducted in two phases – a background "paper" evaluation and a laboratory treatability study.

4.1 Background Data Evaluation

A preliminary "paper" evaluation will be conducted in order to determine which donors are suitable for testing. Factors to be considered in this evaluation include:

- Potential for stimulating complete reductive dechlorination to ethene with commercially available bioaugmentation cultures.
- Electron donor degradation rate.
- Mixing, filtration, or other pretreatment requirements.
- Compound stability and potential for precipitation or fermentation under ambient storage conditions.
- Potential for biofouling amendment wells.
- Flammability and associated infrastructure requirements (i.e., Class I, Division I electrical).
- Permitting requirements including LARWQCB WDRs.
- Capital costs specific to each donor.

The potential for biofouling will be evaluated by reviewing internal CDM experience, conducting a literature review, and interviewing other experts in the field. This knowledge will be leveraged to identify electron donors with lowest tendency for biofouling. In addition, biofouling control strategies such as electron donor pulsing, injection of very high electron donor concentrations, or injection of biofouling control reagents such as hypochlorite will be evaluated. As part of the existing data

evaluation, the Aracdis Bioremediation Amendment Recommendation Memo (Aracdis, 2004b) will also be reviewed to obtain further data for this task.

Flammability is relevant to ethanol and isopropanol which are being considered. The safety concerns and necessary design and operations requirements associated with flammable electron donors must clearly be outweighed by distinct advantages to warrant their recommendation. Nevertheless, it is premature to eliminate these compounds at this stage because of their demonstrated effectiveness at other sites and their relatively low cost.

Permitting requirements will be identified and are anticipated to include at a minimum the LARWQCB WDRs. Certain electron donors including lactate, ethanol, propanol, complex sugars such as molasses and corn syrup, and food process byproducts such as milk whey are included under the general WDR (Order No. R4-2002-0030: Series 007). Other electron donors such as citric acid would require a site-specific WDR. In the case of flammable electron donors (e.g., ethanol and isopropanol) a Los Angeles City Fire Department permit will be required. Ethanol would also require a permit from the Bureau of Alcohol, Tobacco, and Firearms (ATF).

Electron donor costs will be determined by obtaining quotations from vendors. Transportation, storage, and handling costs will be considered in addition to raw chemical costs. These costs are related in part to the engineering infrastructure required for certain electron donors (e.g., explosion proof requirements for the alcohols).

One of the results of the preliminary paper evaluation will be to identify the electron donors that will be further evaluated through laboratory treatability testing, described in Section 4.2.

4.2 Laboratory Treatability Testing Plan

The second phase of the electron donor evaluation is the laboratory treatability testing. The factors to be evaluated during the testing include:

- Potential for stimulating complete reductive dechlorination to ethene with commercially available bioaugmentation cultures.
- Electron donor degradation rate.
- Mixing, filtration, or other pretreatment requirements.
- Compound stability and potential for precipitation or fermentation under ambient storage conditions.

This study will be conducted in CDM's Environmental Treatability Laboratory in Bellevue, Washington. Soil and groundwater samples will be collected during the extraction well installation described in Section 3, for use in conducting the

treatability study. The tests will be conducted using commercially available bioaugmentation cultures obtained from one or more qualified vendors such as SiRem, Shaw, Regenesis, and Bioremediation Consulting, Inc.

Tests will be conducted in serum bottles containing soil, groundwater, electron donor, and bioaugmentation culture. Unamended control tests will be included in the test and all tests will be conducted in duplicate. Each test bottle will be amended with TCE and bioaugmentation culture and groundwater samples will be collected initially and biweekly for three months. These samples will be analyzed in the CDM treatability laboratory by purge and trap gas chromatography for TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). Headspace samples will be analyzed for methane and ethene.

Additionally, pretreatment requirements and stability characteristics of particular electron donor candidates will be evaluated. Specific measurements will include suspended solids concentrations in certain products, stability of complex electron donor solutions with respect to growth of bacterial contaminants and precipitation, solubility of dry products (e.g., whey powder and lactose), and identification of filtration requirements (e.g., particle retention size).

The background evaluation will be continually refined as appropriate based on the findings of the laboratory treatability study.

4.3 Data Evaluation and Reporting

A summary of the results of the background evaluation, the laboratory treatability testing procedures, and recommendations on the preferred electron donor (s) for use at the Site will be provided in the RAP.

Section 5
Electron Donor Injection Test

5.1 Purpose

An electron donor injection test will be performed based on the results of the electron donor evaluation described in Section 4. The reasons for this test include:

- Verification that electron donor injection flow rates and pressure will be similar to those obtained using water injection as described in Section 2;
- Estimation of biofouling potential with the selected electron donor(s) and the commensurate need for biofouling control strategies;
- Validation of the electron donor consumption rate estimate obtained from the laboratory electron donor treatability test; and
- Verification of potential for surface seepage through the well or the well field footprint.

An assessment of these needs will be made following completion of the evaluations described in Sections 2 through 4 and discussed with BRC. If warranted, electron donor injections testing will be conducted in accordance with the procedures described in Section 5.2 .

5.2 Testing Plan

The electron donor injection test will vary depending on the purpose of the test. For example, if testing is needed for the first reason listed above, then this could be accomplished using short-term and/or long-term tests involving injection of one or more electron donors into existing wells and monitoring physical parameters such as flow rate, injection volume, and pressure at the injection points. If testing is needed for the second and third reasons listed above, then groundwater samples may need to be collected for the purpose of estimating electron donor transport rates. While the exact procedure is yet undefined, the following paragraphs provide a general description of testing that is anticipated.

- Injection of the optimal electron donor(s) would be conducted in existing amendment wells. The wells will be selected based on results of evaluations described in Section 2, depth and location of the screened interval, and proximity to existing monitoring wells. The source of water would be a fire hydrant, with sodium bisulfite or another acceptable oxygen scavenger added to remove dissolved oxygen and chlorine.
- Water would be injected continuously at a flow rate of 0.5 gpm or greater (to be determined based on individual well conditions) and concentrated electron donor solution would be periodically injected into the water using chemical feed pumps and chemical tanks. A tracer (e.g., bromide) will be mixed with the electron donor

prior to injection. The frequency of pulsing and the electron donor injection concentration may be varied amongst the different wells to identify the best injection strategy.

- Well heads will be instrumented with flow meters and pressure transmitters or gauges and the data will be recorded manually or on a data logger. Groundwater samples may be collected from nearby monitoring wells or unused amendment wells and analyzed for relevant analytes potentially including temperature, pH, oxidation-reduction potential, dissolved oxygen, ferrous iron, total organic carbon, bromide tracer, and VOCs.

The results and conclusions from this test will be incorporated into the section for Treatability Testing and Electron Donor Evaluation to be included in the RAP.

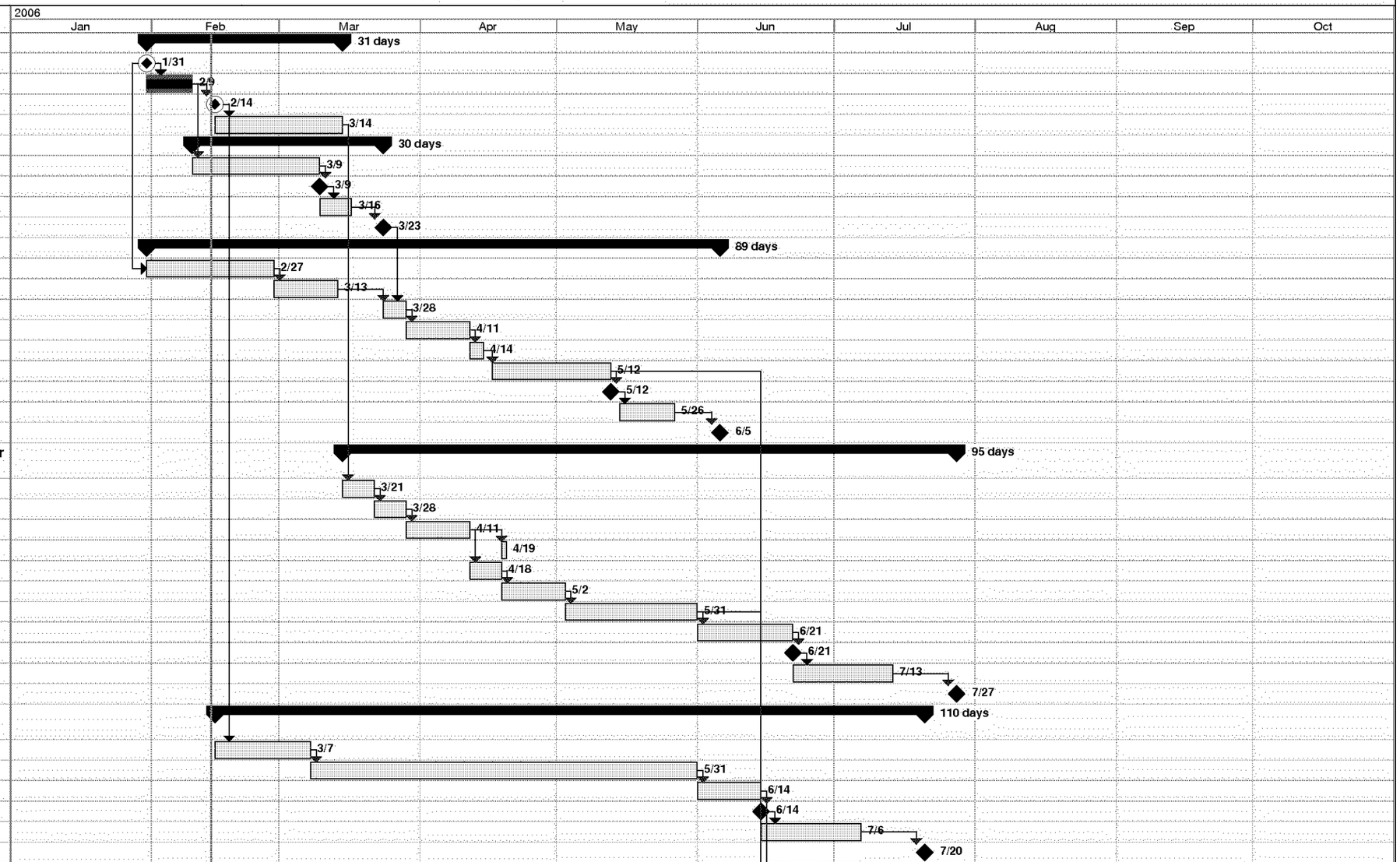
Section 6
Project Schedule

Figure 4 shows the estimated project schedule for the pre-remediation testing activities outlined in this workplan.

Figure 4

Estimated Project Schedule
Pre-Remediation Workplan
Former C-6 Facility, Los Angele, California

ID		Task Name	Start	Finish
1		**Work Plan for Pre-Remediation Activities**		31 days
2	✓	Submit Draft Work plan to BRC		1/31
3	✓	BRC Review and Comment		2/9
4	✓	Agency Draft Work plan to RWQCB		2/14
5		RWQCB Review and Approval		3/14
6		**Field Implementation Plan and HASP**		30 days
7		Prepare Draft Plans		3/9
8		Submit Draft to BRC		3/9
9		BRC Review and Comment		3/16
10		Final Plans		3/23
11		**Evaluation of Existing Amendment Wells (Section 2)**		89 days
12		Obtain/Evaluate existing Arcadis Data		2/27
13		Determine Testing Strategy		3/13
14		Mob/Setup Testing equipment		3/28
15		Field Testing		4/11
16		DeMob Testing equipment		4/14
17		Prepare Draft Tech Memo		5/12
18		Submit Draft to BRC		5/12
19		BRC Review and Comment		5/26
20		Agency Draft Tech Memo to RWQCB		6/5
21		**Test Well Installation, Aquifer Testing, and Groundwater Modeling (Section 3)**		95 days
22		Obtain/Negotiate access and Procure Drillers		3/21
23		Clear underground utilities (Dig Alert/Review Facility Plans)		3/28
24		Well Installation and Development		4/11
25		Well Survey		4/19
26		Aquifer Test		4/18
27		Evaluate Test Data		5/2
28		Groundwater Modeling/Define Optimal Extraction/Injection Strategy		5/31
29		Prepare Draft Tech Memo		6/21
30		Submit Draft to BRC		6/21
31		BRC Review and Comment		7/13
32		Agency Draft Tech Memo to RWQCB		7/27
33		**Treatability Testing and Electron Donor Evaluation (Section 4)**		110 days
34		Existing Data Evaluation		3/7
35		Optimal Donor Selection (Bench Scale Testing)		5/31
36		Prepare Draft Tech Memo		6/14
37		Submit Draft to BRC		6/14
38		BRC Review and Comment		7/6
39		Final Tech Memo		7/20



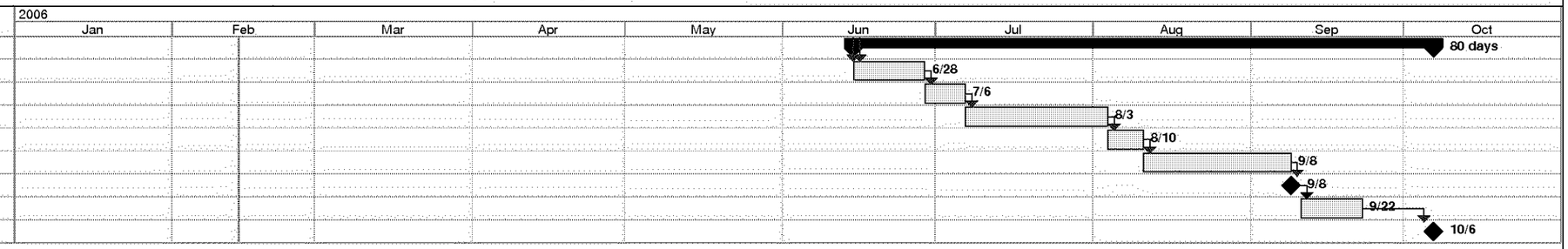
Prepared for: Boeing Realty Corporation
Date: Tue 2/14/06

Pending | Split | Pending Milestone | Summary | Deadline
Completed | Progress | Completed Milestone | External Tasks

Figure 4

Estimated Project Schedule
Pre-Remediation Workplan
Former C-6 Facility, Los Angele, California

ID		Task Name
40		**Electron Donor Injection Test (Section 5)**
41		Determine Testing Strategy
42		Mob/Setup Testing equipment
43		Field Testing
44		DeMob Testing equipment
45		Prepare Draft Tech Memo
46		Submit Draft to BRC
47		BRC Review and Comment
48		Final Tech Memo



Prepared for: Boeing Realty Corporation
Date: Tue 2/14/06

Pending | Split | Pending Milestone | Summary | Deadline
Completed | Progress | Completed Milestone | External Tasks

Section 7
Health and Safety

A site-specific health and safety plan (HSP) in accordance with Title 29 CFR, Section 1910.120 and 8 CCR 5192 will be prepared prior to implementing this workplan. The purpose of the HSP will be to describe the controls and procedures that will be implemented to prevent incidents, injury, and health risks associated with the field activities. The HSP will assign responsibilities, establish personnel protection standards and mandatory safety procedures, and specify appropriate measures and procedures taken for contingencies that may arise while operations are being conducted at the site. The HSP will be prepared to cover all potential work, including remedy implementation and O&M at the former C-6 Facility. The HSP will be used by field staff while conducting field activities.

CDM will use applicable information from the existing HSP for groundwater monitoring at the BRC Former C-6 Facility prepared by Haley & Aldrich on June 8, 2001, and updated by addendum on October 30, 2002 and November 12, 2002 (Haley and Aldrich, Inc.,2001a, 2001b and 2002a).

Section 8
References

Arcadis G&M, Inc. 2005. *Summary of Pre-Injection Test, Lot 8, Building 136 Memo*, dated March 9, 2005.

Arcadis G&M, Inc. 2004a. *C6 Water Injection Test Data*, Project Site: Former Boeing C-6 Facility, Los Angeles, California, File No. 95-036, SLIC 0410, dated September 14, 2004.

Arcadis G&M, Inc. 2004b. *Bioremediation Amendment Recommendation Memo*, dated November 1, 2004.

England Geosystem and Haley and Aldrich, Inc. 2001. *Groundwater Monitoring Report, Semi-Annual Event July 2001* for Boeing Realty Corporation, Former C-6 Facility, 19503 South Normandie Avenue, Los Angeles, CA, dated October 24, 2001.

Haley and Aldrich, Inc. 2001a. *Site-Specific Health & Safety Plan* for Boeing Realty Corporation Former C-6 Facility, 19503 South Normandie Avenue, dated June 8, 2001.

Haley and Aldrich, Inc. 2001b. *Site-Specific Health & Safety Plan* for Boeing Realty Corporation Former C-6 Facility, 19503 South Normandie Avenue, Addendum 1 dated November 12, 2001.

Haley and Aldrich, Inc. 2002a. *Site-Specific Health & Safety Plan* for Boeing Realty Corporation Former C-6 Facility, 19503 South Normandie Avenue, Addendum 2 dated October 30, 2002

Haley and Aldrich, Inc. 2002b. *Site-Wide Groundwater Assessment Report,* Boeing Realty Corporation, Former C-6 Facility, dated November 18, 2002.

Haley & Aldrich, Inc. 2004. *Draft Implementation Plan for Phases II and III, Lot 8 Groundwater Remediation, Well Installation Program*, Former Boeing C-6 Site, Los Angeles California, prepared for Boeing Realty Corporation, 4900 Conant Street, Long Beach, California, dated December 3, 2004.

Kennedy/Jenks Consultants, Inc. 2000a. *Groundwater Status Report*, dated October 27, 2000.

Appendix A
Standard Operating Procedures

(Only those procedures which are directly applicable to this Workplan will be used)

WELL CONSTRUCTION AND DESTRUCTION STANDARD OPERATING PROCEDURES FOR LOT 8 - PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

by:

Haley and Aldrich, Inc.
San Diego, California

for:

Boeing Realty Corporation
Long Beach, California

File No. 28882-604
16 August 2004

HALEY & ALDRICH

1. INTRODUCTION

The purpose of this document is to present the standard operating procedures (SOPs) required for installing and constructing 166 amendment wells (AWs) and seven groundwater monitoring wells (MWs) in Parcel C of the former Boeing C-6 facility (Site) in Los Angeles, California. The wells are to be installed as part of the groundwater remediation program for the Site. This document also presents the procedures to be used if an AW or MW has to be destroyed.

The AWs and MWs will be installed into the B-Sand or the C-Sand in five phases of work, described below:

- Phase I – 18 geologic reconnaissance AWs will be drilled at selected locations in Lot 8 and Parcel A of the Site;
- Phase II – 17 AWs will be installed in Parcel A of the Site;
- Phase III – 40 AWs will be installed in the graded pad of the future building planned for Lot 8.
- Phase IV – 81 AWs will be installed in Lot 8 in areas outside the area of the building pad.
- Phase V – seven MWs will be installed in Lot 8 and Parcel A following development of the Site.

This well installation SOP addresses the following items:

- Pre-drilling activities
- AW and MW well design
- Well installation procedures
- Well destruction procedures

2. PRE-DRILLING ACTIVITIES

The pre-drilling activities addressed in this section include: permits, well location selection and marking, utility clearance, equipment assembly, field documentation, and construction methods documentation.

2.1 Well Permits

Los Angeles County Department of Health Services (LACDHS) requires permits for the injection and monitoring wells. These permits must be obtained for all wells installed at the Site. Upon receipt of the Well Installation Permits, LACDHS requires at least 48-hours notification prior to well installation. Installation of the AWs and MWs should not proceed until approval (written or verbal) has been obtained from the LACDHS.

2.2 Pre-field Documentation and Checklists

The following documents and checklists will be prepared and maintained on-Site during the field activities:

- Site-specific Health and Safety Plan;
- Pre-field Checklist;
- Incident reporting Procedures; and
- Standard Operations Checklist and Dash Card.

2.3 Project Team Kick-off Meetings

Prior to the initial mobilization to the field, a project team kick-off meeting will be held to review the scope of work and the Well Installation Implementation Plan. Attendees to this pre-field kick-off meeting will include Haley and Aldrich's Project Manager and Task Leader, the driller's Project Manager, and the Boeing Project Manager. The kick-off meeting will also discuss and clarify the rolls and responsibilities of project team members during the well installation program, and discuss the schedule of events during the field program. If any changes to the scope or SOPs to be used during the well installation program are identified during the pre-field kick-off meeting, the Implementation Plan and appropriate SOPs will be revised.

One the first day of field work for each of the five phases of the well installation program, a field kick-off meeting will be conducted at the Site. Attendees will include at a minimum Haley and Aldrich's Task Manager, Field Coordinator/Supervising Geologist, Health and Safety Coordinator, and the Oversight Geologist(s), the driller's Task Leader, and the Boeing Project Manager.

2.4 Well Locations and Marking

The locations of the proposed AWs and MWs are shown on Figure 2 of the Implementation Plan. The locations of the AWs and MWs are based on the California Regional Water Quality control Board – Los Angeles Region (LARWQCB) approved locations presented in the work plan for the groundwater remediation pilot study (Arcadis, 2002). The installation phase and well construction details of each well to be installed are presented in Table II of the Implementation Plan. Prior to each phase of the well installation activities, a surveying subcontractor will survey the locations of each of the AWs or MWs to be installed during that phase of work. Locations are to be marked with wood stakes and flagging.

2.5 Utility Clearance

After the well boring locations have been marked, each location will be assessed as to the potential presence of subsurface utilities or known obstructions. The task manager or his/her delegate should identify alternate well boring locations in the event that utilities or other subsurface obstructions are present at the pre-selected locations. In addition, Underground Service Alert (USA) will be notified prior to the advancement of any boring on-site (USA requires at least a 3 business-days notice). Because of on-going development, well locations in Parcel A and the southern portion of Lot 8 along Knox Street will also be cleared for subsurface utilities by a geophysical locator subcontractor and hand augered to a depth of 5 ft below ground surface (bgs) prior to drilling. The remaining well locations in Lot 8 do not require hand auger clearance.

The seven proposed monitoring wells will be installed during Phase V of the installation program, following complete development of the Site. To protect newly installed utilities, each MW location will be cleared by the geophysical locator subcontractor, USA, and will also be hand augered to a depth of 10 ft bgs in a triangular pattern surrounding the well location.

2.6 Concrete Cutting

Some well boring locations may require concrete/asphalt cutting to gain access to the underlying soil. If necessary, well locations will typically require a 2-foot by 2-foot area of asphalt or concrete to be removed to provide sufficient space for the installation of a monitoring well or wells and completion of the well box or protective casing.

2.7 Instrument Calibration and Equipment Organization

Prior to drilling, field equipment will be checked for possible malfunctions, cleaned, and

calibrated. Instruments to be used during well installation and development include:

- Photo Ionization Detector (PID) for work area air monitoring and headspace analysis of soil cuttings;
- Electronic water level sounder;
- Water quality parameters (e.g., pH, electroconductivity, temperature, turbidity and dissolved oxygen) for monitoring purge water quality during well development; and
- Pressure transducers to monitor groundwater levels during development pumping and injection testing.

Calibration procedures provided by the manufacturers should be followed for each instrument. Calibration verification will be performed in the field prior to initial instrument use, at least once a day, or when any indication of instrument malfunction is observed. Oversight geologists are responsible for documenting the calibration verification readings and associated notes for each day that the instruments are used. This information may be recorded in the field activity logbook or on the approximate field instrument calibration log.

Following the maintenance and calibration of all field instruments, the equipment and materials necessary to support the monitoring well installation task will be assembled.

2.8 Field Documentation

A bound field activity logbook will be maintained to document field activities associated with the installation of AWs and MWs. Well construction and development details will be logged (along with any other comments that will aid in the ability to reconstruct the drilling activities without reliance on memory) on the monitoring well construction diagrams (Appendix A – Field Forms) and the field activities logbook. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

The following information will be recorded during well installation:

- Drilling contractor's name;
- Drilling method;

- Date of installation;
- Depth of borehole;
- Name of oversight geologist;
- Well number and location with measurements to nearby landmarks;
- Site name and project number;
- Types of construction material and quantity of material (screen type and length, volumes of filter pack, bentonite chips and cement/bentonite grout, mixture of grout, etc.);
- Methods of placement of filter pack, bentonite seal, and annular Portland cement/bentonite seal;
- Static water level after well installation;
- Total depth of well after installation and description of bottom (i.e., hard, soft, etc.);
- Location and description of survey measuring point on well casing;
- Description of fluids added during installation (composition, source, and volume).

All geologic logs, well construction and well development record forms will be provided to the Boeing Technical Manager every two days for review. Geologic description and well construction details will also be included in an electronic object log and uploaded to the Boeing EDMS. A complete set of all field activity logs and field forms will be transmitted on CD to the Boeing Project Manager upon completion of each phase of work.

3. AMENDMENT WELL AND MONITORING WELL DESIGN

The AWs and MWs have similar designs and installation procedures. The designs for the B-Sand and C-Sand AW and MWs are described in Sections 2.1 and 2.2, respectively. The procedures to be used during installation of the AWs and MWs are described in Section 2.3

3.1 B-Sand Amendment Wells and Monitoring Wells

The typical well diagrams of the B-Sand AWs and MWs are shown on Figures 4 and 5 of the Implementation Plan, respectively. A total of 110 AWs and three MWs will be installed in the B-Sand. The B-Sand water bearing unit AWs and MWs will be constructed to the following design:

- Total depth of approximately 85 ft bgs (Depth to be confirmed through the Phase I geologic reconnaissance program);
- Boring to be drilled using hollow stem auger drill rig with 8-inch outside diameter by 5 ft long augers;
- The well casing will consist of 2-inch diameter, poly vinyl chloride (PVC) well casing and screen;
- The screen of the AWs will consist of approximately 20 ft of screen with 0.020-inch machine cut slots. The screen of the MWs will consist of 15 ft of screen with 0.010-inch machine cut slots.
- The screened interval for the AWs will be placed opposite the VOC-impacted water-bearing sand encountered from approximately 65 ft to 85 ft bgs (70 ft to 85 ft bgs for the MWs). However, the actual depth will be confirmed or refined following evaluation of the geologic reconnaissance AW installation described in Section 2 of the Implementation Plan.
- The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack material may be altered following review of sieve analysis reports of soil samples collected during the Phase I geologic reconnaissance program.
- The filter pack will be installed from total depth to 1 ft above the top of the screened interval. The method of placement and settlement of the filter pack is described in Section 2.3;
- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. A minimum of 2.5 ft of the bentonite chip seal must be installed below the static water table to ensure constant hydration of the seal. The method of placement and hydration of the bentonite seal is

described in Section 2.3;

- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture and procedure for placement of the annular seal is described in Section 2.3.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes or steel rebar and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The surface completion of the MWs will consist of a 12-inch diameter traffic rated well box set in concrete with the top of the box raised approximately ½-inch above the surrounding pavement to promote drainage away from the MW.

3.2 C-Sand Amendment Wells and Monitoring Wells

The typical well diagrams of the C-Sand AWs and MWs are shown on Figures 4 and 5 of the Implementation Plan, respectively. A total of 56 AWs and four MWs will be installed in the C-Sand. The C-Sand water bearing unit AWs and MWs will be constructed to the following design:

- Total depth of approximately 115 ft bgs;
- Boring to be drilled using hollow stem auger drill rig with 8-inch outside diameter by 5 ft long augers;
- The well casing will consist of 2-inch diameter, poly vinyl chloride (PVC) well casing and screen;
- The screen of the AWs will consist of approximately 20 ft of screen with 0.020-inch machine cut slots. The screen of the MWs will consist of 20 ft of screen with 0.010-inch machine cut slots.
- The screened interval will be placed opposite the C-Sand water-bearing sand encountered from approximately 95 ft to 115 ft bgs. However, the actual depth will be confirmed or refined following evaluation of the geologic reconnaissance AW installation described in Section 2 of the Implementation Plan.

- The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack material may be altered following review of sieve analysis reports of soil samples collected during the Phase I geologic reconnaissance program.
- The filter pack will be installed from total depth to 1 ft above the top of the screened interval. The method of placement and settlement of the filter pack is described in Section 2.3;
- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The method of placement and hydration of the bentonite seal is described in Section 2.3;
- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The grout will extend from the top of the bentonite seal to within 3 ft of current grade for the AWs. For the MWs, the grout will be placed to within 2 ft of current grade. The grout mixture and procedure for placement of the annular seal is described in Section 2.3.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The surface completion of the MWs will consist of a 12-inch diameter traffic rated well box set in concrete from 2 ft bgs to the pavement surface. The top of the box will be raised approximately ½-inch above the surrounding pavement to promote drainage away from the MW.

4. WELL INSTALLATION PROCEDURES

The following procedures are to be used during installation of the AWs and MWs at the Site.

1. Refer to Section 2 of the Implementation Plan for the details regarding the collection of continuous cores from the 18 AWs installed as part of the Phase I geologic reconnaissance program. This information will be used to determine the completion depths, well screen intervals, and filter pack specification for the remaining 148 AWs and seven MWs. The 148 remaining AWs are to be drilled without the collection of soil samples for geologic logging. During drilling of the seven MWs, soil samples will be collected for geologic logging at 5 ft intervals using a split-spoon sampler equipped with a sand catcher device but not internal sample rings.

2. Prior to installation, the PVC casing and screen will be decontaminated (if not pre-wrapped. Decontamination of the materials may also be done by high pressure steam cleaning. All personnel handling the decontaminated well materials should wear clean disposable PVC gloves to ensure that the material does not become contaminated prior to installation.

3. After decontamination of all down-hole drilling equipment, the well boring will advanced to the desired well depth. The lead auger/bit used for reaming the boreholes that are not continuously cored will be fitted with a clean wooden plug to maintain a soil-free annulus during reaming.

4. A weighted tape-measure will be used to verify the depth to the bottom of the boring before and after knocking out the wooden plug. The wooden plug is then knocked out with the drill stem rods and 140-pound hammer.

   Note: In cases where heaving sands are encountered, clean potable water may be added to the borehole through the auger to displace the material during installation. The pressure created will keep the casing from moving upward in the augers. During Phase I and possibly Phase II, potable water will be available at the soil vapor extraction compound. For future phases of work, potable water may be obtained from the fire hydrants in Knox Street under permit with the City of Los Angeles. Under no circumstances shall the fire hydrants on the commercial property located south of Knox Street be used due to their connection to an alarm system.

5. When the appropriate depth has been achieved, PVC well screen and casing will be assembled and lowered through the hollow-stem augers. Unless wrapped with plastic from the manufacturer, the well casing and screen for the MWs will be decontaminated before being placed in the borehole. Decontamination of the well casing and screen for the AWs is not required.

6. Once the screen and casing are in place, the sand pack material is poured slowly through the annulus between the interior of the hollow-stem augers and the well casing. The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack specifications may be altered based on the results of sieve analyses of soil samples collected during the Phase I geological reconnaissance well installation program. The augers can be withdrawn during the placement of the filter pack sand, but the tip of the augers must remain below the top of the filter pack throughout the process to prevent caving of formation material into the annulus between the borehole and the well screen. Following placement of the filter pack to a level of 1 ft above the top of the screen, the well will be surged for approximately 10 minutes with a vented surge block to settle the filter pack. The level of the filter pack will then be measured and additional filter pack material added, if necessary, to bring the level a minimum of 1 ft above the top of the screen. The well will then be surged for an additional 5 minutes and the filter pack level again measured. This process will continue until no further settlement of the filter pack greater than 0.05 ft is measured.

7. The final depth to the sand pack will be recorded on the monitoring well construction form (Figure 1-1). In addition, the volume of sand used for the gravel pack should be recorded in the field activity logbook.

8. The bentonite seal is to consist of 5 ft layer of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The thickness, hydration, and placement of the bentonite seal are critical to seal-off adjacent water bearing zones. To insure constant hydration of the bentonite pellets in the B-Sand AWs and MWs, a minimum of 2.5 ft of the bentonite seal must be installed below the static water table depth/elevation as verified in adjacent MWs or AWs. The screen interval of the C-Sand wells is sufficiently deep enough to ensure constant hydration of the bentonite seal. Following placement of each bentonite pellet lift, a capped tremie pipe will be used to tamp the pellets in-place and the lift allowed to hydrate for up to 10 minutes before the next lift is placed. Prior to placing the next lift, it will be confirmed that there is a minimum of 2 ft of water above the top of the previous lift. If necessary, additional potable water will be added to the annulus to allow hydration of the next bentonite pellet lift. This placement method will be repeated until the entire 5 ft bentonite seal is placed. As the bentonite seal bentonite seal is placed, the augers can be withdrawn. However, to prevent the formation material from caving around the well screen and casing, at no time shall the base of the augers be allowed to rise above the top of the placed bentonite seal level.

9. The final depth to the bentonite seal and seal thickness will be recorded on the monitoring well construction form. In addition, the volume of bentonite used for the seal should be recorded in the field activity logbook and compared to the calculated volume in the field to verify adequate seal placement.

10. The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture will consist of the following; 94 pound bag of Portland Type I/II cement, 4 pounds of bentonite powder, and approximately 8 to 9 gallons of potable water. The bentonite powder and water shall be mixed first and the cement added after it has mixed. The cement and bentonite powder must be loose and free of lumps. The grout will be mixed immediately prior to placement in each individual well. Because of the small annular space between the well casing and the inner wall of the hollow stem auger, a tremie pipe of 1-inch diameter must be used. Because of this small diameter tremie pipe, the grout mixture must have a density between 14.5 and 15.0 pounds per gallon and be fully mixed. The oversight geologist must approve the mix and consistency of each grout mix used using a 1/2-gallon container and a weight scale. The grout will be placed from above the bentonite seal to within 3.5 ft of ground surface using a temporary tremie pipe with the bottom of the pipe placed within 2 ft of the bentonite seal. Grout shall be tremied into the auger annular space as the augers are withdrawn. A minimum of 2 ft of grout shall be maintained in the base of the augers at all times as they are withdrawn. The tremie pipe can be withdrawn during the grouting process, but the tip of the pipe and augers must remain below the top of the grout throughout the process. The well will be periodically inspected in the days following placement of the grout seal to ensure that no settlement occurs and additional grout added to maintain the level approximately 3.5 feet bgs. Any soil or other debris observed on top of the grout seal will be removed prior to adding additional grout, if necessary.

11. For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.

12. The surface completion of the seven monitoring wells will be a 12-inch diameter traffic rated well box set in concrete. The top level of the well box will be raised approximately ½-inch above the pavement level to promote drainage away from the box.

13. Record the applicable geologic and well construction data in the electronic object log and upload the log to the Boeing EDMS.

5. WELL DESTRUCTION PROCEDURES

The purpose of this section is to present the procedures required for the destruction of an AW if well development or water injection testing (WIT) (See Appendix D of the Implementation Plan) indicates that the AW does not have good hydraulic connection to the target water bearing unit (i.e., B-Sand or C-Sand) and can not be used for the addition of amendment.

5.1 Destruction Activities

The well destruction activities addressed in this section include: permits, review of existing well information, equipment assembly, field documentation, and well destruction methods.

5.1.1 Required Permits

LACDHS requires permits for well destruction. LACDHS well destruction permits will require at least 7 working days for the approval process. Well destruction should not proceed until written or verbal approval has been obtained from the LACDHS.

5.1.2 Preliminary Well Review

Prior to initiating the well destruction activities, the Field Coordinator/Supervising Geologist or Task Manager will review all relative information regarding the details of construction and the relative soil and groundwater data associated with the well to be destroyed. The site geologist will inspect the well location for access or obstructions such as equipment storage or materials placement on top of or near the well cover.

5.1.3 Concrete Cutting

Prior to well destruction, the concrete and asphalt surrounding the existing well (if present) will be cut and removed. Enough concrete should be removed to provide sufficient space for the well destruction procedure.

5.1.4 Instrument Calibration and Equipment Organization

Prior to drilling, field equipment will be checked for possible malfunctions and calibrated according to procedures provided by the manufacturer. Field instrument calibration verification will be performed in the field prior to their initial use at least once a day, or when any indication of instrument malfunction is observed. This information may be recorded in the field activity logbook or on the appropriate field meter calibration log.

Following the maintenance and calibration of all field instruments, the equipment and materials necessary to support the well destruction task will be assembled.

5.2 Field Documentation

A field activities log book will be maintained for all field activities associated with the destruction of a well. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

The following information will be recorded for each well destroyed:

- Drilling contractor
- Name of field person(s)
- Well number and location
- Well depth and static water level
- Well destruction equipment and method employed
- Date and time of well destruction
- Type and volume of sealant material (volume should be consistent with the anticipated borehole volume)

5.3 Well Destruction Methods

Wells will be destroyed by over-drilling and removal using a hollow-stem auger drilling methods, or LACDHS and Boeing Project Team approved alternate drilling/destruction methods.

The procedures for destroying a well are as follows:

1. Once the surrounding asphalt and concrete (if present) has been removed, the existing well cover and well box (if present) can be removed.

2. Set up the drill rig over the well to be destoyed. With a hollow-stem auger (10-inch minimum diameter), over-drill the existing cement/bentonite seal and sand pack along the entire length of the well.

3. Advance the auger drill string to the desired removal depth (total depth). With the hollow-stem in place, pull the existing well casing through the open augers using the wire-line winch attached to the drill rig. Containerize the well waste materials as described Section 1.4 of this exhibit.

4. Prepare the bentonite-cement grout (sealing material) using the following mixture:

- One 94-pound sack of Portland Type I/II cement
- Approximately 3 to 5 pounds of powdered bentonite
- 6.5 gallons of clean potable water
- The density of the grout mixture should range from 15.6 to 16.2 pounds per gallon and must be verified by the oversight geologist using a calibrated container and weight scale.

NOTE: An alternate approved mixture may be used in place of the bentonite-cement grout mixture above if the alternate mixture complies with the California water well standards.

5. Backfill the vacated boring annulus with a bentonite-cement grout by tremie pipe methods, to prevent the grout from free-falling or becoming diluted or separated during installation. Retract the hollow-stem augers from the borehole at the same rate that the grout is being pumped to prevent the borehole from caving in prior to placement of the sealing material. The grout should be added to the borehole at a speed that will keep the groundwater from rising to the surface and flooding the area around the borehole.

   NOTE: The volume of grout used to seal the borehole should be greater than the calculated volume of the total depth of the borehole.

6. Fill the remaining borehole annulus to approximately 1 ft below the ground or pavement surface with the grout mixture. Record the volume of grout used to seal the borehole.

7. Decontaminate all drilling equipment using a high pressure washer and steam cleaner, or by hand washing with and Alconox solution and two tap water rinses.

8. Contain all soil cuttings, solid wastes, and any displaced groundwater in 55-gallon drums. Seal each drum with a drum lid. Label drums according to the Waste Handling section (Section 3.3) in the Implementation Plan.

9. Place all trash (i.e., spent gloves, paper towels, plastic sheeting, etc.) in plastic garbage bags and dispose of properly.

WELL DEVELOPMENT AND WATER INJECTION TESTING STANDARD OPERATING PROCEDURES FOR LOT 8 – PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

by:

Haley and Aldrich, Inc.
San Diego, California

for:

Boeing Realty Corporation
Long Beach, California

File No. 28882-604
16 August 2004

HALEY & ALDRICH

1. INTRODUCTION

The purpose of this document is to present the standard operating procedures (SOPs) required for development of the 166 bioremediation amendment wells (AW) and seven groundwater monitoring wells (MWs) in Lot 8 – Parcel C of the former Boeing C-6 facility (Site) in Los Angeles, California. The wells are to be installed as part of the groundwater remediation program for the Site. This document also presents the SOPs to be used for water injection testing if an AW displays low recharge during well development. The development and water injection testing will be overseen by a geologist who will be responsible for ensuring that these standard operating procedures (SOP) are followed.

1.1 Objectives

All newly installed AWs and MWs will be developed prior to use but after the surface seals have been allowed to set for a minimum of 72 hours following well completion. The purposes of well development are to;

- Remove fine-grained formation material from the well which may have entered the well screen during installation;
- Clear fine-grained sediment from the well screen openings to increase hydraulic communication with the filter pack;
- Wash fine grain sediment from the filter pack and increase hydraulic communication with the formation of the water bearing unit; and
- Restore the groundwater properties disturbed during the well installation process.

Removal of fines from the AWs is particularly important, as any fine-grained formation materials could be forced into the formation during amendment injection activities and could inhibit flow and reduce well efficiency.

If any AW displays slow recharge rates during development, a water injection test (WIT) will be performed. The primary purpose of this test is to evaluate the competency of the AW for use as an amendment well. The WIT will also provide hydraulic data that will be used to better plan injection activities.

2. WELL DEVELOPMENT SOP

Development of wells consists of initial development (pre-development) during construction of the well, to settle the filter pack, and development of the well a minimum of 72 hours following placement of the surface seal to wash the well screen and increase hydraulic communication with the formation of the water bearing units. The SOPs for these tasks are described below.

2.1 Pre-Development

Initial development of the AWs and MWs (pre-development) will be performed during emplacement of the well filter pack to ensure that the filter pack has settled. This pre-development procedure is covered in the Well Construction and Destruction SOP (Appendix C, Section 4), but is included here for completeness and cross-reference. Once the well screen and casing are in place, the filter pack material is poured slowly through the annulus between the interior of the hollow-stem augers and the well casing. The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The augers can be withdrawn during the placement of the filter pack sand, but the tip of the augers must remain below the top of the filter pack throughout the process to prevent caving of formation material into the annulus between the borehole and the well screen. Following placement of the filter pack to a level of 1 ft above the top of the screen, the well will be surged for approximately 10 minutes with a vented surge block to settle the filter pack. The level of the filter pack will then be measured and additional filter pack material added, if necessary, to bring the level a minimum of 1 ft above the top of the screen. The well will then be surged for an additional 5 minutes and the filter pack level again measured. This process will continue until no further settlement of the filter pack greater than 0.05 ft is measured.

2.2 Well Development

This section presents the equipment and procedures to be used during well development.

2.2.1 Equipment

The equipment to be used during well development includes the following:

- Well development rig equipped with boom, winch, submersible pump, electric generator, and high pressure washer and steam cleaner;
- 2-inch diameter vented rubber surge block;
- 1.5-inch diameter steel bailer;
- 2-inch diameter submersible electric pump (e.g., Grunfos Redi-Flo 2) with electric cable, steel retaining cable, and Nalgene or Teflon discharge hose;
- Calibrated container and stop watch to measure pump discharge rate;
- 1-liter Imhoff Cone;
- Electronic water level sounder with 0.01 ft increments;
- Level pressure transducer connected to surface data logger with data cable;
- Water quality meters for monitoring pH, electroconductivity, turbidity, temperature, and dissolved oxygen

- Water Development Record form (included in Appendix A of the Implementation Plan)

2.2.2 Well Development Procedures

Prior to development, total depth, the feel of the bottom of the well (i.e., soft or hard bottom), and the static water level in the well will be measured and recorded in the Well Development Record form. A copy of the Well Development Record form is included in Appendix A – Field Forms of the Implementation Plan.

The volume of water contained in the well casing (casing volume) will be calculated using the well diameter, total depth, and the static depth of water measured prior to the start of development activities. The casing column conversion factor for 2-inch inside diameter (ID) schedule 40 Poly vinyl chloride (PVC) well casing is 0.175 gallons per linear foot of casing. Well development will then proceed following the steps below.

1) Wells will first be bailed of any accumulated sediment in the bottom of the well using a steel bailer to remove as much sediment as possible. The bailing time duration, total depth of the well, and volume of water and sediment removed at the end of bailing will be estimated and noted on the Well Development Record.
2) Wells will then be surged using a 2-inch diameter, vented rubber surge block for a period of no less than 1 minute for every linear foot of well screen (a minimum of 20 minutes for a 20 ft length of well screen) to wash water in and out of the well screen through the slotted openings. The surge time duration and total depth of the well will again be measured and recorded on the Well Development Record.
3) The well will again be bailed of any accumulated sediment. The suspended sediment load should be monitored during bailing using a 1-liter Imhoff Cone. Bailing of sediment should be performed until the sediment load decreases to a point that a submersible pump can be used. This point is typically when less than ½- to 1-inch of sediment settles in the bottom of a 1-liter Imhoff Cone. The bailing duration, well total depth, and the volume of water and sediment bailed from the well should again be measured and recorded in the Well Development Record.
4) An electric submersible pump and a water level pressure transducer with data wire leading to the surface will then be inserted into the well and lowered to the pumping depth approximately 2 ft above the base of the well. The transducer's data wire will be connected to a laptop computer for monitoring the water levels during the pumping phase of development. The pre-pumping water level will be measured with an electronic sounder and level transducer activated with water level data recorded every 30 seconds. The simultaneous measurement of the sounder's depth to water level and the transducer's level (height of water column above transducer) reading should be recorded together on the Well Development Record.
5) The submersible pump should be started and adjusted to an initial pumping rate of approximately 2 gallons per minute (gpm). The well should be pumped at 2 gpm for a minimum of 10 minutes to remove suspended sediment. The water level in the well should be monitored with the level transducer data. Every 5 minutes during pumping,

the sediment loading in the discharge water should be monitored with Imhoff Cone and the water quality parameters (i.e., pH, temperature, electroconductivity, turbidity, and dissolved oxygen) monitored with field instruments and recorded in the Well Development Record. The volume of water pumped and the stabilization of the water level at the end of the initial pumping at 2 gpm should also be recorded.

6) If after 10 minutes of pumping at 2 gpm the sediment load in the discharge water remains high (i.e., greater than the sediment loading goal of ¼- to ½-inch of sediment in the base of the Imhoff Cone), the 2 gpm pumping rate should be maintained until the sediment load decreases to less than ¼- to ½-inch in the Imhoff Cone). After the sediment loading goal is reached at the 2 gpm rate, the pumping rate should be increased to approximately 5 gpm for a period of 10 minutes, and the above described monitoring performed.

7) After 10 minutes or if the sediment loading goal is reached (which ever is longer), the discharge rate should be increase to the maximum pumping rate of the pump and the well pumped at this rate until the sediment loading goal is reached. Given the depth of the wells to be developed, 8 gpm is probably the maximum pumping rate possible with the development pump.

8) If the water level in the well drops to the pump intake during pumping, the pumping rate should be decreased until a sustained pumping rate is achieved. The well should be pumped at this sustained rate until the sediment loading goal and the water quality parameters stabilize to within 10 percent of previous readings.

9) If the sediment loading does not decrease to less than ¼- to ½-inch of sediment in the Imhoff Cone within 2 hours of total pumping time, the pump and level transducer should be removed and the well surged for 10 minutes and bailed again to wash fine-grained sediment from the well screen and filter pack, and the pumping process resumed. If the sediment loading goal is not reached with 1 hour of this second pumping phase, the pump should be turned off, but remain in the well with the transducer, and the water level recovery monitored with the level transducer until 80 percent of the static water level is recorded, or 30-minutes, which ever is less. The 80 percent recovery is defined as 80 percent of the distance between the initial static water level and the pumping level measured at the end of the pumping stage. Following this recovery stage, the pump and level transducer can then be removed from the well. The development results should then be evaluated by the Project Team to assess if further development is required or if the well should be identified as unacceptable. If filter pack material is observed in the bailed sediment, video camera logging of the well may be performed to assess the source of the filter pack (e.g., cracked well screen).

10) Once the pump and level transducer are removed from the well, the total depth of the well should be measured and the conditions in the bottom (i.e., hard or soft bottom) of the well recorded in the Well Development Record. This measurement shall be repeated the following day to allow any sediment to settle to the base of the well. If sediment is detected in the base of the well following pump removal or the following day, the well may have to be bailed (with a clean bailer) to remove this sediment.

This sediment may have been washed from the well screen but did not enter the pump intake during the pumping stage and settled in the base of the well.

11) If the sediment loading goal is reached within the 3 hours of total pumping time, the pump should be turned off and the water level recovery monitored as described above until 80 percent of the static level is achieved, or ½-hour of recovery time is measured. The time to achieve 80 percent (or more) recovery should be noted in the Well Development Record.

12) The level transducer data should be saved on the computer with a filename with the AW identification number and date (e.g., filename "AW0022C Devdata 082704.xls") for download and possible further analysis.

13) For MWs, once the sediment loading goal is achieved and the water quality parameters stabilize to within 10 percent of previous readings, development of the MW is considered complete.

14) If an AW takes longer than ½-hour to achieve 80 percent of static water level recovery, the AW should be flagged as a "Slow Recharge Well" and a Water Injection Test (WIT) performed following the WIT SOPs presented in the following section.

15) Following well development, all used equipment (i.e., surge block, bailer, winch cable, pump, electronic sounder, level transducer and data cable, and the water quality meters) should be decontaminated between each well by use of a high pressure washer and steam cleaner, or hand washing with an Alconox solution and a double tap water rinse followed with a distilled water final rinse.

2.2.3 Waste Management

Storage and disposal of the investigation derived wastes (IDW) generated during the well development program will be coordinated with the Boeing Waste Management Specialist Ms. Marcia Taleff a minimum of 2-weeks prior to mobilization for each phase of the program.

Where possible, bailed sediment will be separated from well development water and placed in roll-off bins to be located in a designated waste handling area on the Site. The driller will transport the separated sediment from the well location to the roll-off bins using a soil hopper and a forklift.

Well development water and decontamination rinse water will be placed in a 6,000 gallon holding tank located in a designated waste handling area on the Site. The driller will be responsible for pumping all decon rinse water and well development water into the holding tank. All debris and trash will be collected and disposed of daily by the driller.

All IDW containers will be labeled with an adhesive waterproof label and waterproof marker and catalogued on a daily basis. Each container label will contain the following information:

- Client (generator) identification (name and address);

- Name and phone number of Boeing Waste Management Specialist;
- Date(s) generated;
- Container Contents (example: well cuttings from well AW-112, development purge water from wells AW-97 and AW-98, etc);
- Estimated volume or capacity; and
- Physical state of material (solid or liquid)

The Field Coordinator will be responsible for maintaining a compiled list of all of the IDW containers generated on a daily basis. A waste inventory form is included in Appendix A. This list is to be provided to the Boeing Waste Management Specialist every Friday during the drilling program.

3. AMENDMENT WELL WATER INJECTION TEST SOP

The evaluation of AWs for acceptance will follow the Well Construction Plan flow Chart (Figure 3 of Implementation Plan). During the AW development process described in the proceeding section, AWs will be evaluated as to their recharge capability. If an AW requires more than ½-hour to achieve 80 percent recovery of the static water level once the pumping stage is completed, the AW will be flagged as a "Slow Recharge Well" and a water injection test (WIT) performed. The equipment and SOPs required for the WIT are described below.

3.1 Equipment

The equipment required for the proposed WIT includes the following:

- 500 gallon holding tank with bottom drain fitting and filled with potable tap water mounted on trailer or flatbed truck;
- Electric pump connected between holding tank's bottom drain fitting and manifold capable of pumping up to 30 gpm at a minimum of 25 psi;
- In lieu of use of the holding tank and pump, it may be possible to use long lengths of fire hose and the fire hydrants on Knox Street to provide the water for the WIT;
- Two 25 ft lengths of 1-inch diameter hose with appropriate connections to the pump discharge, the valve manifold, and a 2-inch slip-fit coupling for attachment to the AW wellhead;
- The water test manifold used by Arcadis G&M, Inc. during the Building 2 Area amendment well testing program.
- One combined pressure transducer/datalogger (e.g., Solinist Levellogger) (rated to a minimum 150 ft head);
- Parts for assembling the well-head fitting (2-inch PVC TEE, 2-inch PVC ball valve, pressure gauge [0 to 10 psi range], and fittings to connect hose as shown in Figure 1);
- Water level sounder with 150 ft length.

The PVC TEE should be securely attached to the AW well-head by cementing a 2-inch PVC male adapter to the well casing with PVC cement for one-time use. A 2-inch PVC female adapter can be cemented to the re-usable PVC TEE so the TEE can be used for WITs on other AW wells. This well-head fitting will provide a seal that will sustain the applied pressure (about 15 psi max) during the WIT.

The 2-inch ball valve on top of the well-head allows use of a water level sounder, allows the well casing to be vented as the well casing fills.

Using a pressure transducer with an aboveground datalogger allows the collection and recording of the height of water in the well casing during the WIT. The electronic data cable for the transducer must have a pressure fitting due to the pressurized well. Because this transducer needs to be able to measure the full range of response, which will be as high as 60 psi (120 ft of water), the Soloinst Levellogger can not be used due to its limited response range. An additional transducer and datalogger can be used for nearby AWs or MWs screened in the same water bearing unit to provide for monitoring of water levels in these wells during the WIT. The water level sounder will be used during the WIT to monitor water levels within the casing of the injection well as well as any adjacent AWs or MWs.

3.2 Water Injection Test Procedures

The WIT will be implemented following the Well Construction Plan Flow Chart (Figure 3 in the Implementation Plan). The AW WIT will evaluate the specific injection capacity of the well (i.e. incrementally fill and maintain the water level in the well casing and monitor the injection rate. If the WIT injection rate is greater than 2 gpm, the AW is acceptable for use during the amendment injection program. If the injection rate is less than 2 gpm, the AW shall be rejected for use as an amendment well.

During the WIT, nearby AWs or MWs, if present may be used to provide additional data on the effect of the injection as a secondary check on the response of the WIT on the AW.

The data collected during the WIT will include the following:

- The water level in the injection well and any adjacent AWs or MWs will be recorded during injection, along with the corresponding injection flow rate (read from the digital flow meter).
- The line pressure and flow rate achieved at the maximum pressure setting will be recorded.
- A volume totalizer will be used to monitor the total volume of water injected into the well over the course of testing.

The field log sheet to be used for data collection is included in the Field Forms in Appendix A of the Implementation Plan.

The Stage I atmospheric water injection test will be conducted without applying excess pressure to the well-head. This will simulate the water injection rate under conditions most likely to be applied during future amendment addition events. The WIT shall be conducted as follows:

1) Prior to the test, a City of Los Angeles Hydrant Meter will be attached directly to the fire hydrant source. Fire hydrant sources may be too far away from the AW being testing. In lieu of a fire hydrant source, a 500 gallon mobile holding tank and electrical pump can

be used. All fittings should be secured before commencing the test. The oversight geologist will document the injection equipment used and the fittings used to connect to the well head. Photographs of the equipment should be taken.

2) Check the calibration of the flow meter in the test apparatus, if this has not already been done beforehand.

3) Measure static water level in the injection well.

4) Measure static water level in the adjacent wells that will be used as observation points. The observation wells should be within 50 feet of the AW being tested. Suspend a pressure transducer (if available) in each of the observation wells. Record the position of each logger.

5) Attach the well-head fitting to the well, suspending a pressure transducer connected to a data logger in the well at the same time. The recording interval for the data logger should be set at 15 second intervals. Since this logger will be exposed to the full range of the injection pressure, it needs to have a minimum full-scale response of 150 ft. The Solonist Levelloggers have a reading range of about 62 ft and should not be used. Record the position of the logger.

6) The test should last approximately 30 minutes, or not more than 500 gallons of injected water. During the test, injection flow rates, water levels (pressures) and total volume of water injected should be recorded on the log sheet provided in Appendix A of the Implementation Plan. Periodic water level measurements should be taken from the adjacent observation wells by hand (if available) to confirm the datalogger results.

7) Set the water level sounder to 15 ft above the static water table level. With the well vent valve open to allow air to escape, initiate flow to the well, beginning with a flow rate of 2 to 3 gpm. Gradually increase the flow rate until the water level in the well has risen to the water level sounder sensor. Maintain this sustained atmospheric injection rate for 5 minutes. Record flow rate and water level. Record the water level in the adjacent observation well(s) (if available).

8) Reposition the water level tape 30 ft above the static water level.

9) Increase the flow rate until the water level in the well has risen to 30 ft above the initial (static) level. Maintain this injection rate for 5 minutes. Record flow rate and water level. Record water level in adjacent monitor well(s) (if available).

10) Reposition the water level tape 45 ft above the static water level.

11) Increase the flow rate until the water level in the well has risen to 45 ft above the initial (static) level. Maintain this injection rate for 5 minutes. Record flow rate and water level. Record water level in adjacent observation wells (if available).

12) Reposition the water level tape to 2 ft below the top of the well-head, about 60 ft above the static water level.

13) Increase the flow rate until the water level in the well has risen to the water level sensor (near ground surface), approximately 60 ft above the initial (static) level. Maintain this injection rate for 5 minutes. Record flow rate and water level. Record water level in adjacent observation wells (if used).

14) Stop water addition. Record times and water levels as the water in the casing falls. The logger should capture this information, so the manual measurements will serve as a check on the data. Record water levels in monitor well(s).

Calculate specific capacity (flow rate/height of water in casing) for the four steady-state height of water in casings and injection rates. If the AW can accept injection of water at rates greater than 2 gpm, the AW is acceptable for use. If the injection rate is less than 2 gpm, the AW can not be used, and the cause of the failure of the AW shall be evaluated. And the well replaced.

Following the WIT, all down hole equipment must be decontaminated by hand washing with an Alconox solution, double rinse with tap water, and a final rinse with distilled water.

Well Testing Record forms will be provided to the Boeing Task Manager for review. Data logger data will be graphed and evaluated to assess the specific injection capacity of the AW and AW acceptance or the requirement to destroy the unacceptable well and re-install the AW according to the Well Construction Plan Flow Chart.