Sampling and Analysis Plan
Phase I Pre-Design Investigation

North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Revision 1

September 10, 2012

AMEC Project Number: 4088115718

AMEC Environment & Infrastructure, Inc.
2101 Webster Street, 12th Floor
Oakland, California 94612-3066

amec

September 10, 2012

Mr. Matt Salazar
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Subject: **Sampling and Analysis Plan**
Phase 1 Pre-Design Investigation
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design
AMEC Project 4088115718

Dear Mr. Salazar:

AMEC Environment & Infrastructure, Inc. is pleased to submit this Sampling and Analysis Plan for the North Hollywood Operable Unit on behalf of Lockheed Martin Corporation and Honeywell International Inc., to the U.S. Environmental Protection Agency (USEPA), Region IX. This document has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent for Remedial Design dated February 14, 2011 and revised in response to USEPA comments received on August 10, 2012.

If you have any questions regarding this report, please contact Michael Taraszki at (510) 663-3996.

Sincerely,
AMEC Environment & Infrastructure, Inc.

Michael Taraszki, PG, CHG, PMP
Project Manager

Margaret K. (Peggy) Peischl, PE
Quality Assurance Manager

mt/pp/smm

Enclosure

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Project:	NHOU Second Interim Remedy Groundwater Remediation Design	Project number:	4088115718
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Revision 1

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September 10, 2012

IMPORTANT NOTICE

This document was prepared exclusively for (Honeywell International, Inc. and Lockheed Martin Corporation), by AMEC Environment & Infrastructure, Inc (AMEC). The quality of information contained herein is consistent with the level of effort involved in AMEC services and is based on: (i) information available at the time of preparation, (ii) data supplied by outside sources, and (iii) the assumptions, conditions and qualifications set forth in this document. This document is intended to be used by Honeywell International, Inc., and Lockheed Martin Corporation only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this document by any third party is at that party's sole risk.

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ABBREVIATIONS AND ACRONYMS

1,2,3-TCP	1,2,3-trichloropropane
µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
AOC	Agreement and Order on Consent
CDPH	California Department of Public Health
COC	chemical of concern
CSM	conceptual site model
DI	Deionized
DQO	data quality objective
EDD	electronic data deliverable
ERB	equipment rinsate blank
FSP	Field Sampling Plan
Honeywell	Honeywell International, Inc.
LC	laboratory control
Lockheed Martin	Lockheed Martin Corporation
MCL	maximum contaminant level
MDL	method detection limit
NDMA	n-nitrosodimethylamine
NHE	North Hollywood extraction (well)
NHOU	North Hollywood Operable Unit
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCE	Tetrachloroethene
QA	quality assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	quality control
RD	remedial design
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SFB	San Fernando Valley Basin
SOP	standard operating procedures
TCE	Trichloroethene
ULARA	Upper Los Angeles River Area
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by AMEC Environment & Infrastructure, Inc. (AMEC), on behalf of Honeywell International, Inc. (Honeywell) and Lockheed Martin Corporation (Lockheed Martin) to describe the quality assurance/quality control (QA/QC) procedures to be followed during additional studies to be conducted by AMEC as part of the remedial design (RD) activities for the Second Interim Remedy for the North Hollywood Operable Unit (NHOU; Figure 1-1) in compliance with the U.S. Environmental Protection Agency's (USEPA) Interim Action Record of Decision dated September 30, 2009. Specific QA/QC requirements are included in the Administrative Settlement Agreement and Order on Consent (AOC) for Remedial Design, dated February 21, 2011 (USEPA, 2011). The Second Interim Remedy is intended to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect water supply production well fields, and address emerging chemicals, hexavalent chromium,1,4-dioxane, 1,2,3-trichloropropane (1,2,3-TCP), perchlorate, and n-nitrosodimethylamine (NDMA).

The SAP describes the methods and procedures, documentation, equipment, and materials requirements for expected tasks including piezometer installations, groundwater monitoring and sampling, aquifer testing, sample handling, waste management, and laboratory sample retention and documentation.

As defined in the AOC, this SAP includescomponents of a Quality Assurance Project Plan (QAPP) that is designed to provide a framework of QA/QC procedures for planned activities at NHOU and presents the organization, objectives, planned activities, and common specific QA/QC procedures to be used for the Second Interim Remedy. Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described. Where applicable, components of this document reference information in the Phase 1 Pre-Design Investigation Work Plan (AMEC, 2012a).

This SAP also includes field sampling plans (FSPs) for groundwater monitoring and sampling (Appendix A), drilling and piezometer installation (Appendix B), and aquifer testing (Appendix C) tasks. Specific procedures for the methodology described herein will be addressed as necessary in the FSPs and future project work plans. Additionally, QA/QC procedures and sampling associated with California Department of Public Health (CDPH) policy number 97-005 will be addressed in future addenda to this SAP.

This SAP has been prepared in general compliance with the following U.S. Environmental Protection Agency (USEPA) guidance documents, as specified in the AOC:

- Guidance for Quality Assurance Project Plans (USEPA, 2002a)
- Guidance on Systematic Planning Using the Data Quality Objectives (DQOs) Process (USEPA, 2006a)
- EPA Requirements for Quality Assurance Project Plans (USEPA, 2006b)
- EPA Region IX Sampling and Analysis Plan Guidance and Template (USEPA, 2000)

This SAP was also prepared with consideration of the San Gabriel Valley and San Fernando Valley QAPP (CH2M Hill, 2008), which was coauthored by the USEPA and Los Angeles Regional Water Quality Control Board (RWQCB-LA).

2.0 PROJECT MANAGEMENT

This section provides an overall approach to managing the work within the NHOU study area, including discussion of each of the following approach aspects:

- Project organization, roles, and responsibilities
- Problem definition
- Problem description
- Project DQOs and criteria for measurement of data
- Project method performance objectives
- Special training requirements or certificates required for work performed
- Documentation and records management

2.1 Project Organization and Roles and Responsibilities

This section outlines the management responsibilities of key project personnel and lines of authority and communication. Personnel assigned to management positions are shown on the project organization chart (Figure 2-1). As stated in the AOC, the “Respondent” is identified as Honeywell and Lockheed Martin and the “Contractor” is identified as AMEC. The management responsibilities are as described below.

2.1.1 U.S. Environmental Protection Agency

The USEPA Region IX Project Manager, Mr. Matt Salazar has USEPA oversight responsibility.

2.1.2 Honeywell and Lockheed Martin

The Respondent Project Coordinators, Mr. Benny DeHghi (Honeywell) and Ms. Carolyn Monteith (Lockheed Martin), are responsible for implementing the work and have the authority to commit the resources necessary to meet project objectives and requirements. The Project Coordinators have directed AMEC to prepare this SAP and perform the Second Interim Remedy work. The Project Coordinators will work directly with the Project Manager to ensure that the project objectives and standards are addressed.

2.1.3 AMEC Environment & Infrastructure, Inc.

AMEC is contracted to the Respondent to provide environmental consulting services for this Phase 1 Pre-Design Investigation. The following is an overview of the duties of the AMEC personnel assigned to the Project.

2.1.3.1 Project Principals

The Project Principals, Mr. Warren Chamberlain, PE, PG, CHG, and Mr. Neven Kresic, PhD, PG, PH, CGWP, are responsible for reviewing the technical aspects of the project to ensure that all work elements meet the project objectives and technical standards, and are completed in accordance with the SAP standards.

2.1.3.2 Health and Safety Coordinator

The Health and Safety Coordinator (also known as the Health, Safety, and Environment Coordinator) Mr. Don Kubik, PG, CIH, is responsible for assisting in implementing the applicable requirements of the Integrated Health, Safety and Environment Program Manual within the office or project.

2.1.3.3 Project Manager

The AMEC Project Manager, Mr. Michael Taraszki, PG, CHG, PMP, is responsible for the scope, cost, and technical considerations related to the project; staff and project coordination; and implementation of review of overall project quality related to the collection, completeness, and presentation of data. He will ensure that documents prepared by AMEC follow QA/QC procedures, and he will make final decisions on recommendations, personnel assignments, and submission final reports. The AMEC Project Manager oversees the technical work conducted by the Task Manager, Quality Assurance (QA) activities conducted by the QA Manager, and health and safety activities conducted by the Project Health and Safety Coordinator. The AMEC Project Manger is responsible for all the project files. For the purposes of this SAP, the term “Project Manager” refers to the AMEC Project Manager.

2.1.3.4 Quality Assurance Manager

The QA Manager, Ms. Margaret K. (Peggy) Peischl, PE, is responsible for reviewing the project QA program as it relates to the collection and completeness of data from field and laboratory operations, including training personnel to follow established protocols and procedures. The QA Manager will also be responsible for approving modifications to the SAP as needed and distributing the approved modifications to all parties; reviewing data validation reports prepared by the third-party Data Validator, independent of the laboratory; directing and reviewing the management of data by the project team; and reviewing project deliverables.

2.1.3.5 Data Manager

This individual is responsible for verifying that data validation procedures were followed and completed according to the National Functional Guidelines (USEPA, 2008 and 2010), and coordinating with the providing laboratory oversight. The Data Manager for this project will be Mr. Fred Albrecht. Mr. Albrecht, a Senior Technical Specialist has been trained in data validation and has extensive experience on projects requiring detailed data review. He will submit laboratory reports to the QA Manager and third-party Data Validator within three working days of receiving final, complete analytical reports from the laboratory. Mr. Albrecht will also be responsible for setup and maintenance of the electronic database and electronic data deliverables (EDDs).

2.1.3.6 Task Manager

The project Task Manager, Mr. Mike Barnes, Senior Environmental Scientist, is responsible for executing the planned work elements, issuing specific instructions for performing assigned work elements, and performing and directing the work so it is conducted in compliance with project-specific objectives and applicable QA procedures. The Task Manager will coordinate with the Project Manager and QA Manager to review general work plans and specific work elements. For field sampling activities, the Task Manager will be responsible for performing or overseeing the field work, preparing proper documentation, and sample handling for all sampling activities.

2.1.3.7 Field Team Leaders

AMEC Field Team Leaders will be Ms. Eileen Bailiff, PG, CEG, Senior Geologist for the groundwater monitoring and sampling task; Mr. Damian Hriciga, PG, Project Geologist for the drilling and piezometer installation task; and Mr. Sean Culkin, PG, Project Geologist for the aquifer testing task. The Field Team Leaders have the responsibility for leading and coordinating AMEC activities undertaken during the field investigation tasks as described in the FSPs (Appendices A, B, and C). The Field Team Leaders, who report directly to the AMEC Task Manager and Project Manager, have expertise in geology, hydrogeology, and groundwater monitoring. All field tasks including drilling and piezometer installation activities will be overseen by a California-licensed Professional Geologist and/or a California-licensed Professional Engineer. The Field Team Leaders will be responsible for overseeing and documenting the field activities and coordinating the sampling efforts with the QA Manager and Data Manager; overseeing implementation of the FSP and site-specific Health and Safety Plan (AMEC, 2012b); coordinating field activities with subcontractors, as appropriate; communicating with the project team about potential changes in field conditions that may require modification of the SAP and/or HASP; and assisting with data analysis and preparing project deliverables. The Field Team Leaders maintain all field documentation and deliverables in the project files during the performance of the assigned tasks.

2.1.4 Contract Analytical Laboratory

The contract laboratory's management and technical staff are responsible for actively supporting and implementing the laboratory's quality assurance manual within the laboratory, maintaining rigorous attention to standard operating procedures (SOPs) and enforcing their use in the laboratory, and maintaining a work environment that emphasizes the importance of data quality. The contract laboratory management and technical staff will analyze soil and groundwater samples, assess analytical data, and prepare analytical reports and data packages that meet all the terms and conditions of the SAP. Management and technical staff will include the laboratory director, QA officer, project manager, chemists, technicians, and other specialists as needed. The contract laboratory will report directly to the AMEC Project Manager and QA Manager.

The analytical laboratory for this project will be selected before the field program begins. Information regarding the selected laboratory and laboratory project manager will also be provided as required in the AOC. The Laboratory Project Manager will be the primary laboratory contact for the Field Team Leader and the QA Manager. Personnel organization, responsibility, and training for the analytical laboratory will be provided in the laboratory QA manual.

2.2 Problem Definition

The following subsections summarize the conditions in the area, including the site setting, the local geology and hydrogeology, and the presence of impacted groundwater in the NHOU.

2.2.1 Site Description and Setting

The NHOU is located within the San Fernando Valley groundwater basin, one of several basins within the Los Angeles River Watershed in the County of Los Angeles. The NHOU comprises approximately 4 square miles of contaminated groundwater underlying an area of mixed industrial, commercial, and residential land use in the community of North Hollywood (a district of the City of Los Angeles). The NHOU is approximately 15 miles northwest of downtown Los Angeles immediately west of the City of Burbank, and has approximate site boundaries of Sun Valley and Interstate 5 to the north, State Highway 170 and Lankershim Boulevard to the west, the Burbank Airport to the east, and Burbank Boulevard to the south. North Hollywood has a population of approximately 78,000.

2.2.2 Local Geology and Hydrogeology

The San Fernando Valley Basin (SFB) is an alluvial-filled basin consisting of fine- to coarse-grained sediments in the western portion and coarse-grained sediments (e.g., consisting largely of sand, gravel, and cobbles) in the eastern portion that are derived primarily from the San Gabriel Mountains. Various subunits have been identified within the SFB using geophysical signatures and lithology, but in general, many of the identified units are difficult to correlate across the SFB without use of downhole geophysical data. Within the NHOU study area, however, these units appear to correlate well and suggest relatively flat orientations with little structural dip. Aquifer hydraulic parameters of most units in the SFB suggest relatively high-transmissivity conditions, consistent with a granitic source area and a high-energy depositional environment, also consistent with the mountainous topography surrounding the SFB. Fine-grained units have previously been associated with in situ weathering of granitic feldspar to clay particles and are thus more prevalent with older, deeper sediments (James M. Montgomery, Inc. [JMM], 1992).

Depth Regions 1 through 4 are currently used to describe the aquifer system within the SFB and are based primarily on pumping well perforation zones, but these do not necessarily correspond with geologic or hydrostratigraphic units. An important refinement to the previous hydrogeologic conceptual site model (CSM) is the recognition that Depth Regions 1 and 2, specifically, bisect a finer-grained unit, within which most chemical of concern (COC) mass occurs. This unit has been recognized previously and has been referred to as the “Middle Zone” (JMM, 1992) and, in part, the “AA Group” by the Upper Los Angeles River Area (ULARA) Watermaster; however, neither definition encapsulates the importance of this unit with regarding the NHOU design. A refined CSM was presented in the Final Data Gap Analysis prepared by AMEC in March 2012 (AMEC, 2012c), which defined the "A-Zone" as saturated sediments that include the AA group and shallower sediment units throughout the NHOU study area. The base of the A-Zone (approximately 350 feet bgs) extends 20 to 80 feet below the base of Depth Region 1 and encapsulates the majority of sediments within which most COC mass remains that requires remedial action. Because the top of the A-Zone is defined by the water table, this denomination also includes the relatively thin “Shallow Zone”, as referred to in the 1992 Remedial Investigation report (JMM, 1992).

The A-Zone overlies a coarse-grained unit referred to by the ULARA Watermaster as the “BB Group”, which is included in Depth Region 2. The refined CSM refers to this unit as the “B-Zone”, the base of which is generally consistent with the base of Depth Region 2

2.2.3 Impacts to NHOU Groundwater

Volatile organic compound (VOC) contamination, primarily trichloroethene (TCE) and tetrachloroethene (PCE), in groundwater beneath the community of North Hollywood, California, is currently being addressed by the existing NHOU Extraction and Treatment System. The existing NHOU Extraction and Treatment System consists of eight groundwater extraction wells

(NHE) (NHE-1 through NHE-8), which is designed to achieve VOC plume containment and reduction of VOC contaminant mass using groundwater extraction, air stripping, and vapor-phase granular activated carbon treatment. The system began operating in December 1989 and remains in operation today. The treated water, which is delivered to the water supply system for the City of Los Angeles, has consistently had levels of TCE and PCE well below the maximum contaminant level (MCL) for drinking water of 5 micrograms per liter (µg/L).

Although the existing NHOU Extraction and Treatment System has reduced contaminant migration in the groundwater and removed substantial VOC mass from the aquifer, VOC concentrations remain above MCLs in groundwater. In addition, changing groundwater conditions and pumping patterns in the SFB and the discovery of VOC contamination in new areas have demonstrated that the existing NHOU Extraction and Treatment System is not capable of fully containing the VOC plume. Hexavalent chromium and emerging chemicals have also been detected in the NHOU study area in excess of MCLs or state notification levels. The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals. The CDPH advised Los Angeles Department of Water and Power to shut down well NHE-2 on February 14, 2007 because the high concentration of chromium (hexavalent and total chromium) in groundwater extracted from the well was largely responsible for a total chromium concentration in the combined effluent from the NHOU Central Treatment Facility exceeding 30 µg/L, equivalent to 60 percent of the 50 µg/L MCL.

Recognizing the significance of the COC distribution in the A-Zone is important to understanding the potential mass migration pathways through vertical conduits at active and formerly active production wells. Many production wells in the North Hollywood area were constructed with multiple perforation zones that allow COCs to rapidly migrate from the A-Zone to deeper units in response to seasonal or pumping-induced vertical gradients. These pathways need to be blocked to allow the NHOU Extraction and Treatment System to protect surrounding active production well fields from continued COC mass migration.

2.3 Problem Description

The following problem statements are relevant to the work for this Project:

- Additional characterization of groundwater flow and quality in the NHOU is needed to ensure that the Second Interim Remedy design will achieve remedial action objectives specified in the AOC and meet CDPH 97-005 requirements.
- Additional data are needed to further delineate the lateral and vertical distribution of COCs in the NHOU study area.
- Additional data are needed to estimate hydraulic parameters specific to the A- and B-Zones; these estimates are needed to accurately simulate groundwater flow directions, hydraulic capture areas, and influent pumping rates to the new treatment system.
- Not all wells used for groundwater monitoring have been surveyed to the same vertical datum, and reference elevations on old wells may have changed since they were originally surveyed.

To address the issues identified in the problem statements above additional wells will be installed in order to collect additional water quality data within the A- and B-Zones. Aquifer testing will be conducted to gain a better understanding of the hydraulic parameters within the A- and B-Zones to update the CSM for design of the groundwater containment and treatment system. Groundwater elevations will be calculated to better understand regional flow and groundwater samples will be analyzed for the constituents shown in Table 2-1 including TCE and PCE, hexavalent chromium, 1,2,3-TCP, 1,4-dioxane, perchlorate, and NDMA to provide additional information regarding the vertical and lateral extent of COCs. Analytical results for cations, anions, total hardness, total alkalinity, total dissolved solids, pH, and specific conductance will provide information regarding the general chemical character of the groundwater. This information will be used by AMEC in evaluating the RD.

2.3.1 Potential Measurements

Various types of measurements may be collected in the NHOU study area during implementation of the Second Interim Remedy. Task-specific measurements, procedures, and protocols are identified in each FSP (Appendices A, B, and C) and in each proposed work plan prepared according to the AOC. The following types of measurements may be collected:

- Borehole geophysical data
- Analytical chemical data for groundwater and treatment system effluent
- Depths to groundwater
- Intra-well groundwater vertical flow rates
- Vertical elevations and horizontal location of borings and wells

Analytes that will be tested for are listed in Table 2-1. The primary target analytes associated with the NHOU are VOCs (including TCE and PCE), total and hexavalent chromium, 1,4-dioxane, and other emerging chemicals (e.g. NDMA, 1,2,3-TCP, and perchlorate). Groundwater samples previously collected from monitoring wells in the NHOU study area have been analyzed for VOCs using EPA Test Method 8260; EPA Test Method 524.2 will be considered if lower method detection limits are warranted. Analytical results for cations, anions, total hardness, alkalinity, total dissolved solids, and field water quality parameters for pH, and specific conductance will provide information about the general chemical character of the groundwater; this information will be used by AMEC in developing the RD.

2.3.2 Applicable Technical Quality Standards and Criteria

The potentially applicable regulatory standards or guidelines that will be used to screen the groundwater data include:

- USEPA or California EPA MCLs. In the absence of MCLs, California Department of Health Notification Levels (CDPH, 2010), USEPA Region IX Preliminary Remediation Goals (USEPA, 2012) or other USEPA-mandated cleanup levels will be used.

The applicable performance standards for the target compounds are stipulated in the AOC scope of work and are summarized in the table below.

Analyte	Performance Standard[1]
TCE	5 µg/L[2]
PCE	5 µg/L
1,1-Dichloroethane	5 µg/L
1,2-Dichhloroethane	0.5 µg/L
1,1-Dichloroethene	6 µg/L
cis-1,2-Dichloroethene	6 µg/L
1,1,2-Trichloroethane	5 µg/L
Carbon tetrachloride	0.5 µg/L
Methylene chloride	5 µg/L
Total chromium	50 µg/L
Hexavalent chromium	5 µg/L
Perchlorate	6 µg/L
1,2,3-TCP	0.005 µg/L
1,4-Dioxane	1 µg/L[3]
NDMA	0.01 µg/L

2.3.3 Special Equipment and Personnel Requirements

Personnel who are trained to work and/or take measurements and samples as described in the FSPs will be used for this project. The equipment used for the work may include drilling rigs; low-flow bladder pumps and controls; depth-discrete water sampling tools (e.g., HydroPunch, HydraSleeve, passive diffusion bags, or equivalent); electric water level sounders; submersible pumps; water discharge piping and tubing; pressure transducers; flow meters; and photoionization detectors.

2.3.4 Assessment Techniques

Assessment of field operations and laboratory operations are required for the anticipated work. To evaluate the performance of field operations, frequent reviews may be conducted of sample collection documentation, chain-of-custody forms, and field records and measurements. Unannounced field operation audits may be conducted. To evaluate the performance of the selected analytical laboratory, an internal audit program will be implemented to assess the laboratory's adherence to its own policies and procedures. Additionally, for each task, the Project Manager and/or Task Manager will be in frequent contact with the analytical laboratory to assess progress in meeting DQOs and to identify problems requiring corrective action.

Specific details of assessment procedures can be found in Section 4.0.

2.3.5 Project Records and Reports

Critical records for the work will be maintained at AMEC's Oakland, California, office. File maintenance will be under the direct control of the Task Manager. Project records will be

[1] The CDPH permitting process may require lower concentrations in the treated effluent
[2] µg/L = micrograms per liter
[3] The 1,4-dioxane notification limit was lowered from 3 µg/L to 1 µg/L in November 2010

organized with a project-specific file and document numbering system in accordance with AMEC's file retention policies. The following records will be retained for the project:

- Daily field records or field notes
- Boring and Well Construction logs
- Well development records
- Well sampling records
- Well monitoring records
- Field instrument calibration sheets
- Aquifer testing records
- Investigation-derived waste inventory
- Chain of custody records
- Sample control logs
- Laboratory reports
- Summary report of the results.

These records are internal documents and may be included in the Phase 1 Pre-Design findings report ("Findings Report") for the project. Data and document management is discussed in Section 3.10.

Project reports (external reports) summarizing the planned field investigations, chemical analytical programs, and technical evaluations will be submitted to the USEPA Project Manager. The anticipated technical documents are this SAP (including the FSPs), the Work Plan, and the Findings Report.

The Findings Report will be prepared by the team members, including the Project Manager and the Task Manager, to summarize the work performed, the results of the laboratory analyses, and the results of the data review and validation. The report, which will be reviewed for quality-control purposes by the Project Principals, will include a summary table for the analytical laboratory results for the analyses performed and will be used to transmit copies of the field records, laboratory analytical results, data review and validation forms. In the event that the results of the laboratory analyses do not meet project objectives, the Findings Report will include a discussion of data usability.

2.3.6 Work Schedule

The schedule for each task performed under the AOC will be presented in the task-specific work plans prepared for each investigative phase and remedial measure as approved by the USEPA. The current NHOU project schedule was provided to the USEPA on March 14, 2012 and is included in Appendix D; schedule revisions will be provided to the USEPA as needed.

2.4 Data Quality Objectives

Data collected at a site need to be of sufficient quality and quantity to support defensible decision making. DQOs are identified before the sampling and analysis begin. They will be used to ascertain the type, quality, and quantity of data necessary to address problems. The USEPA guidance document, QA-G4 (USEPA, 2006a) outlines a seven-step process for establishing DQOs. These steps are as follows:

1. **State the Problem.** Concisely describe the problem to be studied.
2. **Identify the Decision.** Identify the decision that will solve the problem using data.
3. **Identify the Inputs to the Decision.** Identify the information needed and the resulting measurements that need to be made in order to support the decision
4. **Define the Study Boundaries.** Specify the conditions (time periods, spatial areas, and situations) to which the decision will apply and within which the data will be collected.
5. **Develop a Decision Rule.** Define the conditions by which the decision-maker will choose among alternative risk management actions. This is usually specified in the form of an "if…then…" statement.
6. **Specify acceptable limits on decision errors.** Define in statistical terms the decision-maker's acceptable error rate based on the consequence of making an incorrect decision.
7. **Optimize the Design for Obtaining Data.** Evaluate the results of the previous steps and develop the most resource-efficient design for data collection that meets all of the DQOs.

Specific DQOs have been developed for each of the three FSPs (Appendices A, B, and C, respectively) to address groundwater sampling, drilling and piezometer installation, and aquifer testing activities.

2.5 Method Performance Objectives

Analytical performance requirements for work performed are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). Each PARCCS parameter is discussed below. A summary of the PARCCS parameters, frequency, and acceptance criteria is included in Table 2-2.

2.5.1 Precision

Precision is a measurement of the degree of agreement of replicate data. Replicate data is quantitatively assessed based on the relative percent difference (RPD) or standard deviation.

2.5.1.1 Field Precision

Field precision will be assessed through the collection and measurement of one field duplicate set of samples for every 10 or fewer samples. Duplicate samples will be analyzed to check for overall variability introduced by sampling and analytical procedures.

2.5.1.2 Laboratory Precision

Laboratory precision accuracy is assessed by calculating RPDs for two replicate samples. The precision of the analysis can be inferred through one of the following: laboratory control duplicate samples; matrix spike (MS) and matrix spike duplicate (MSD) samples, or unspiked duplicate samples. The laboratory analyzes one or more of these duplicate samples at a rate of one per batch of 20 samples per matrix.

The MS/MSD samples provide information about the effect of the sample matrix on extraction and measurement methodology. An MS/MSD pair will be analyzed at a rate of one per batch of 20 or fewer investigative samples per matrix.

The precision of laboratory analyses will be assessed by calculating the RPD for each pair of duplicate samples (MS/MSD), laboratory control (LC) sample spike duplicates, unspiked duplicate samples, and field duplicate sets using the following equation:

$$\% \ RPD = \frac{S_1 - S_2}{S_{av}} \ x \ 100$$

where:

S1 = first sample result (original or MS value)

S2 = second sample result (duplicate or MSD value)

Sav = average of sample and duplicate = (S1 + S2)/2

2.5.2 Accuracy

Accuracy is the degree of agreement between a measurement or observation and an accepted value.

2.5.2.1 Field Accuracy

Field accuracy, assessed through appropriate field equipment and trip blanks, is achieved by adhering to all sampling, handling, preservation, and holding time requirements. Field blank samples are analyzed to check for possible procedural contamination that could affect samples. Equipment rinse blanks are used to assess the adequacy of decontamination of sampling equipment between individual sample collections. Trip blanks are used to assess the potential for contamination of samples due to migration of contaminants (e.g., VOCs) during sample shipment, handling, and/or storage. Accuracy of field instruments is assessed by daily instrument calibration and calibration checks.

2.5.2.2 Laboratory Accuracy

Laboratory accuracy is assessed by analyzing MS samples and LC samples. The results are expressed as a percent recovery. Surrogate recoveries may also be used to assess accuracy. Method blanks are used to assess possible contamination from laboratory procedures. LC samples, method blanks, and preparation blanks will be analyzed at least once with each analytical batch, with a minimum of one for every 20 samples. The percent recovery is calculated with the following equation:

$$\% R = \frac{A - B}{C} x\, 100$$

where:

A = The sample result

B = The background level determined by a separate analysis of the unspiked sample

C = The amount of the spike added

2.5.3 Representativeness

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter used to evaluate the efficacy of the sampling plan design. Representativeness is demonstrated in the project planning documents by providing full descriptions of the sampling techniques and the rationale used for selecting sampling locations. The measure of representativeness is established during preparation of the sampling and analysis approach and rationale, and then reassessed during the data usability process. Numerical goals cannot be used to evaluate this subjective measure.

2.5.4 Completeness

Completeness is a measure of the quantity of valid data obtained from a measurement system compared to the quantity that was planned under normal conditions. Percent completeness is calculated with the following equation:

$$\% \, Completeness = \frac{Valid \; Data \; Obtained}{Total \; Data \; Planned} \, \mathrm{x}\, 100$$

Experience on similar projects has shown that a reasonable goal, considering combined historical field and laboratory performance, is 90 percent completeness. If insufficient valid data are obtained, the Project Manager will initiate corrective action.

2.5.5 Comparability

Comparability expresses the confidence with which one data set can be compared with another data set obtained during parallel or previous investigations. Comparability can be related to precision and accuracy because these parameters are measures of data reliability.

Chemical samples from the same media generally are considered comparable if the same procedures for collecting and analyzing the samples are used, if the samples comply with the same QA/QC procedures, and if the units of measurement are the same. To provide comparability, all data generated will be subject to the QA/QC procedures specified in this SAP and each FSP.

2.5.6 Sensitivity

Sensitivity is the measure of the concentration at which an analytical method can positively identify and report analytical results. The sensitivity of a given method commonly is referred to as the detection limit. Although there is no single definition of this term, the following terms and definition of detection limits will be used.

- Instrument detection limit is the minimum concentration that can be measured as distinct from instrument background noise under ideal conditions.
- Method detection limit (MDL) is a statistically determined concentration. It is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero as determined in the same or a similar matrix. Because of the lack of analytical precision in this range, sample results greater than the MDL but less than the reporting limit (RL) will be reported as estimated and flagged with a "J".
- RL is the concentration of the target analyte that the laboratory has demonstrated the ability to measure within specified limits of precision and accuracy during routine laboratory operating conditions. This value is variable and highly matrix-dependent. It is the minimum concentration that the laboratory will report as unqualified.

For sensitivity, the quality objective is to analyze data using a method that achieves RLs that are below or equal to the task-specific target analysis goals or concentrations. The RLs for analytes anticipated for this work are presented in Table 2-1.

2.6 Special Training Requirements and Certification

The training requirements and certifications associated with major roles on this project:

- Project management: The Project Manager is responsible for assembling a project team who have the necessary experience and technical skills. Part of the process is to identify special training requirements or certifications necessary to successfully execute the project. Specific professional registrations are not required for this work; however, all technical documents will be reviewed and signed by the following individuals: AMEC Project Manager, a Professional Geologist registered in California, a Certified Hydrogeologist in California, and an experienced environmental professional.
- Data validation: Data review and validation will be performed by technical personnel experienced with the requirements of the USEPA National Functional Guidelines for Inorganic and Organic Data Review under the direction of the project QA Manager.
- Geologic records: All geologic plans, specifications, reports, or documents will be prepared by a professional geologist or registered certified specialty geologist, or by a subordinate employee under the geologist's direction. These records must also be either signed or stamped with the seal of the professional geologist or registered certified specialty geologist.
- Health and safety: The HASP will be signed by a certified industrial hygienist. All field personnel will have the appropriate health and safety training as specified in the HASP.

2.7 Documentation and Records

This section identifies critical field and laboratory records required for most sampling work, the information to be included in reports, the format for reporting data in analytical data report packages, and the document control procedures to be used.

2.7.1 Required Records

The critical records required for the project include field and laboratory records, and technical reports. Field records are described in Section 3.1.1; critical laboratory records are described in Section 2.7.2. As discussed in Section 2.3.5, the following technical reports (external reports) are anticipated for this project: this SAP (including FSPs) and a Findings Report to describe work to be conducted and associated observations.

2.7.2 Laboratory Records

All analytical results for groundwater samples will be reported in the laboratory's approved format, as described below. In addition to the reported data, the laboratory data report will, at a minimum, include a narrative that will discuss any problems or discrepancies, and will provide sufficient calibration and quality control (QC) information to determine that the method was within control limits at the time that the samples were analyzed. The laboratory data report will consist of the following records:

- Case narrative
- Chain-of-custody documentation (external)
- Final analyte concentration including reporting limit, laboratory qualifiers, and re-analyses
- Laboratory sample ID, field sample ID, matrix, and dilution factors
- Sample collection receipt, extraction, and analysis dates for holding time validation
- Percent recovery of each surrogate
- Surrogate recovery control limits
- Percent recovery of each compound in the MS sample
- MS recovery control limits
- RPD for all MS/MSD results
- RPD control limits for MS/MSD reports
- LCS results when analyzed
- Recovery control limits for LCS
- Condition and temperature of samples upon receipt
- Results for method blanks, field blanks, equipment blanks, and trip blanks
- Method blank summary indicating associated samples.

In addition to the hard-copy report requirements, the laboratory will provide electronic data deliverables (EDDs) conforming to one or more of the following formats for all data reported, as specified: ASCII comma-delimited; Microsoft Excel; EarthSoft, Inc. EQuIS (or equivalent); Honeywell Environmental Information Management System (Locus Software); and/or RWQCB GeoTracker. The standard laboratory turnaround time will be 10 working days.

Information regarding GeoTracker may be found at: http://geotracker.swrcb.ca.gov/. The AMEC Data Manager will have the responsibility for obtaining and tracking GeoTracker deliverables and ensuring that data uploads are completed in a timely manner.

The laboratory's internal records management protocols will be described in its QA manual.

2.7.3 Records Maintenance and Storage

All documents relating to the project will be controlled to provide proper distribution, filing, and retrieval, and to ensure that revisions are properly recorded, distributed, and filed. Project records will be stored and maintained by AMEC personnel. The AMEC Project Manager is responsible for organizing, storing, and cataloging all project information including field documentation managed and maintained by the Field Team Leaders. The Project Manager is also responsible for collecting records and supporting data from project team members. Once cataloged, project records are filed by category in the appropriate project file. Filed documents are available to AMEC staff through checkout procedures developed to protect the integrity of project files. Individual project team members may maintain separate files or notebooks for individual tasks, but all such documents will eventually be incorporated into the project files. Additional information on records management can be found in Section 3.10 of this SAP.

3.0 MEASUREMENT AND DATA ACQUISITION

This section describes the design and implementation of measurement procedures and discusses the methods to be used for sampling, analysis, data handling, and QC in support of the tasks performed. The following specific aspects of measurement and data acquisition will be covered in this section:

- Design of sampling process
- Requirements for sampling methods
- Requirements for sample handling and custody
- Requirements for analytical methods
- QC requirements
- Requirements for instrument/equipment testing, inspection, and maintenance
- Instrument calibration and frequency
- Requirements for inspection and acceptance of supplies and consumables
- Requirements for data acquisition
- Data management.

3.1 Sampling Process Design

The planned sampling locations and rationale for their selection is discussed in the FSPs, and the analytical parameters are shown in Table 2-1. The measurements to be taken and media to be sampled will likely include the following:

- Geologic and physical properties of soil samples
- Depths to groundwater
- Physical properties of groundwater samples (e.g. temperature)
- Analytical chemistry for groundwater samples
- Flow measurements for groundwater
- Aquifer hydraulic properties.

3.1.1 Field Sampling Documentation

The Field Team Leader and other field sampling team members will maintain field records to provide a daily record of significant events, observations, and measurements during sampling. All information pertinent to sampling will be recorded in the field notes or on activity-specific data forms. Each day's field record entries, which will be signed and dated, will consist of the following information:

- Date and time of entry, and weather and environmental conditions during the field activity
- Project name and number

- Location of sampling activity
- Name of field crew members
- Name of site visitors
- Sample media (e.g., groundwater)
- Sample collection method (e.g., low-flow bladder pump)
- Number of samples taken.

When activity-specific data forms are used, entries will include the following additional information:

- Investigation location
- Sampler's initials
- Sampling medium
- Sampling method.

The following information will be recorded either on the field notes or on the activity-specific data forms:

- Volume and number of samples taken
- Date and time of collection
- Sample depth
- Sample identification number(s), including well name and/or number
- Sample destination (e.g., analytical laboratory)
- Water-level measurement data
- Field observations
- Field measurements (e.g., pH, temperature, and conductivity)
- Sample handling (e.g., preservatives used).

Applicable field data and sampling forms for each task are presented in the respective FSPs (Appendices A, B, and C).

Original data recorded in field notes, field data forms, sample labels, and chain-of-custody forms must be written with waterproof, indelible ink. None of these documents are to be destroyed or discarded, even if one is illegible or contains inaccuracies requiring document replacement. If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by drawing a line through the error, entering the correct information, and initialing and dating the correction. The erroneous information will not be removed. The person who made the entry will correct any subsequent error discovered on an accountable document, and that correction will be initialed and dated.

In addition to daily field records, photographs will be taken to document representative field procedures. When a photograph is taken, the date, time, weather conditions (if applicable), subject, purpose for the photograph, and number of photograph will be recorded on a Daily Field Record form. Site-specific baseline photographs will be taken before field work begins.

3.1.2 Sample Identification

The method of sample identification used depends on the sample collection date, type of sample and the sampler or sampling team. Sample identification numbers will be unique. The following sample identification methodology will be used:

- YY = Year
- MM Month
- DD = Day
- X = One letter ID assigned to each sampler or team
- 000 = Three-digit sequence number for each sampler or team for that day
- F = Sample Type (including one of the following options)
  - F = Regular Field Sample
  - D = Duplicate
  - T = Field Trip Blank
  - E = Field Equipment Blank
  - B = Field Blank

The field analysis data are recorded either in field notes or on data sheets, along with sample identity information while in the custody of the sampling team. A sample label will be completed and attached to each sample container for every sample collected. Labels consist of a waterproof material backed with a water-resistant adhesive. Labels are to be filled out using waterproof ink and are to contain, at a minimum, the following information:

- Project number
- Sampling date and time
- Sample identification number
- Location number (including well/boring name and/or number)
- Preservatives (if any)
- Sampler's initials
- Analyses to be conducted.

Each analytical sample will be assigned a unique number consisting of an alphanumeric code that identifies the specific sampling location. These numbers will be tracked from collection through laboratory analysis and will be used in the final reports. The sample number will be cross-referenced with the sample location on the chain-of-custody form. Additional sample volume will be collected for samples identified by the Task Manager for laboratory QC (e.g., MS/MSD).

3.2 Field Methods and Procedures

This section provides a brief description of the field methods and procedures to be used for the field tasks outlined in this SAP. FSPs in Appendices A, B, and C present a detailed discussion of methods and procedures, documentation, equipment, and materials requirements for the field tasks including: piezometer installations; groundwater monitoring, sampling, and flow monitoring; aquifer testing; sample handling; waste management; and laboratory sample retention and documentation.

3.2.1 Groundwater Sample Collection and Flow Monitoring

Groundwater sampling activities will be performed at selected well locations to further delineate the lateral and vertical distribution of COCs in the NHOU study area. Discrete samples from the A-Zone and B-Zone will be collected in spring and fall using low-flow sampling and/or passive sampling systems to represent seasonal conditions and further delineate COC distributions in each zone. Additional A-Zone and B-Zone samples will be collected from selected extraction wells to further evaluate the lateral and vertical distribution of COCs that may be present in this area. Groundwater samples will be analyzed for COCs including: VOCs, 1,4-dioxane, 1,2,3-TCP, NDMA, perchlorate, hexavalent and total chromium, and major ions. Specific analytical methods are listed in Table 2-1 and are detailed in the FSPs.

Depth to water will be measured quarterly at selected existing monitoring wells using an electronic sounder. Wells to be used for this phase of work will be surveyed by a licensed surveyor to a common vertical elevation datum to better estimate groundwater flow directions and gradients.

Vertical flow logs will be generated using an electromagnetic borehole flow meter at selected existing monitoring wells during the spring and fall seasons to evaluate the magnitude and direction of vertical flow through long-screened monitoring wells in response to seasonal pumping patterns.

Details regarding this task are presented in Appendix A.

3.2.2 Piezometer Installation

Three sets of piezometer couplets (i.e., two co-located, hydraulically isolated piezometers to monitor groundwater conditions at different depths) will be installed using mud-rotary drilling methods adjacent to existing extraction wells NHE-3, NHE-5, and NHE-7.

During drilling of the boreholes for the new piezometers, discrete soil samples will be collected from the A-Zone and B-Zone using a wire-line coring system to assess soil characteristics that may result in or limit COC attenuation within the A-Zone.

The shallower well screen will be consistent with the associated NHE screen interval, pending review of geologic and geophysical observations. The deeper well screen will target the A-Zone beneath the associated NHE screen interval. The wells will be constructed of 3-inch diameter schedule 80 polyvinyl chloride materials. The wells will be developed using appropriate bailing, swabbing, surging, air-lifting, and/or pumping techniques.

In addition to developing the new piezometers, each extraction well to be used for aquifer testing will be video-inspected and, if deemed necessary, re-developed to potentially improve their performance. Results from this step will be used to consider potential benefits to rehabilitating other NHOU extraction wells. The same drilling subcontractor responsible for installing and developing the piezometers will be responsible for removing the existing pumps from the NHOU extraction wells, performing the video log and, if deemed necessary, redeveloping the extraction wells.

Details regarding this task, including stabilization parameters used to determine when piezometer development is complete, are presented in Appendix B.

3.2.3 Aquifer Testing

Slug tests will be performed using either pneumatic or solid slug test methods at existing monitoring wells to estimate A-Zone and B-Zone hydraulic parameters (e.g., hydraulic conductivity).

Aquifer testing will be performed at selected extraction wells. Upon completion of the rehabilitation task (as discussed in Appendix B), each extraction well pump will be reinstalled and operated for at least 48 hours (to a maximum of 72 hours) at a constant discharge rate. Pressure transducers with data logging capabilities will be installed in the pumping extraction well and at nearby observation wells before the aquifer testing begins. Drawdown and recovery will be monitored continuously at each extraction well and adjacent piezometer.

Drawdown and recovery data observed during each test will be used to estimate A-Zone hydraulic parameters, including hydraulic conductivity and storativity. These data will be used to estimate the lateral and vertical extent of influence from each tested extraction well.

Details regarding this task, including drawdown stabilization criteria that will be used to terminate the pumping test, are presented in Appendix C.

3.2.4 Support Facilities for Sampling Methods

The laboratory that will analyze samples collected by these methods will be state-certified and will be selected before the field program begins.

3.2.5 Sampling/Measurement System Failure Response and Corrective Action

If QC observations and/or field audits detect unacceptable conditions or data, the Project Manager, together with the QA Manager, will be responsible for developing and directing implementation of corrective actions. Corrective actions will include one or more of the following:

- Identifying the source of the violation
- Evaluating and amending sampling and analytical procedures
- Accepting data but flagging it to indicate the level of uncertainty associated with failure to meet the specified QC performance criteria.

Any finding in the field or laboratory that requires corrective action must be documented and notification must be provided to the Project Manager. The QA Manager will check that corrective actions have been implemented and that the problem has been resolved. If a problem can be addressed relatively easily, it will be addressed and the corrective action noted in the appropriate laboratory or field data form.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by drawing a line through the error, entering the correct information, and initialing and dating the correction. The erroneous information will not be removed. The person who made the entry will correct any subsequent error discovered on an accountable document, and that correction will be initialed and dated.

3.2.6 Sample Equipment, Preservation, and Holding Time Requirements

The sample containers, preservative requirements, and maximum holding times for the analytical methods are presented in Table 2-1. Before the samples are submitted to the laboratory, the QA Manager will confirm that the laboratory can meet the detection and reporting limits needed for this project.

3.3 Sample Handling and Custody Requirements

Proper sample handling, appropriate shipment, and maintenance of chain-of-custody records are essential to building the documentation and support for data that can be used to make program decisions. Requirements for sample handling and chain of custody must be met for all samples collected in a complete, accurate, and consistent manner.

3.3.1 Sample Custody

Sample custody and documentation procedures described herein must be followed throughout sample collection activities. Components of sample custody procedures include the use of field notes, sample labels, custody seals, and chain-of-custody forms. The chain-of-custody forms must accompany the samples during shipment from the field to the laboratory.

A sample is in custody under the any of the following conditions:

- It is in a person's possession
- It is in a person's view after being in his or her physical possession
- It was in a person's physical possession and that person placed the sample in a locked area to prevent tampering
- It is in a designated and identified secure area.

The following procedures must be used to document, establish, and maintain custody of field samples.

- A label will be completed and attached to each sample container for every sample collected. Labels consist of a waterproof material backed with a water-resistant adhesive. Labels are to be filled out legibly using waterproof ink and then affixed firmly on the sample container. Sample labels are to contain, at a minimum, the following information: AMEC project number, sampling date and time; sample identification number; preservatives, if any; sampler's initials; and analyses to be conducted. The sample label will not indicate the project name by site or collection location; that information will be recorded in the field notes and on activity-specific data forms.
- All sample-related information must be recorded in the field notes or on activity-specific data forms.
- A custody seal will be placed on each sample before shipment to the laboratory.

- The field sampler must retain custody of samples until they are transferred or properly dispatched.
- To simplify the chain-of-custody record and minimize potential problems, as few people as possible should handle samples or physical evidence. For this reason, one individual from the field sampling team should be designated as the responsible individual for all sample transfer activities. This individual will be responsible for the care and custody of the samples until they are properly transferred to another person or facility.
- A chain-of-custody record will accompany all samples. This record documents the transfer of custody of samples from the field investigator to another person, the laboratory, or another organizational entity. Signatures that acknowledge relinquishment and receipt of the samples must accompany each change of possession. Chain-of-custody records will be prepared for groups of samples collected at a given location on a given day. A chain-of-custody form will accompany every shipment of samples to the laboratory. A copy of each chain-of-custody form will be made and retained in the project file.
- The chain-of-custody form makes provision for documenting sample integrity and the identity of persons involved in sample transfer. The following information will be entered on the chain-of-custody form:
  - AMEC project number
  - Chain-of-custody form serial number
  - Number of containers/samples
  - Sample numbers
  - Sampler/recorder’s signature
  - Date and time of collection of each sample
  - Sample type
  - Analyses requested
  - Inclusive dates of possession
  - Name of person receiving the sample
  - Laboratory sample number
  - Date of receipt of sample
  - MS/MSD samples.

Completed chain-of-custody forms will be inserted into a plastic cover and placed inside the container used to transport samples from the field to the laboratory. A copy of a typical chain-of-custody form to be used is included in the FSPs**.** When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill will be recorded on the chain-of-custody form.

3.3.2 Sample Packing and Shipping

Field personnel, laboratory couriers, or commercial shipping services (e.g., UPS or Federal Express) will deliver samples to the designated laboratory. The method of shipment will be noted on the chain-of-custody form. During the field effort, the Field Team Leader or a designee will inform the laboratory daily of planned shipments. Hard plastic coolers will be used for shipping samples. The coolers must be able to withstand a 4-foot drop onto solid concrete in the position most likely to cause damage; the samples must be cushioned so as to sustain the least amount of damage if such a fall should occur. After packing is complete, the cooler will be taped shut. Custody seals will be affixed across the joints between the cooler lid and body.

The following procedures must be used when transferring samples for shipment.

- A chain-of-custody record must accompany samples. When transferring possession of samples, the individuals relinquishing and receiving must sign, date, and note the time on the record. This record documents transfer of custody of samples from the field sampler to another person or to the laboratory. Overnight shipping companies will not be required to sign the chain-of-custody record. A copy of the receipt of shipment will accompany the chain-of-custody record.
- Samples must be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a signed chain-of-custody record for each shipment.
- A chain-of-custody record identifying the contents must accompany all shipments. The original record must accompany the shipment, and the Field Team Leader must retain a copy.
- A temperature blank will be included in each cooler.

3.3.3 Laboratory Sample Handling and Custody

The Task Manager or Field Team Leader will notify the Laboratory Project Manager of upcoming field-sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information about the number and type of samples to be shipped, analyses requested, and the expected date of arrival. The Laboratory Project Manager will notify appropriate laboratory personnel, including the sample custodian, about the expected shipment. When the samples arrive at the laboratory, they will be received and logged in by a trained sample custodian in accordance with the laboratory's sample handling and internal custody program. Upon receipt of the samples, the sample custodian will be responsible for performing the following activities where appropriate:

- Examine the shipping containers to verify that the custody seal is intact
- Measure and document the shipping container temperature by recording it on the chain-of-custody form
- Examine all sample containers for damage
- Compare samples received against those listed on the chain-of-custody record
- Verify that sample holding times have not been exceeded
- Determine sample temperatures and documenting on the chain-of-custody record any variations from the acceptable range

- Determine sample pH, if required, and document on the chain-of-custody record
- Immediately sign and date the chain-of-custody record after accepting shipment
- Note any sample receipt problems on the chain-of-custody record, initiate a Condition Upon Receipt report, and notify the Laboratory Project Manager
- Attach the laboratory's sample container labels with laboratory identification number and test
- Place the samples in proper laboratory storage.

The Laboratory Project Manager is responsible for contacting the Project Manager as soon as possible if any problems are identified during sample receipt. All problems identified during sample receipt will be resolved before sample preparation and analysis.

After receiving the samples, the sample custodian will be responsible for logging them in the laboratory log-in book and/or the Laboratory Information Management System with the following information:

- Laboratory project number
- Sample numbers (laboratory and client)
- Type of samples
- Required tests
- Date received.

The sample custodian is also responsible for notifying the Laboratory Project Manager and appropriate Task Manager of sample arrival, and for placing completed chain-of-custody records, waybills, and any additional documentation in the project file.

Samples will be stored appropriately within the laboratory to maintain any prescribed temperature, protect against contamination, and maintain the security of the samples.

Sample custody procedures within the laboratory will be followed to appropriately document the handling and possession of the sample from receipt until final analysis and disposal. If any samples are transferred to a different laboratory, the transfer will be done under chain-of-custody procedures, and the labs will maintain the appropriate documentation to preserve the traceability of the samples through final analysis and disposal.

3.4 Analytical Methods Requirements

This section describes the general requirements for analytical methods that may be performed, including preparation/extraction procedures where appropriate and method performance requirements. The laboratory's QA manual will contain summary information from the analytical methods, including the following:

- Sample containers, preservatives, and holding times
- Calibration requirements, including frequency and acceptance criteria
- Laboratory quality control samples, including frequency, acceptance criteria, and corrective actions

- MDLs and RLs.

More detailed information on the laboratory's analytical methods is contained in laboratory-specific SOPs developed by the laboratory.

3.4.1 Analytical Methods

In general, all analyses will us USEPA-approved methods or other recognized standard methods. Method references for laboratory analyses that will be performed for the sampling round are provided in Table 2-1, including preparation/extraction methods where appropriate.

3.4.2 Reporting Limits

Project-specific MDLs and RLs for the analyses are identified in Table 2-1. The laboratory's MDLs and RLs may be modified based on the laboratory's current performance, changes to the methods, and any MDL studies. However, the QA Manager must approve any modifications that will affect the project data.

The MDLs and RLs provided by the laboratory will be evaluated in the DQO process for the proposed work. The adequacy of MDLs and RLs are important DQOs because they are used to identify the nature and extent of chemical impacts as well as the risk due to potential exposure.

In general, the RLs for the various analytical methods reported by the laboratory appear to be sufficient for the anticipated use of data. If a task-specific target is less than the RLs reported by the laboratory, a discussion of the exception and any recommended solutions will be presented in the associated Findings Report.

3.4.3 Laboratory Method Performance Requirements

A description of the method-specific QC samples that the laboratory uses will be presented in the laboratory QA manual, including the types of QC samples to be run, frequency, acceptance criteria, and corrective action to be taken when acceptance criteria are not met. The laboratory analyst will review results of the QC samples against the acceptance criteria. Any identified discrepancies will trigger the laboratory's internal corrective action system as described below.

3.4.4 Manual Integrations

Manual integrations are an essential part of the chromatographic analysis process. They will be used judiciously to correct any incorrect integration by the automated instrumentation, and will not be used routinely for the purpose of meeting calibration or method QC acceptance criteria. Manual integrations will be done only as a corrective action measure. Examples of instances where manual integration would be warranted include: co-eluting compounds resulting in poor peak resolution, a misidentified peak, an incorrect retention time, or a problematic baseline. When manual integrations are used, procedures will be implemented to document the event, ensure consistency in performing the manual integration, and facilitate review and acceptance of manually integrated data.

Manual integrations will have a laboratory SOP. This SOP will specify when automated integrations by the instrument are likely to be unreliable, what constitutes an unacceptable automated integration, and how the problems will be resolved by the analyst. This includes procedures for the analyst to follow in documenting any required manual integrations.

When manual integrations are performed, raw data records will include a complete audit trail for those manipulations. The raw data records will include the results of both the automated and manual integrations (i.e., "before" and "after" chromatograms of manually integrated peaks), notation of the cause and justification for performing the manual integrations, and date, and signature/initials of the person performing the manual operations. All manual integrations will be identified in the case narrative.

3.4.5 Laboratory Corrective Action

The laboratory has a formal corrective action system in place to ensure that prompt action is taken when an unplanned deviation from a procedure or plan occurs and that, whenever possible, corrective actions include measures to prevent the reoccurrence of deviations. Specific corrective actions to be taken when a QC sample does not meet acceptance criteria will be presented in the laboratory QAPP. The following is a description of how information from the laboratory's corrective action system is communicated to the project team.

Each laboratory's corrective action procedure includes promptly notifying the project contact of any significant problems or discrepancies. The Laboratory Project Manager is responsible for reporting to the Project Manager or other identified project contact any significant problems or discrepancies that occur as analyses are conducted. The Laboratory Project Manager is also responsible for ensuring that corrective action is taken where appropriate to prevent the reoccurrence of similar problems or discrepancies. In addition, each analytical data report will include a case narrative that discusses any problems or discrepancies, as well as sufficient calibration and QC information to verify that the method was in control at the time the samples were analyzed. The case narrative will include a discussion of any corrective action taken by the laboratory to prevent the reoccurrence of similar problems or discrepancies in the future.

3.5 Quality Control Requirements

This section presents the field QC checks that will be performed during field investigations, including a discussion of field QC samples, sampling frequency, acceptance criteria, and field corrective action procedures.

3.5.1 Field QC Samples

Field cross-contamination can be assessed through the collection of different types of blank samples. Equipment rinsate blank samples are obtained by passing distilled or deionized (DI) water, as appropriate, over or through the decontaminated equipment used for sampling. These blank samples provide the best overall means of assessing contamination arising from equipment, ambient conditions, sample containers, transit, and the laboratory.

Trip blank samples are prepared by the laboratory and shipped to and from the field. These blank samples help assess contamination from the laboratory, the shipping process, and are for VOCs only.

Field or decontamination water blank samples are collected from each source of water used for equipment decontamination. These blank samples help assess potential contaminants introduced from the source water.

Definitions for these types of samples are provided in the following subsections. The specific field QC samples required for the anticipated sampling program are presented in Table 3-1.

3.5.1.1 Equipment Rinsate Blank Samples
Equipment rinsate blank (ERB) samples are used to monitor effectiveness of the decontamination process. ERBs contain DI water passed through and over the surface of decontaminated sampling equipment. The rinse water is collected in sample bottles, preserved as necessary, and handled in the same manner as the samples. The ERBs will be analyzed for the same analytes as the corresponding samples collected that day. An ERB sample will be taken for each day that a nondedicated pump is used.

3.5.1.2 Field or Decontamination Water Blanks
Field blanks are samples of the source water used for decontamination of equipment that enters a monitoring well or is used for piezometer construction. This blank is used to monitor for potential contaminants introduced from the water source during field equipment decontamination procedures. Typically, at least one sample for each source of water or one field blank of analyte-free water for a specified event will be collected and analyzed for the same parameters as the corresponding field environmental samples. DI water or potable water from a public water source (such as a fire hydrant) will be used for decontamination water. If more than one source of DI water is used, or if potable water from more than one location is used, additional field blanks are collected because these constitute different sources. The requirement for field blanks will be at the discretion of the AMEC Project Manager.

3.5.1.3 Trip Blanks
Trip blanks are used to detect VOC contamination during sample shipping and handling. Trip blanks are 40-milliliter volatile organic analysis vials of water that are filled by the laboratory, transported to the sampling site, and returned to the laboratory with VOC samples. Trip blanks are not opened in the field. The planned frequency for trip blanks is one trip blank per cooler containing samples for VOC analysis.

3.5.1.4 Duplicate Field Samples
Duplicate or “blind” field samples are collected to monitor the precision of the field sampling process. The identity of the duplicate sample is not noted on the laboratory chain-of-custody record. The Field Team Leader will choose at least 10 percent of the total number of samples for duplicate field sampling. The identity of the duplicate samples is recorded in the field notes, and this information is forwarded to the data quality evaluation team to aid in reviewing and evaluating the data. The source of the field duplicate for the QA samples will be blind to the laboratory. The source of the field duplicate sample will be listed as a field sample on the chain-of-custody record sent to the laboratory.

3.5.2 Field Corrective Action

Problems that require corrective action may be encountered in the field. Findings that require corrective action must be documented to the Project Manager and QA Manager. The QA Manager will confirm that corrective actions have been implemented and that the problem has been resolved. If a problem can be addressed relatively easily, it will be addressed and the corrective action noted in the field notes. If an error is made on an accountable document assigned to one individual, that individual will make all corrections by drawing a line through the error, entering the correct information, and initialing and dating the correction. The erroneous information will not be removed. The person who made the entry will correct any subsequent error discovered on an accountable document, and that correction will be initialed and dated.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Maintenance and inspection of both field and laboratory equipment are described in the following subsections.

3.6.1 Field Instruments and Equipment

Field equipment that will need calibration may include meters that measure volatile organic vapors and pressure transducers. Proper maintenance, calibration, and operation of each instrument will be the responsibility of field sampling team personnel assigned to a particular field activity. All instruments and equipment used during the field investigations will be maintained, calibrated, and operated according to the manufacturer's guidelines and recommendations. All field equipment requiring regular calibration will be calibrated at least once per day. Relevant manuals will be kept with field sampling team personnel during the performance of field activities. All equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Any items found to be inoperable will be taken out of use and a note stating the time and date of this action will be made in the daily field records.

3.6.2 Laboratory Instruments and Equipment

Testing, inspection, and maintenance of laboratory instruments/equipment will be conducted in accordance with the procedures specified in the laboratory's QA manual. The manual discusses the schedule, procedures, criteria, and documentation in place at the laboratory to prevent instrument and equipment failure and minimize downtime. For each instrument or piece of equipment, the laboratory maintains the following information:

- Instrument/equipment inventory list
- List or inventory of major spare parts
- External vendor service agreements (if applicable)
- Instrument-specific preventive maintenance logbook or file.

The laboratory documents all preventive maintenance of equipment in dedicated logbooks or files.

3.7 Instrument Calibration and Frequency

General guidance regarding calibration and frequency of calibration of both field and laboratory equipment is described in the following subsections.

3.7.1 Field Instruments

The field equipment that will need calibration for the sampling event includes a pH/temperature meter, conductivity meter, turbidity meter and organic vapor meter. Proper maintenance, calibration, and operation of each instrument will be the responsibility of field sampling team personnel assigned to a particular field activity. Instruments and equipment used during the field investigations will be maintained, calibrated, and operated according to the manufacturer's guidelines and recommendations. Field equipment requiring regular calibration will be calibrated at least once per day. Relevant manuals will be kept with field sampling team personnel during the performance of field activities. Equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Items found to be inoperable will be taken out of use and a note stating the time and date of this action will be made in the daily field records. A Field Equipment Calibration Sheet is presented in the FSP.

3.7.2 Laboratory Equipment and Instrumentation

All laboratory equipment and instruments specific to each analysis are included in method-specific SOPs. The SOPs have been developed by the laboratory.

Whenever possible, the laboratory uses recognized procedures for calibration, such as those published by the USEPA or the American Society for Testing and Materials International. If established procedures are not available, the laboratory develops a calibration procedure based on the type of equipment, stability, characteristics of the equipment, required accuracy, and effect of operation error on the quantities measured. Whenever possible, the laboratory uses physical reference standards associated with periodic calibrations such as weights or certified thermometers with known relationships to nationally recognized standards. When national reference standards are unavailable, the basis for the reference standard is documented.

Equipment or instruments that fail calibration or become inoperable during use are tagged to indicate they are out of calibration. Such instruments or equipment are repaired and successfully recalibrated before re-use.

3.8 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables that may be used during field investigations include sample bottles, calibration gases, hoses, tubing, materials for decontamination activities, DI water, and potable water. Project team members obtaining supplies and consumables are responsible for confirming that the materials meet the required specifications and are intact and in good condition, available in adequate supply, and stored appropriately until use. Project team members will direct any questions or any identified problems regarding supplies and consumables to the Task Manager for resolution.

3.9 Data Acquisition Requirements (Non-Direct Measurements)

Some non-directly-measured data may be required for this work. Examples of non-directly-measured data include previous investigation or RD reports, geologic logs and well construction records, historical groundwater quality data, survey data, pumping records and plans, well location maps, and site plans.

Non-directly-measured data will be retained in the project files. The data may be of unknown quality and will be assessed by the Project Manager. The accuracy of each source will be assessed based on the way the source document was prepared.

3.10 Data Management

The objective of data management is to establish procedures to be used during field investigations for documenting, tracking, and presenting investigative data. Data generated during the field investigations, as well as previously existing data, will form the basis for developing conclusions and recommendations. The available data must be properly organized in order to be comprehensive and useful. Organization of the data will be planned before it is collected to ensure the data generated are identifiable and usable.

This section describes the process by which sufficient data are collected to be accurately validated and then transferred to a data management system for evaluation. This section also describes the operating practices to be followed by personnel while collecting and reporting data.

The project data will be as processed as follows:

- Field data sheets will be forwarded to the AMEC Project Manager.
- Soil and water samples will be sent directly from the field to the selected laboratory. Copies of chain-of-custody forms and other field data sheets will be forwarded to AMEC.
- Laboratory results, including EDDs and hard copies, will be sent to the AMEC Project Manager.
- A third-party Data Validator will perform data validation with oversight by the QA Manager. The Data Manager will review the laboratory data packages and data validation sheets. The QA Manager will provide oversight of the data validation process.

3.10.1 Data Recording

Observations made and measurements taken in the field are recorded on appropriate data sheets or in the field notes. Copies of the selected original data records may be attached to the project report as appendices.

Data used for analysis, presentation, and reporting will be stored in an electronic database, which will facilitate tracking of chain-of-custody and sample identification data, review and evaluation of analytical data against project-specific criteria, and production of data tables and figures.

Laboratory results will be submitted as a complete and single EDD. It is expected that the laboratory will compare electronic data with the hard-copy report before submittal to confirm that the EDD and hard-copy data are identical. AMEC will check the EDD against the hard copy for all detected analytes. The EDD will be submitted on a compact disk or via e-mail, with the disk label or email including the Laboratory Delivery Group, submittal date, laboratory name, and site description. If an EDD is resubmitted to AMEC, the EDD will be labeled “Revised”.

3.10.2 Data Validation

Data validation, which is an integral part of the QA program, consists of reviewing and assessing the quality of data. Data validation provides assurance that the data as reported are of acceptable quality. For validity, the characteristics of importance are PARCCS. Data usability describes whether a data set is sufficiently complete and of sufficient quality to support a decision or action in terms of the specific DQOs.

Analytical data submitted by the laboratory in electronic form will be verified by comparing to the hardcopy or portable document format forms. All analytical data will be validated by a qualified third party, as described in Section 5.1. The results will be summarized in data validation reports for submittal to AMEC and the USEPA, pursuant to requirements in the AOC. Qualified results will be loaded into the project database.

3.10.3 Data Transformation

Transforming data by converting individual data point values into related values or symbols using conversion formulas or a system of replacement is not currently proposed for data evaluation for the project at this time. If data transformation is required at a later date, then conversion procedures will be described in detail in the associated technical report.

3.10.4 Data Transmittal

Analytical data are provided by the laboratory in both hard-copy and EDD format. The electronic data are to be provided in a specified format that will be uploaded to intermediate files; the data will be reviewed for completeness and accuracy by the Project Manager before being validated, and will then be uploaded to the project database.

3.10.5 Data Analysis

Data analysis (e.g., computation of summary statistics, standard errors, confidence intervals) is not currently proposed for data evaluation for this project at this time. If data analysis is required at a later date, then the analysis procedures will be described in detail in the associated technical report.

3.10.6 Data Tracking

The Project Manager is responsible for data management. The Project Manager has the authority to enforce proper procedures as outlined in this SAP and to implement corrective procedures to provide for the accurate and timely flow and transfer of data. The Project Manager will review final data reports.

Data will be generated from environmental sampling and analysis, field analyses, and field readings. The individuals who generate data (geologists, engineers, samplers, and chemical analysts) will be responsible for accurate and complete documentation of required data, and for ensuring that those data are provided to their supervisor in a timely manner.

The Task Manager will be responsible for the day-to-day monitoring of data collected in the field. He will ensure that data are collected in the format specified in the FSPs, and will assign sample designation and route data to the project files. At least one copy of all project documents will be retained by the Task Manager for project use during the work activity. Original documents will be maintained in the project file.

The Task Manager will also be responsible for the day-to-day monitoring of activities related to the generation and reporting of chemical data. He will ensure that samples are analyzed according to the specified procedures, that data are validated, and that the data are properly coded, checked for accuracy, and entered into the data management system. He will ensure that the data are then routed to the project file.

3.10.7 Data Storage and Retrieval

A project file will be established for storing original data, historical data, written documents and data collected or generated during this work. AMEC maintains a central filing system in which the project file will be located. The file will, at a minimum, consist of the following records:

- Correspondence
- Project Member Contact Information
- Budgets
- Contracts
- Field Data
- Figures and Maps
- Permits
- Laboratory Data and QA/QC Documents
- Chain-of-custody records
- Photographs
- Reports
- Schedules.

All materials will be dated and will indicate the project number and the initials of the person responsible for preparing the document. All documents relating to the project will be controlled to provide proper distribution, filing, and retrieval. Document control shall also assure that revisions are properly recorded, distributed, and filed. The Project Manager maintains overall responsibility for the project files and ensures that the appropriate documents are filed. Filed documents are available to AMEC staff through checkout procedures developed to protect the integrity of the project files.

4.0 ASSESSMENT AND OVERSIGHT

Internal and external checks (assessments) have been built into this project, as follows:

- Elements of this SAP have been properly implemented as prescribed for all investigations
- The quality of the data generated is adequate and satisfies the DQOs that have been identified in this SAP
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

Assessment activities may include observation, inspection, peer review, review of management systems, readiness review, technical systems audit, performance evaluation, and data quality assessment.

4.1 Assessment Activities

The following subsections identify the assessment and oversight activities planned to provide that the objectives identified above are attained by field and laboratory operations. The QA Manager, Project Manager, and/or Project Principals may identify additional assessment activities to be performed during the project that are based on findings of the planned activities described below.

4.1.1 Assessment of Field Operations

In general, the Project Manager, Task Manager and/or other designated members of the project team as appropriate will conduct internal assessments of field operations. Criteria for evaluating performance during field operations include the following:

- Are sampling operations being conducted in accordance with the associated SAP?
- Are the sample labels being filled out completely and accurately?
- Are the chain-of-custody records complete and accurate?
- Are the field notes and other forms and records being filled out completely and accurately?
- Are the sampling activities being conducted in accordance with the approved work plan?

Planned assessment activities to evaluate these and other field operations issues include frequent review of sample collection documentation, sample handling records (chain-of-custody forms), field notes, and field measurements, and the performance of unannounced audits of field operations. The team member who conducts an assessment activity will report the results to the appropriate Project Manager. Reports assessment activities will include the findings and identification of any corrective actions taken or planned.

4.1.2 Assessment of Laboratory Operations

The laboratory has ongoing internal audit programs for monitoring the degree of adherence to its own policies, procedures, and standards. The internal audit programs, described in the laboratory's QA manual, include systems audits, performance evaluations, data audits, and spot assessments. Laboratory personnel who are independent of the area(s) being evaluated conduct internal audits. The laboratory also participates in external audits conducted by regulatory agencies and other clients. Project-specific assessments of laboratory operations are described below.

The Task Manager will be in frequent contact with the analytical laboratory during the time that samples are being analyzed. This regular contact will enable assessment of progress in meeting DQOs and early identification of any problems requiring corrective actions. The Task Manager will report promptly to the Project Manager and QA Manager any identified problems, corrective actions taken, and recommendations for additional corrective actions. The Project Manager and QA Manager will review the problem and provide for swift implementation of any outstanding corrective actions. The Project Manager or Task Manager will be responsible for working directly with the laboratory to ensure the prompt resolution of any problems that have been identified.

4.2 Reports to Management

This subsection discusses internal reports within the project team. External reports are those submitted to the Respondents and the USEPA Region IX Project Manager. Internal project records and external reports are discussed in Section 2.3.5.

Reports to management will include project status reports, the results of observation evaluations, field and/or laboratory audits, and data quality assessments. These various reports will be prepared by the Task Manager, field personnel, the Data Validator, and/or the QA Manager and directed to the AMEC Project Manager The Project Manger has ultimate responsibility for ensuring that any corrective action response is completed, validated, and documented by the AMEC Project Manager.

As appropriate, the reports to management will include mention of the project progress and a QA section with descriptions of the following:

- Problems (including QA/QC deviations) that required corrective action and the resolution of those problems (i.e., how they were addressed)
- Assessment of data quality in terms of precision and accuracy and how they affect the usability of analytical results
- Limitations on any qualified results and a discussion of any rejected results
- Results of field and laboratory QA/QC samples.

Copies of written communications between project team members, including reports to project management, will be maintained in the project files.

5.0 DATA VALIDATION AND USABILITY

This section of the SAP provides a description of the QA activities that will occur after the data collection phase of the project is completed. Implementation of this section will determine whether the data conform to the specified criteria, thus satisfying the project objectives.

5.1 Data Review and Validation

Data validation involves reviewing and accepting, qualifying, or rejecting data on the basis of sound criteria and following USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Review (USEPA, 2010) and the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 2008). Data validation will consist of a systematic review of the analytical results and associated QC methods and results. In any area not specifically addressed by USEPA guidelines, best professional judgment will be used and described in the Usability Assessment portion of the data validation report.

The process outlined below is required for all analytical data obtained for the NHOU project unless specifically modified in an approved FSP.

All analytical data submitted by the laboratory will be validated by a qualified third party. As required by the AOC, approximately 80 percent of the data will be validated consistent with USEPA Region IX Tier 2 evaluation requirements, and approximately 20 percent will be validated consistent with Tier 3 evaluation requirements (USEPA, 2002b). The laboratory will submit full data packages prepared in accordance with Region IX guidance (USEPA, 2001).

The Region IX evaluation process is based on several tiers that require an increasingly more detailed review of the data. The data validation process for the work conducted under this SAP is as follows:

- Tier 1A evaluation (all data):
  - Review of the data package for completeness
  - Review of chain of custody forms (against laboratory reported information); signatures; sample condition upon receipt by the laboratory; and sample preservation
  - Confirm analytical method, analytes, and reporting limits
  - Evaluate against criteria for blanks—laboratory and field blanks
  - Evaluate against accuracy criteria—holding times, surrogates, LC samples, and MS samples
  - Evaluate against precision criteria—MS/MSDs and field and laboratory duplicates
- Tier 2 evaluation (80 percent of the data):
  - All Tier 1A elements, plus evaluate the following:
  - Initial and continuing calibrations (recalculate relative response factors)
  - Instrument performance checks (raw data review)
  - Compound identification (review raw data, mass spectra, check calculations

- Compound quantitation (review raw data)
- Tier 3 evaluation (20 percent of the data):
  - All Tier 1A and 2 elements, plus evaluate the following:
    - Interference check sample results (review raw data, check calculations)
    - Serial dilutions (review raw data, check calculations)
    - MS tune analysis (review raw data, check calculations)
    - Internal standards (review raw data, chromatograms, and retention times)
    - LCS recoveries (transcriptions from raw data and check calculations)
    - System performance (check baseline shifts, chromatographic quality)

The results of the data validation and any corrective actions implemented will be summarized in data validation reports for submittal to AMEC and the USEPA.

5.2 Validation Methods

Data validation is conducted to assess the effect of the overall sampling and analysis process on the usability of the data. There are two areas of review: laboratory performance and the effect of matrix interferences. Evaluation of laboratory performance is a straightforward examination for compliance with the method requirements. The laboratory either did or did not analyze the samples within the QC limits of the analytical method and according to protocol requirements. The assessment of potential matrix effects consists of a QC evaluation of the analytical results and the results of blank, duplicate, and MS samples. The results of the data validation and any corrective actions implemented will be summarized in data validation reports, which will include the following:

- A completed data review worksheet
- A comprehensive narrative detailing all QC exceedances and explaining qualifications of data results. In cases where data are qualified because of quantifiable QC exceedances, the bias (high or low) will be identified.
- Data summaries in tabular format reporting all data results with the qualifiers that were added during data validation. Qualifying flags are shown in Table 5-1. These tables will include sample ID; laboratory ID; date sampled; sample type (e.g., field duplicate, field blank); units; concentration of analytes; and validation qualifiers. The tables may be modified to report other appropriate information (such as depth of discrete-depth samples, date analyzed, dilution factor).
- Resubmittal requests sent to the laboratory for missing information, validation of analytical information, etc.

During validation, the entire data set will be examined for overall trends in data quality and usability. Information summarized as part of the data quality validation will include frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set also will be evaluated to identify potential data limitations or uncertainties in the laboratory procedures.

5.3 Reconciliation with User Requirements

The usability of the validated data will be assessed by comparing the data to the validation criteria and DQOs. The usability assessment will provide an overall summary of data quality, defining acceptability or problems with accuracy, precision, sensitivity, and/or representativeness of the results and providing clear guidance to the data users on any uncertainties in data that have been qualified as estimated. Because of the cumulative effects of QC exceedances, some specific results may be determined to be unusable. Alternatively, based on USEPA guidelines and best professional judgment, specific results may be determined to be usable for DQOs when they are not significantly outside the QC criteria.

The final step of the data validation process is to assess whether the data meet the DQOs. The final results, adjusted for the findings of data validation, will be compared to the DQOs to assess whether the data are of sufficient quality to support the DQOs. The decision regarding data sufficiency may be affected by the overall precision, accuracy, and completeness of the data as demonstrated by the data validation process. If the data are sufficient to achieve project objectives, the Project Manager will release the data and work can proceed. If the data are insufficient, corrective action will be required.

6.0 REFERENCES

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TABLES

Table 2-1 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Target Analytes	Analytical Method	Sample Volume; Container	Preservation	MDL[1]	Reporting Limits[1]	Holding Time
Volatile Organic Compounds	EPA 8260	(3) 40 mL VOAs	Cool to 4±2º C pH <2 HCL	0.133 - 10 µg/L	0.5 – 20 µg/L	14 days
	EPA 524.2	(3) 40 mL VOAs	Cool to 4±2º C pH <2 HCL	0.09 - 12 µg/L	0.5 – 5.0 µg/L	14 days
1,2,3-Trichloropropane	SRL 524M -TCP	(3) 40 mL VOAs	Cool to 4±2º C HCL	0.0025 µg/L	0.005 µg/L	14 days
1,4-Dioxane	EPA 8270C	1 Liter amber glass	Cool to 4±2º C	0.284 µg/L	1 µg/L	7 days
	EPA 522	2 Liter amber glass	Cool to 4±2º C $NaHSO_4$	0.01 µg/L	0.07 µg/L	14 days
n-nitrosodimethylamine (NDMA)	EPA 1625CM	1 Liter amber glass	Cool to 4±2º C	0.00932 µg/L	0.002 µg/L	7 days
	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00028 µg/L	0.002 µg/L	14 days
N-Nitrosodibutylamine (NDBA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00059 µg/L	0.002 µg/L	14 days
N-Nitrosodi-n-propylamin(NDPA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00035 µg/L	0.002 µg/L	14 days
N-Nitrosodiethylamine (NDEA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00072 µg/L	0.002 µg/L	14 days
N-Nitrosomethylethylamin(NMEA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00028 µg/L	0.002 µg/L	14 days

Table 2-1 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Target Analytes	Analytical Method	Sample Volume; Container	Preservation	MDL[1]	Reporting Limits[1]	Holding Time
N-Nitrosopyrollidine (NPYR)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00066 µg/L	0.002 µg/L	14 days
Perchlorate	EPA 314.0	100 mL poly	Cool to 4±2º C	0.356 µg/L	2 µg/L	28 days
Total Chromium	EPA 200.8	500 mL poly	Cool to 4±2º C pH <2 HNO3	0.293 µg/L	1 µg/L	6 months
Hexavalent Chromium	EPA 218.6	500 mL poly	Cool to 4±2º C	0.041 µg/L	0.2 µg/L	24 hours
Cations Ca, Mg, Na, K, Fe	EPA 200.7	500 mL poly	Cool to 4±2º C pH <2 HNO3	0.00336 – 0.103 mg/L	0.1 – 0.5 mg/L	6 months
Anions Nitrate, Nitrite, Cl, SO_4, Total Nitrate/Nitrite	EPA 300.0	500 mL poly	Cool to 4±2º C pH <2	0.159 – 0.296 mg/L	0.1 – 1 mg/L	28 days Nitrate - 48 hours
Total Hardness	200.7	250 mL poly	Cool to 4±2º C pH <2 HNO3	0.989 mg/L	2 mg/L	6 months
Alkalinity	SM2320B	500 mL poly	Cool to 4±2º C	0.850 mg/L	1 mg/L	14 days
Total Dissolved Solids	SM2540C	500 mL poly	Cool to 4±2º C	0.820 mg/L	10 mg/L	7 days

Table 2-1 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Notes:

1. MDLs and Reporting Limits were provided by CalScience Environmental Laborotories, Inc, from Garden Grove, California.

Abbreviations:

Ca = Calcium
Cl = Chloride
EPA = U.S. Environmental Protection Agency
Fe = Iron
HCL = hydrochloric acid
HNO3 = Nitric Acid
K = Potassium
MCL = Maximum Contaminant Level (Cal/EPA)
Mg = Magnesium
mg/L = milligrams per liter
mL = milliliter
Na = Sodium
NO_3-N = Nitrate
NO_2-N = Nitrite
SM = Standard Methods
SO_4 = Sulfate
VOA = Volatile Organic Analysis
µg/L = micro grams per liter

Table 2-2 Method Performance Objectives—Acceptance Criteria

North Hollywood Operable Unit
Los Angeles County, California

Method Performance Objective	Type of Quality Control Sample	Frequency	Acceptance Criteria
Precision			
Field	Duplicate field sample	1 per 10 samples	Relative percent difference, RPD <30
Laboratory	Laboratory control samples (LCS) and laboratory control duplicate (LCSD) samples	1 per batch of 20 samples per matrix	RPD <20
	Matrix spike (MS) and matrix spike duplicate (MSD) samples	1 per batch of 20 or fewer investigative samples per matrix	RPD <20
	Unspiked duplicate samples	1 per batch of 20 samples per matrix	RPD <20
Accuracy			
Field	Trip blanks	1 per cooler of volatile organic compounds (VOC) samples	U.S. Environmental Protection Agency (USEPA) National Functional Guidelines Protocol [1,2]
	Equipment rinsate blank	1 per day per equipment type (non-dedicated equipment)	USEPA National Functional Guidelines Protocol [1,2]
	Temperature blank	1 per cooler with chilled samples	< 4±2 degrees centigrade
	Field blank	1 per water source per sampling event	USEPA National Functional Guidelines Protocol [1,2]
Laboratory	Matrix spike (MS) samples	1 per batch of 20 or fewer investigative samples per matrix	Percent recovery, %R, less than compound specific limit (refer to Laboratory Quality Assurance Manual)
	Laboratory control samples (LCS)	At least once with each analytical batch, with a minimum of 1 for every 20 samples	%R less than compound specific limit (Refer to Laboratory Quality Assurance Manual)
	Method blanks	At least once with each analytical batch, with a minimum of 1 for every 20 samples	No compound should be detected above its respective Reporting Limit in laboratory method blanks

Table 2-2 Method Performance Objectives—Acceptance Criteria

North Hollywood Operable Unit
Los Angeles County, California

Method Performance Objective	Type of Quality Control Sample	Frequency	Acceptance Criteria
Laboratory (cont'd)	Preparation blanks	At least once with each analytical batch, with a minimum of 1 for every 20 samples	No compound should be detected above its respective Reporting Limit in laboratory preparation blanks
	Surrogates		%R less than compound specific limit (refer to Laboratory Quality Assurance Manual)
Representativeness	Not applicable	Not applicable	Numerical goals cannot be used to evaluate this subjective measure.
Completeness	Not applicable	Not applicable	90% completeness
Comparability	Not applicable	Not applicable	Comparable if the same procedures for collecting and analyzing the samples are used, if the samples comply with the same QA/QC procedures, and if the units of measurement are the same
Sensitivity	Not applicable	Not applicable	Reporting limits (RLs) below or equal to the task-specific target analysis goals or concentrations

Notes:

1. USEPA, 2008, Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review; U.S. Environmental Protection Agency Office of Emergency and Remedial Response, EPA-540-R-08-01, June.
2. USEPA, 2010, Contract Laboratory Program National functional Guidelines for Inorganic Superfund Data Review, OSWER 9240, EPA 540-R-10-011, January.

Table 3-1 Field Quality Control Samples
North Hollywood Operable Unit
Los Angeles County, California

Type of Quality Control Sample	Frequency	Acceptance Criteria
Trip blanks	1 per cooler of VOC samples	USEPA National Functional Guidelines Protocol
Equipment rinsate blank	1 per day per equipment type (non-dedicated equipment)	USEPA National Functional Guidelines Protocol
Temperature Blank	1 per cooler with chilled samples	< 4±2 degrees centigrade
Field blank	1 per water source per sampling event	USEPA National Functional Guidelines Protocol
Duplicate	1 per 10 samples	Relative percent difference, RPD <30

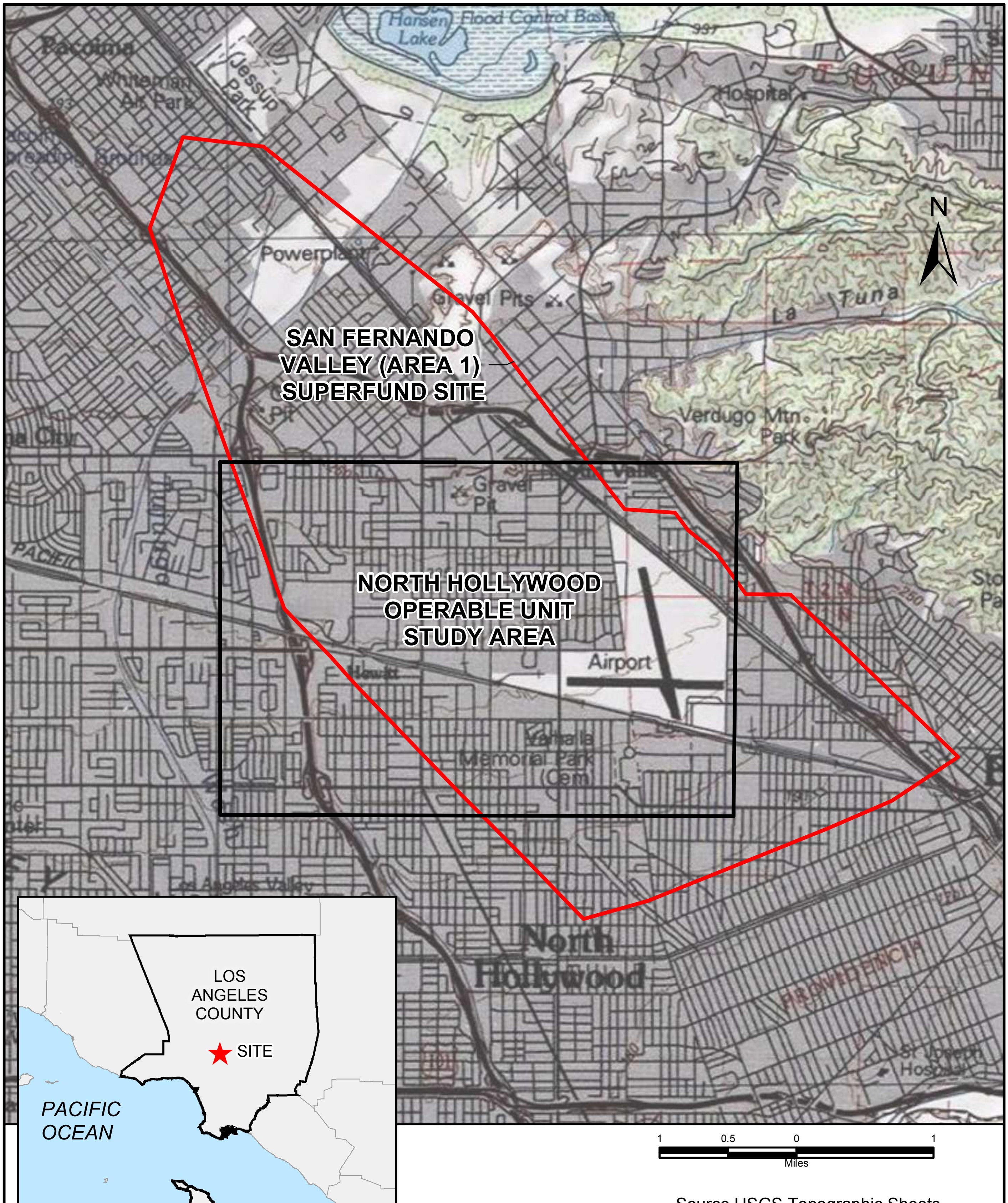
Abbreviations:
RPD = relative percent difference
VOCs = volatile organic compounds
USEPA = U.S. Environmental Protection Agency

Table 5-1 Data Qualifier Definitions
North Hollywood Operable Unit
Los Angeles County, California

Qualifier	Explanation of Qualifier
Organic Analyses [1]	
U	The compound was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification”.
NJ	The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
Inorganic Analyses [2]	
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting Quality Control (QC) criteria. The analyte may or may not be present in the sample.

Notes:
1. USEPA, 2008, Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review; U.S. Environmental Protection Agency Office of Emergency and Remedial Response, EPA-540-R-08-01, June.
2. USEPA, 2010, Contract Laboratory Program National functional Guidelines for Inorganic Superfund Data Review, OSWER 9240, EPA 540-R-10-011, January.

FIGURES



Source USGS Topographic Sheets

Site Vicinity Map
Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

FIGURE **1-1**

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
TJH	4088115718		4/2012		

Thursday, August 23, 2012 9:21:40 AM
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United States Environmental Protection Agency
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Matt Salazar

Honeywell and Lockheed Martin
Benny DeHghi (Honeywell)
Carolyn Monteith (Lockheed Martin)

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Drilling, Well Installation
Damian Hriciga, *PG,*
Project Geologist

Aquifer Testing
Sean Culkin, *PG,*
Project Hydrogeologist

Subcontractors

Contract Analytical Laboratory
TBD
Contract Drilling Company
TBD

Contract Data Validation
TBD
Contract Subsurface Utility Locator
TBD
Surveyor
TBD

EXPLANATION

PE Professional Engineer
PG Professional Geologist
CHG Certified Hydrogeologist
PH Professional Hydrogeologist
CGWP Certified Groundwater Professional
PMP Professional Project Manager
CIH Certified Industrial Hygienist

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DRAWN BY	JC
DATE	8/2012
REVIEWED BY	MSB
REVIEWED DATE	4/2012
APPROVED BY	MDT
APPROVED DATE	4/2012

PROJECT ORGANIZATIONAL CHART
Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

FIGURE
2-1

PROJECT NO.
4088115718.4100

APPENDIX A

Groundwater Monitoring and Sampling Field Sampling Plan

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FIGURES

APPENDIX

ABBREVIATIONS AND ACRONYMS

1,2,3-TCP	1,2,3-trichloropropane
AMEC	AMEC Environment & Infrastructure, Inc.
AOC	Agreement and Order on Consent
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHG	Certified Hydrogeologist
CIH	Certified Industrial Hygienist
COC	chemical of concern
CSM	conceptual site model
DI	de-ionized
DO	dissolved oxygen
DQIs	Data Quality Indicators
DQOs	Data Quality Objectives
DTSC	Department of Toxic Substances Control
EBF	electromagnetic borehole flowmeter
EDD	electronic data deliverable
FSP	Field Sampling Plan
GPS	global positioning system
HASP	Health and Safety Plan
Honeywell	Honeywell International, Inc.
HPLC	high performance liquid-chromatography
IDW	investigation-derived waste
LADWP	Los Angeles Department of Water and Power
Lockheed Martin	Lockheed Martin Corporation
MCL	Maximum Contaminant Level
MDL	method detection limit
mg/L	milligram(s) per liter
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NDMA	n-nitrosodimethylamine
NGVD29	National Geodetic Vertical Datum of 1929
NHE	North Hollywood extraction wells
NHOU	North Hollywood Operable Unit
ORP	oxidation reduction potential
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCE	tetrachloroethene
PDB	passive diffusion bag
PE	Principal Engineer
PG	Principal Geologist

pH	potential hydrogen
PID	photoionization detector
PMP	Project Management Professional
PPE	Personal Protective Equipment
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QEC	Quantum Engineering Corporation
QSP	Qualified Storm Water Practitioner
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SC	specific conductivity
S/cm	Siemens per centimeter
SFV	San Fernando Valley
TCE	trichloroethylene
USEPA	U.S. Environmental Protection Agency
VOA	volatile organic analysis
VOCs	volatile organic compounds

A1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC), has prepared this Field Sampling Plan (FSP) on behalf of Honeywell International, Inc. (Honeywell) and Lockheed Martin Corporation (Lockheed Martin) to present the rationale, field methods and procedures, analytical requests, and quality assurance/quality control (QA/QC) procedures for planned Second Interim Remedy activities for the North Hollywood Operable Unit (NHOU), in compliance with the U. S. Environmental Protection Agency's (USEPA) Interim Action Record of Decision (ROD) dated September 30, 2009. The Second Interim Remedy is intended to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect water supply production well fields, and address emerging chemicals. This FSP addresses activities for groundwater sample collection recommended by the Final Data Gap Analysis (AMEC, 2012a) and described in the Phase 1 Pre-Design Investigation Work Plan (AMEC, 2012b).

The organization of this FSP follows the outline presented in the USEPA Sampling and Analysis Plan Guidance and Template (USEPA, 2000). This FSP is an appendix to the Sampling and Analysis Plan (SAP)which provides additional information about the Second Interim Remedy for the NHOU, historical information, the study area setting, and the objectives of the Phase 1 Pre-Design Investigation.

A1.1 Sampling Area

The Site is known as the North Hollywood Operable Unit study area, which is part of the San Fernando Valley (Area 1) Superfund Site.

A1.2 Sampling Area Location

The NHOU study area, which is part of the San Fernando Valley (SFV; Area 1) Superfund Site, is the sampling area. The NHOU is located in the community of North Hollywood (a district of the City of Los Angeles; Figure A-1). The NHOU is approximately 15 miles northwest of downtown Los Angeles and immediately west of the City of Burbank, California.

A1.3 Responsible Agency

The work described in this FSP will be conducted by AMEC under contract by Honeywell and Lockheed Martin. The lead regulatory agency is the USEPARegion IX.

A1.4 Project Organization

Title/Responsibility	Name	Phone Number
USEPA Project Manager	Matt Salazar	415.972.3982
Honeywell Project Manager	Benny DeHghi	310.512.2296
Lockheed Martin Project Manager	Carolyn Monteith	228.813.2211
AMEC Staff:		
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Engineering Manager	Robert Hartwell, PE	773.693.6030
Lead Modeler	Jeff Weaver	970.764.4070
Quality Assurance Manager	Margaret K. (Peggy) Peischl, PE	510.663.4100
Health and Safety Manager	Donald Kubik, Jr., CIH, PG	510.663.4100
Field Team Leader	Eileen Bailiff, PG, CEG	949.574.7506

A1.5 Statement of the Specific Problem

The results of the Data Gap Analysis indicate that additional groundwater data are needed to ensure that the Second Interim Remedy design will meet remedial action objectives (RAOs) and comply with California Department of Public Health (CDPH) 97-005 requirements (AMEC, 2012a). The following critical groundwater data gaps are covered by this specific FSP:

- Analytical data are insufficient to delineate the lateral and vertical distribution and temporal variability of chemicals of concern (COCs) in the NHOU study area with respect to the A-Zone and B-Zone, and to define the necessary target capture area.
- Groundwater elevation data are not surveyed to a common elevation datum to verify and clarify groundwater flow directions and gradients in some locations.
- Vertical conduits throughout the NHOU are not sufficiently evaluated to quantify the volume of groundwater and COC mass induced to different depths in response to municipal pumping.

A1.6 Schedule

The work described in this FSP is expected to be completed per schedule in Appendix D in multiple sampling events, (in accordance with the NHOU project schedule included in the Final Phase 1 Pre-Design Investigation Work Plan. Before sampling begins), the Field Team Leader will confirm that required access agreements are completed, qualified subcontractors are available to perform the work, secure locations are identified for temporarily storing investigation-derived waste (IDW), and arrangements for disposal of IDW are confirmed.

A2.0 BACKGROUND

This section provides an overview of the location, previous investigations, and the current understanding of the site conditions.

A2.1 Site or Sampling Area Description

The NHOU comprises approximately 4 square miles of contaminated groundwater underlying an area of mixed industrial, commercial, and residential land use in the community of North Hollywood (a district of the City of Los Angeles) (Figure A-1). The NHOU is approximately 15 miles northwest of downtown Los Angeles, immediately west of the City of Burbank, and has approximate Site boundaries of Sun Valley and Interstate 5 to the north, State Highway 170 and Lankershim Boulevard to the west, the Burbank Airport to the east, and Burbank Boulevard to the south.

The work described in this FSP will be conducted at existing monitoring wells within the NHOU study area. The NHOU groundwater monitoring well network is shown on Figure A-2.

A2.2 Operational History

The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8); a collector line; and a central treatment system consisting of an air-stripping treatment system to remove volatile organic compounds (VOCs) from the extracted groundwater, two activated carbon filters to remove VOCs from the air stream, a chlorination system, and ancillary equipment. The treated groundwater is discharged into a Los Angeles Department of Water and Power (LADWP) blending facility where it is combined with water from other sources before entering the LADWP water supply system. The existing NHOU Extraction and Treatment System began operation in December 1989 and remains in operation today. As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHOU Extraction and Treatment System, and NHE-5 has not operated since 2008.

A2.3 Previous Investigations/Regulatory Involvement

This section presents a brief summary of the previous investigations and regulatory involvement for the NHOU that occurred from 1984 through 2011. For additional details, consult the main Quality Assurance Project Plan (QAPP) text or documents identified in the references section (Section A13.0).

The NHOU was proposed by the USEPA in 1984 in response to the discovery in the late 1970s of tricholoroethene (TCE) and tetrachloroethene (PCE) in groundwater from production wells in the San Fernando groundwater basin and throughout much of the eastern portion of the San Fernando Valley. In 1989, LADWP constructed the existing NHOU Extraction and Treatment System.

The USEPA conducted a series of five-year reviews for the NHOU interim remedy (USEPA, 1993, 1998, 2003, 2008) and concluded that the TCE and PCE groundwater plume was migrating vertically and laterally beyond the remedy's zone of hydraulic control. A separate evaluation by LADWP (2003) also raised concerns about detections of total chromium and hexavalent chromium in extraction well NHE-2 of the NHOU interim remedy.

The USEPA's groundwater monitoring program for the San Fernando groundwater basin started in 1993, and groundwater samples have since been collected on either a quarterly, semiannual, or annual basis. The USEPA has identified new contaminants in NHOU groundwater in excess of maximum contaminant level (MCL) or state notification levels, including hexavalent chromium; 1, 4-dioxane; 1, 2, 3-trichloropropane (1,2-3-TCP); and other select emerging chemicals (including perchlorate and n-nitrosodimethylamine [NDMA]). The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals. The USEPA issued a ROD on September 30, 2009 (USEPA, 2009), referred to as the Second Interim Remedy, with the intent to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect production well fields, and address emerging chemicals.

An Agreement and Order on Consent (AOC), dated February 21, 2011, was executed between the USEPA, Honeywell, and Lockheed Martin to conduct pre-design data acquisition, establish RAOs, and describe remedial design activities associated with the ROD (USEPA, 2011). Available data were reviewed to refine the NHOU conceptual site model (CSM) and identify critical data gaps. Recommendations for additional work were presented to the USEPA in the Final Data Gap Analysis (AMEC, 2012a). The work described in this FSP is based on the recommendations presented in the Final Data Gap Analysis report and has been prepared consistent with requirements stated in the AOC.

A2.4 Geological and Hydrogeological Information

The geology and hydrogeology in the area of the NHOU are described in detail in the Final Data Gap Analysis report (AMEC, 2012a), which also includes a refined CSM. The planned groundwater sampling described in this FSP will be conducted in the hydrogeologic units referred to as the A-Zone and the B-Zone.

A2.5 Environmental and/or Human Impact

Although the existing NHOU Extraction and Treatment System has reduced contaminant migration in the groundwater and removed substantial VOC mass from the aquifer, VOC concentrations remain above MCLs in groundwater. In addition, declining water table and changing groundwater pumping patterns in the SFV groundwater basin and the discovery of VOC contamination in new areas have demonstrated that the existing NHOU Extraction and Treatment System is not capable of fully containing the VOC plume. The USEPA has also identified emerging chemicals in NHOU groundwater in excess of MCLs or state notification levels, including hexavalent chromium; 1, 4-dioxane; 1,2,3-TCP; and other select emerging chemicals (including perchlorate and NDMA). The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals.

A3.0 PROJECT DATA QUALITY OBJECTIVES

A3.1 Project Task and Problem Definition

The objective of the additional groundwater sampling is to further delineate the lateral and vertical distribution of COCs in the NHOU study area. Table A-1 summarizes the wells to be sampled, chemical analyses for each sample, and locations where water levels will be measured for the groundwater monitoring program. The planned work includes the following tasks:

1) Resurvey monitoring wells relative to North American Datum of 1983 (NAD83) and North American Vertical Datum of 1988 ([NAVD88), respectively, to accurately depict groundwater flow directions and calculated gradients. The wells to be resurveyed are listed in Table A-1.
2) Measure groundwater elevations quarterly for one year at select existing monitoring wells to better understand temporal changes in groundwater flow directions and gradients.
3) Generate vertical flow logs at monitoring wells during the spring and fall seasons to evaluate the magnitude and direction of vertical flow through long-screened monitoring wells in response to seasonal pumping patterns. The wells are identified in Table A-1.
4) Collect depth discrete samples from the A-Zone and B-Zone in spring and fall to represent seasonal conditions and further delineate COC distributions in each zone.
5) Obtain additional A-Zone and B-Zone groundwater quality samples and groundwater elevation measurements near the NHE-1 extraction well from existing infrastructure to further evaluate the lateral and vertical distribution of COCs that may be present in this area and to further evaluate the potential utilization of the well (which has never operated as part of the NHOU Extraction and Treatment System) as part of the Second Interim Remedy.
6) Collect a continuous vertical profile from existing monitoring wells NH-C19 and NH-C23 (i.e., no more than 10-foot intervals) to evaluate the vertical distribution of COCs in these intervals.

A3.2 Data Quality Objectives (DQOs)

Data quality objectives (DQOs) are both qualitative and quantitative statements that define the type, quality, and quantity of environmental data appropriate for the intended application. In addition to the information presented in this section, the QAPP provides other information regarding overall data quality objectives. The task-specific DQOs for the groundwater sampling program were developed consistent with USEPA guidance (USEPA, 2006) and the following seven-step process:

1) State the Problem. Concisely describe the problem to be studied.
2) Identify the Decision. Identify the decision that will solve the problem using data.

3) Identify the Inputs to the Decision. Identify the information needed and the resulting measurements that need to be made in order to support the decision.
4) Define the Study Boundaries. Specify the conditions (time periods, spatial areas, and situations) to which the decision will apply and within which the data will be collected.
5) Develop a Decision Rule. Define the conditions by which the decision-maker will choose among alternative risk management actions. This is usually specified in the form of an "if…then…" statement.
6) Specify Acceptable Limits on Decision Errors. Define in statistical terms the decision-maker's acceptable error rate based on the consequence of making an incorrect decision.
7) Optimize the Sampling Design. Evaluate the results of the previous steps and develop the most resource-efficient design for data collection that meets all of the DQOs.

The results of the DQO steps, based on the purpose and scope for the work described in this FSP, are summarized below:

1) State the Problem.
    a) Analytical data are insufficient to delineate the lateral and vertical distribution and temporal variability of COCs in the NHOU study area with respect to the A-Zone and B-Zone and to define the necessary target capture area such that the Second Interim Remedy will meet, with reasonable certainty, RAOs and comply with CDPH 97-005 requirements.
    b) Groundwater elevation data are not surveyed to a common elevation datum to accurately verify and clarify groundwater flow directions and gradients in some locations.
    c) Vertical conduits throughout the NHOU are not sufficiently evaluated to quantify the volume of groundwater and COC mass induced to different depths in response to municipal pumping.
2) Identify the Decision.
    a) What are the vertical and lateral extents of COCs in the groundwater within the NHOU?
    b) How do the COC concentrations in groundwater differ from the spring to fall seasons?
    c) What is the capture area of the NHOU?
    d) For each well to be sampled, what is the current elevation of the depth measuring point?
    e) What are the estimated horizontal and vertical groundwater flow directions and gradients?
3) Identify the Inputs to the Decision.

a) Analytical results for groundwater samples, including depth-discrete samples and continuous vertical profile samples, as summarized in Table A-1.

b) Horizontal and vertical survey data for the wells listed in Table A-1 relative to NAD83 and NAVD88.

c) Depth to groundwater measurements at select monitoring wells, as summarized in Table A-1.

d) Vertical flow logs at select long-screened monitoring wells during the spring and fall seasons in response to seasonal pumping patterns. The wells are identified in Table A-1.

4) Define the Study Boundaries.

a) Groundwater will be sampled semiannually for one year (i.e., two events) from existing wells shown on Figure A-2: one event is identified as the spring season, and one event is identified as the fall season.

b) Depth to groundwater will be measured quarterly for one year as indicated in Table A-1.

c) Vertical flow logging will be performed at seasonal extremes, assumed to be May and October.

5) Develop a Decision Rule.

a) The applicable decision rules are as follows:

i) Groundwater data will be combined with existing data into the NHOU CSM. These data and the model will be used to further delineate the lateral and vertical distribution and temporal variability of COCs in groundwater (specific to the A-Zone and B-Zone), estimate groundwater flow directions and gradients, and evaluate the magnitude and direction of vertical flow in response to seasonal pumping patterns.

ii) If additional data gaps are identified or unanticipated chemicals are detected, the need for additional groundwater sampling from existing or new monitoring wells will be evaluated.

6) Specify acceptable limits on decision errors.

a) The QAPP and this FSP have been prepared based on the sample locations and data gaps previously identified in the Final Data Gap Analysis report (AMEC, 2012a). The predominant quantitative variability is measurement error. The measurements to be made include the depth to water in monitoring wells, the concentrations of COCs in groundwater, and the rates of vertical flow within long-screened monitoring wells.

b) Variability introduced by measurement of the depth to water could result in misplacement of contours on a potentiometric surface map, which might result in misinterpretation of the direction of the groundwater gradient. The consequences of the misinterpretation will vary depending on the application of the potentiometric map or the groundwater model.

c) Variability introduced by sampling, sample handling, and chemical analysis could result in a conclusion that the concentration of a COC has changed at a well when it has not, or has not changed when it actually has. The consequence of incorrectly deciding that a concentration has or has not changed is unnecessary additional work, including additional sampling and analysis and other assessment work.

d) Variability introduced by measurement of vertical distribution of later inflow into screened intervals of the wells could result in a misinterpretation of potential for contaminant transport through wellbore conduits. Inaccurate or unreliable flow data collected from these profiles may result in over or under-estimation of vertical contaminant transport rates within the SFV, which in turn will affect the reliability of the CSM.

7) Optimize the Sampling Design.

a) Sampling locations, number of samples, and analytical methodologies are proposed herein. As described in DQO Step 5, additional sampling may be conducted based on the findings of the anticipated work. The results of the sampling, with any modifications that were generated based on the DQO process, will be further described in the Findings Report.

A3.3 Data Quality Indicators (DQIs)

Data quality indicators (DQIs) refer to quality control criteria established for various aspects of data gathering, sampling, or analysis. The quality control requirements are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). The PARCCS parameters and calculation equations, as appropriate, are described in the main QAPP. The DQIs, type of quality control sample, frequency requirement, and acceptance criteria are presented in Table A-2. Field precision will be assessed on the basis of reproducibility by multiple readings from field instruments. Duplicate field instrument readings will be made on 1 out of every 10 samples per matrix to determine field instrument reproducibility. Accuracy of field instruments is assessed by daily instrument calibration and calibration checks.

A3.4 Data Review and Validation

Overall QA activities are described in the main QAPP and are included herein by reference. This section of the FSP provides a description of the QA activities that are specific for the anticipated groundwater sampling collection task:

- The laboratory will report 80 percent of the results in reports consistent with a Region IX Tier 2 data package and 20 percent in reports consistent with a Region IX Tier 3 data package.
- A third party will perform the data validation consistent with Region IX Tier 2 for 80 percent of the results and Region IX Tier 3 for 20 perecent of the results. The results will be summarized in data validation reports for submittal to AMEC and the USEPA.
- The usability of the data will be assessed by comparing the data to the review criteria and DQOs presented in Section 3.2.

- If the data are sufficient to achieve project objectives, the Project Manager will release the data and work can proceed. If the data are insufficient, corrective action will be required.
- If additional data are needed beyond the scope of the activities outlined in this FSP, the USEPA Project Manager will be notified within 30 days of their completion by written memorandum.

A3.5 Data Management and Assessment Oversight

Data management and assessment oversight for groundwater sample collection includes steps that will be taken to confirm that data are transferred accurately from collection to analysis to reporting. These steps include measures to review the data collection process, including field records, laboratory reports, and preparation of the final report for this work. Data management and assessment activities, including responsible team members, are described in this section of the FSP and in Sections 3.0 and 4.0 of the QAPP.

Data collected for the groundwater sampling program will be reviewed as part of the QA/QC process. The flow of data for the project will be as follows:

- Field data sheets (or their electronic equivalents) will be forwarded by the Field Task Leader to the AMEC Project Manager. The Field Task Leader and the AMEC Project Manager will review the data sheets. The review will include verification of the use of procedures in accordance with the QAPP and this FSP.
- Groundwater samples will be sent directly from the field to the selected laboratory. Copies of chain-of-custody forms and other field data sheets will be forwarded to AMEC. The Field Task Leader will review these forms and data sheets. The AMEC Project Manager will confirm with the Field Task Leader that the data have been reviewed and approved.
- Laboratory results, including electronic data deliverables (EDDs) and complete laboratory reports (as hard copies or pdf format), will be sent to the AMEC Project Manager. The AMEC Project Manager or appropriate technical designee will review this information.
- A third party will validate the analytical results and prepare data validation reports. The AMEC Project Manager or appropriate technical designee will review the reports.
- AMEC will document validated data in both electronic format (e.g., database) and hardcopy format.

In accordance with the AOC, the following interim submittals will be made to the USEPA Project Manager:

Relative Deadline	Submittal
Within 60 calendar days of sample shipment to the laboratory, or 14 days of receipt of analytical results from the laboratory, whichever occurs first	All analytical data, whether or not validated
Within 90 calendar days of the sample shipment to the laboratory	All validated analytical data in an approved electronic format

In compliance with the AOC Statement of Work Section 4.3.5, a Data Usability Evaluation and Field QA/QC submittal will be prepared for the USEPA and will describe the following:

- The criteria used to review and validate data, in an objective and consistent manner.
- The results obtained from the task, reconciled with the requirements defined by the data user or decision maker.
- The methods used to analyze the data and determine possible anomalies or departures from assumptions established in the planning phase of data collection.
- The methods used for field QA/QC.

In compliance with the AOC Statement of Work Section 4.3.6, a Data Reduction, Tabulation, and Evaluation submittal will be prepared for the USEPA and will include the following:

- Data that have been tabulated, evaluated and interpreted
- Data presented in an appropriate format for final data tables
- A database designed and set up with information that is pertinent and usable during the performance of the work
- An electronic database in a format compatible with USEPA's existing database
- Processed data tables.

The Data Usability Evaluation and Field QA/QC submittal, and the Data Reduction Tabulation, and Evaluation Submittal will be submitted to the USEPA 90 days after completion of the groundwater sampling program.

A4.0 SAMPLING RATIONALE

Groundwater samples were recommended in the Data Gap Analysis (AMEC, 2012a) to further characterize and distinguish groundwater quality conditions in the A-Zone and B-Zone to ensure the Second Interim Remedy design will meet remedial action objectives stated in the AOC and comply with CDPH 97-005 requirements. Results from depth-discrete groundwater samples will be used to verify that most COC mass is located within the A-Zone and that lower concentrations are associated with the B-Zone, as limited existing data suggests. Wells to be sampled during two semi-annual events are illustrated on Figure A-2.

Because existing wells cross-screen the A-Zone and B-Zone, particular care will be taken to allow stratified conditions within the saturated screen interval to restabilize after installation of low-flow sampling equipment. Vertical flow monitoring findings will also be considered when evaluating vertical groundwater quality data to account for intra-well flow conditions, if present at the time samples were collected. Vertical profiles of groundwater quality will be established using passive diffusion bag (PDB) samplers and will rely on VOCs as a proxy for other COCs.

The analyte list is consistent with the AOC scope of work and also includes major cations and anions, which will be used to further evaluate the chemical distinction of the A-Zone and the B-Zone. Otherwise, the primary COCs include TCE, PCE, 1,4-dioxane, and hexavalent chromium. An extended analyte list, and possibly different monitoring wells, needed for evaluation to comply with CDPH 97-005 requirements, will be detailed in a SAP Addendum; however, we anticipate that this additional sampling will be coordinated with the second semiannual sampling event (which will include piezometers to be installed next to NHE-3, NHE-5, and NHE-7).

A5.0 REQUEST FOR ANALYSES

A5.1 Analyses Narrative

As enumerated in Table A-1, groundwater samples will be collected semiannually from approximately 30 monitoring wells. Additional water volume will be collected as QA samples. Duplicate groundwater samples will be collected at a rate of 1 field duplicate set of samples for every 10 or fewer samples. MS/MSD groundwater samples will be collected at a rate of 1 MS/MSD for every 20 or fewer samples. Locations where duplicate samples and MS/MD samples will be collected are indicated in Table A-1.

The chemical analytical program will include analytes accounting for all COCs for depth-discrete A-Zone and B-Zone samples (including VOCs, 1,4-dioxane, hexavalent chromium, and emerging chemicals) as well as VOCs for vertical profile samples (Table A-3). Laboratory analyses will be completed on a standard turn-around-time basis.

A5.2 Analytical Laboratory

Groundwater analysis will be contracted to a laboratory at a date no later than one month before sampling activities. The laboratory's QA manual will be included as an addendum to the QAPP.

In general, all analyses will utilize USEPA-approved methods or other recognized standard methods. The laboratory analyses to be performed for the sampling event are listed in Table A-3.

A6.0 FIELD METHODS AND PROCEDURES

Sampling procedures, methods, and equipment anticipated for this work are described in this section. Decontamination procedures and corrective action procedures are also described. Refer to Section 7.0 for sampling tracking and shipping information.

Before work begins, well and encroachment permits will be acquired from the LADWP, Environmental Health Division, County of Los Angeles, and the City of North Hollywood, as necessary. Traffic plans will be prepared in accordance with Los Angeles County Health Department requirements and the Work Area Traffic Control Handbook to access wells located in streets. Coordination with the EPA and LADWP will also occur to avoid conflicts with other monitoring programs or activities that may be in progress, including NHOU Extraction and Treatment System operations during aquifer testing activities.

A6.1 Field Equipment

A6.1.1 List of Equipment Needed

The following sampling tools and equipment may be used to produce data during the implementation of the work:

- electrical sounder
- tag line
- photoionization detector (PID)
- multiparameter water quality meter (temperature, pH, specific conductivity [SC], oxidation reduction potential [ORP], and dissolved oxygen [DO])
- turbidimeter
- bladder pump (low-flow) and control box
- peristaltic pump
- silicon, Teflon, and/or polyethylene tubing
- 0.45 micron disposable capsule filters
- PDBs

A6.1.2 Calibration of Field Equipment

The field equipment that may be used on a regular basis that will need calibration cosists of the following:

- electric sounder
- PID
- multiparameter water meter (temperature, pH, SC, ORP, and DO)
- turbidimeter.

Proper maintenance, calibration, and operation of each instrument will be the responsibility of field personnel assigned to a particular field activity. Instruments and equipment used during the field investigations will be maintained, calibrated, and operated according to the manufacturer's guidelines and recommendations. Field equipment requiring regular calibration will be calibrated at least once per day. Relevant manuals will be kept with field personnel during the performance of field activities. Equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Items found to be inoperable will be taken out of use and a note stating the time and date of this action will be made in the daily field records. All entries will be signed and dated by the personnel performing the required action. An equipment calibration daily log form for selected equipment is provided in Appendix A-1.

A6.2 Field Screening

Field screening of groundwater will be conducted during monitoring well sampling using multiparameter water quality meter for temperature, pH, SC, ORP, DO, and turbidity. Results of field screening will be used during well purging as described in Section 6.3.3.

A6.3 Groundwater Sampling

A6.3.1 Wellhead Screening

Sampling team members will screen the headspace of each well before measuring total depth and static water levels to determine the presence or confirm the absence of volatile or combustible vapors in the well. PIDs will be used for headspace screening.

Sampling teams will field calibrate PIDs the morning of use to ensure that accurate data will be collected. After the instrumentation is calibrated and warmed up, the procedure to be used at each well is as follows:

- Confirm the monitoring well number
- Take an ambient air reading with the selected instrumentation to determine a background value and record this number
- Carefully remove the well cap (remove any water that may be found inside the valve box before removing the well cap)
- With the instrument running, lower the instrument probe into the wellhead, cover the opening of the well with a gloved hand as well as possible, and watch instrument response. Instrument response is typically one of the following:
    - No instrument response
    - A rapid rise and rapid drop to non-detect, indicating something was present in the well but has been vented to ambient air
    - A rise to a number where the response stabilizes, indicating the presence of volatile or combustible compounds. If this is the response observed, the site HASP must be reviewed to determine whether secondary measurements in the breathing zone are to be taken and whether upgraded personal protective equipment (PPE) must be donned

- After the instrument reading is recorded in the field notes, the equipment should be purged with clean air (ambient or bottled) to purge the sensor and ensure accurate readings at the next location.

A6.3.2 Measurement of Well Total Depth

After headspace has been screened, total depth of monitoring wells will be measured during the first quarterly event to confirm depth and determine whether sediment is accumulating in the bottom of the well. Sediment accumulation may indicate well redevelopment may be necessary. To measure the total depth of a well, a stainless steel sounding device (i.e., a tag line, not a water-level gauge or an oil-water interface probe) should be lowered into the well until it gently strikes the bottom of the well. The bottom of the well may feel “soft” if sediment is present. The device should be lowered to the bottom of the well and the tape pulled taut. The measurement should be taken relative to the same well reference point used for water-level measurements and recorded. It may not be possible to record measurements to an accuracy of ±0.01 feet.

Before being used on the first well and between wells, the well depth sounding device must be decontaminated. All tape that is lowered down-hole must be decontaminated, not just the weight at the end of the tape.

A6.3.3 Static Water Level Measurements

After headspace has been screened, static water levels will be measured using an electric sounder in wells listed in Table A-1 before purging and sampling activities begin. Water levels at all monitoring wells in the Pre-Design Investigation program will be measured as quickly as possible to ensure that, to the exent possible, the data are collected under the same conditions and a meaningful potentiometric (groundwater contour) map can be generated for the site.

If the monitoring well is not vented, samplers may observe a release of pressure when the well cap is removed, indicating that pressure has built up in the well as a result of water-level and barometric pressure changes since the last sampling event. Removal of the well cap will make it possible for the water level to equilibrate to ambient air pressure, which may take several minutes or longer, particularly in fine-grained formations. Field samplers will take multiple depth to water measurements to ensure water levels are static.

Static water-level measurements will be measured to a standardized reference point that has been permanently marked and surveyed relative to a known elevation datum. The reference point may be established on the well casing or on the outer well protective casing or valve box in the case of flush-to-grade well installations. In many cases, the measuring point at the top of the well casing is on the north side of the casing.

Before being used on the first well and between uses in additional wells, the water-level gauge tape and probe must be decontaminated. All tape that is lowered down-hole must be decontaminated, not just the probe at the end of the tape.

A second static water-level measurement will be taken in each well when the sampling team returns to the well to begin purging and sampling to verify the current static water level. This measurement may be used for calculating the height of the water column in the well and establish the proper sample depths.

When the depth to water in wells is more than 100 feet below ground surface, it may not be possible to attain the ±0.01-foot accuracy requirement. Accuracy for electrical conductivity tapes is limited to the stretch factor of the tape being used. This degree of accuracy is manufacturer-dependent and a certification of accuracy should be consulted to obtain specifications for the equipment used on a specific project.

A6.3.4 Depth-Discrete Samples

Depth-discrete samples will be collected from monitoring wells listed in Table A-1. Identified wells will be purged and sampled using low-flow sampling methods. Using a bladder pump and controller, compressed air or carbon dioxide, and poly and/or Teflon tubing, water quality parameters will be measured from groundwater through a closed flow-through cell. Low-flow well purging and sampling techniques are described in detail in the Resource Conservation and Recovery Act (RCRA) Ground-Water Monitoring Technical Enforcement Guidance Document (USEPA, 1986). Micro-purge and sampling techniques are described in detail in the USEPA Low-Flow Minimal Drawdown Ground-Water Sampling Procedure (USEPA, 1996).The following procedure may be followed to conduct low-flow purging and sampling:

1. Set portable pump to predetermined depth (Table A-1). Required tubing length will be measured to set the pump at the desired point in the screen, allowing for a few feet of tubing above the wellhead to attach the discharge tubing to the flow cell.
2. Portable pumps and tubing will be lowered slowly into the monitoring well measuring the depth of the pump intakes that correlate with the A-Zone and B-Zone sample depths. Pump intake locations within the well screen will be recorded on the groundwater sampling log.
3. Both pumps will remain in the well for at least one day to allow for groundwater stratification within the well screen to equilibrate following their installation. The wellhead will be secured during this time.
4. Before pumping begins, depth to water level will be measured to ±0.01 feet to establish the static water level at the start of purging. The water-level sounder will remain in the monitoring well throughout purging unless the low-flow sampling system has the ability to monitor drawdown and adjust the flow rate accordingly. Otherwise, the sounder will be used, as described below, to measure water-level decline during pumping.
5. A closed flow-through cell will be used in conjunction with a multiparameter water quality meter. Discharge tubing will be connected from the pump to the bottom inlet port of a flow cell. A “T” connection may be needed between the discharge tubing and flow cell to allow for the collection of water samples for turbidity measurement (if not using a multi-parameter device with a built-in turbidity sensor). Discharge from the flow cell will be directed to a container (e.g., a 5-gallon bucket) to contain the purge water generated during purging of the monitoring well. Care will be taken to avoid exposing the flow cell to direct sunlight to prevent an increase in water temperature during purging.
6. Wells will be pumped at a low flow rate (0.2 to 0.5 liters per minute). Depth to water measurements will be taken to measure declining water level during pumping to the point at which the water level stabilizes. If the water level continues to decline after a few minutes of pumping, decrease the flow rate of the pump and continue checking for water-level stabilization. Discharge rate will be measured in milliters per minute (mL/min) with a graduated cylinder and stop watch and record this pumping rate in the field book.

7. For wells in which the water stabilizes, measurements of water-quality indicator parameters can be taken after water-level stabilization using a multi-parameter meter installed within a flow cell. A minimum of one sampling system volume (the volume of water in the pump, tubing and flow cell) will be purged before recording the initial set of water-quality data. Equations to determine system volume are included on field parameter sheets (Appendix A-1) Water quality parameters to be measured include temperature, pH, SC, ORP, DO, and turbidity are to be measured, but they will typically include: DO, SC, pH, ORP, and temperature.
8. Independent water-quality measurements can be taken when a complete exchange of water has occurred in the flow cell. This time is calculated using the displaced volume of the flow cell (in mL) and the discharge rate of the pump (in mL/min). Groundwater chemistry stabilization is achieved when all parameters are within an acceptable range for three consecutive independent readings.

   ±0.1 pH units for pH
   ±3% S/cm for SC
   ±10 mV for ORP
   ±0.3 mg/L for DO

9. Turbidity readings will be recorded but not used as a stabilization parameter evaluated before collecting the groundwater sample.
10. After water-quality parameters are stable, the flow cell will be disconnected from the pump discharge tubing in preparation for sample collection. Samples will be collected at the same pumping rate as the well was purged.

A6.3.5 Continuous Vertical Profile Samples

Continuous vertical profile groundwater quality samples will be collected from select monitoring wells at the predetermined depths listed in Table A-1. Groundwater quality profiles will be evaluated using PDBs that will be deployed after low-flow sampling activities. PDBs are not appropriate for evaluating 1,4-dioxane or hexavalent chromium, and thus VOCs will be used as a proxy for other COCs. Results will be compared to low-flow depth-discrete samples from the same well and the need for additional samples will be considered. PDBs will be deployed at 10-foot intervals beginning at 3 feet below the screened interval. If static depth is greater than 3 feet below the top of the screened interval, PDBs will be deployed at 10-foot increments beginning at 3 feet below the static water level. PDBs will be deployed at 10-foot intervals throughout the entire screened interval.

Sealed PDB sampler bags will be stored in a cool area to preserve the integrity of the DI water-filled polyethylene bags and minimize formation of headspace inside the polyethylene bag.

Before mobilization to the site, well construction details and historical water levels in selected wells will be reviewed. Well construction and PDB sampler/holder parameter fields on PDB Forms will be completed (Appendix A-1). Snap hooks on the PDB holder will be adjusted such that the DI water-filled polyethylene bag will be secured by the hooks within the selected saturated screened interval of the well and the stainless-steel weight will barely rest below the screened interval. A knot will be tied at the top of the line to coincide with the top of the well casing to facilitate the proper placement of the PDB sampler within the well. To minimize the potential for contamination, each well-specific PDB holder will be placed in a labeled Ziploc bag for transport to the site.

Water level and total depth measurements will be obtained with an electronic water level indicator before a PDB sampler is installed in a well. Follow procedures for well depth measurements and water levels in Sections 6.3.2 and 6.3.3, respectively and record on PDB Forms.

The procedures for installing a PDB sampler are as follows:

1. Upon arrival at a well, don new nitrile gloves and remove a DI water-filled PDB sampler from cooler.
2. Attach the PDB sampler to the dedicated, well-specific PDB holder by zip tying the PDB sampler to the fixed plastic disks on the harness. Confirm PDB sampler position using the calculations presented on PDB Forms.
3. Slowly lower the PDB sampler down the well until the stainless-steel weight reaches the bottom of the well. Confirm that the sampler is properly positioned in the screened interval by positioning the top knot at the top of the well casing.
4. Secure the line extending above the top knot either to the steel casing of the well stickup or, for a flush mounted well, to the locking cap.
5. Close and lock the well.
6. Record the date and time of placement of the PDB sampler in the well on PDB Forms.

After a minimum 14-day sampling period, the procedures for collecting the PDB samplers will be as follows:

1. Before removal of the PDB samplers, don new nitrile gloves.
2. Remove the sample-filled PDB sampler from the well using the attached line.
3. Remove the sample-filled PDB sampler from the plastic disks and dry with a clean paper towel.
4. Cut open the sample-filled PDB using clean scissors and pour the water directly into the sampling containers. Record sample identification, date, time, analysis required, project identification, and sampler identification on each sample container. Place the sample containers in an ice-cooled chest immediately after collection. All information should also be entered on PDB Forms.
5. Return the dedicated holder to the appropriately labeled Ziploc bag. Close and lock the well after sampling activities are complete. Or, attach a new PDB sampler and lower into the well as described above.
6. Clean the scissors between retrieval of each PDB sampler using a Liquinox and DI water wash and rinse with DI water.
7. Deliver the samples to the laboratory within 24 hours of collection.

A6.4 Vertical Flow Logging

The vertical distribution of later inflow into the screened interval of the well will be measured in monitoring wells listed in Table A-1 using an Electromagnetic Borehole Flowmeter (EBF).

Operating instructions are detailed below and can be found in the Operating Instructions for the Electromagnetic Borehole Flowmeter (QEC, 1998).

The EBF has two components: the down-hole probe and the up-hole electronics. An armored cable connects the probe and the electronics box. The probe consists of an electromagnet, two electrodes and amplifiers inside a hollow cylinder. The electromagnet creates a magnetic field across the cylinder oriented 90 degrees to the electrodes.

The flowmeter operates according to Faraday's Law of Induction, which states that the voltage induced by a conductor moving at right angles through a magnetic field is directly proportional to the velocity of the conductor moving through the field. The water is the conductor and the electrodes sense the voltage gradient generated by the water moving through the magnetic field. The voltage induced is not dependent on the conductivity of the water, only the velocity. The flowmeter will measure flow in either direction. A positive reading on the display and the analog output indicates the flow is up through the meter. A negative reading indicates the flow is down. Pulling the flow-meter up through the water simulates downward flow and is a good system check.

The 1-inch probe will be used to measure the vertical flow. It has an inside diameter of one inch and an outside diameter of 1.94 inches and is designed to measure flows between 40 milliliters per minute and 40 liters per minute. It is designed to fit in schedule 40 two-inch PVC well casing, but can be modified with a flexible collar to seal off bypass flow for use in wells up to 6 inches in diameter. When using the collar, the probe must be centered in the well to keep one side of the collar from compressing and allowing the flow to bypass the meter.

The up-hole electronics consist of a magnet drive, signal conditioning, display, analog output and the following controls:

- Meter Factor — Digital push button potentiometer for setting system gain
- Probe Size — A toggle switch for selecting the ½-inch or 1-inch probe
- Zero — A locking potentiometer for zeroing the system
- Analog Out — Terminals for a voltage output proportional to the flow
- Time Constant — A three-position switch to set the response time of the flowmeter
- Display — digital meter displaying the flow in liters per minute
- On/Off — Power switch

The meter factor sets the gain of the system and is determined by placing a known flow through the probe and adjusting the meter factor until the readout is correct. The known flow should be approximately one-half the full-scale range of the system and can vary from one meter to the next; the meter factor calibrated by Quantum Engineering Corporation (QEC) can be found on the label on the neck of the probe.

The zero is set by pushing down the locking ring and turning the knob until the display reads zero. The analog output is used for automated logging of the data. The output voltage for the 1-inch flow meter is 1 volt = 4 liters per minute. Full-scale output is ±10 volts.

There are two cautionary procedures that must be followed to avoid damaging the system:

1) Be sure the system power is turned off before connecting and disconnecting the flowmeter probe
2) Take care to avoid pin misalignment. Pin misalignment applies power to the wrong pins and will damage the probe.

With these precautions in mind, the EBF system should be assembled and activated as follows:

1) Fit probe with collar Sometimes extra weight is required to force the EBF probe down the well with a collar attached, especially in larger-diameter wells, because water below the probe assembly must pass through the interior of the probe for the assembly to descend.
2) Attach the cable to the probe making sure the pins are correctly aligned. Plug the other end of the cable into the up-hole electronics.
3) Place the probe in water and turn power on. Do not leave the probe out of water with power on for long periods of time as this could overheat and damage the instrument.
4) Select the ½-inch or 1-inch meter position for the probe being used.
5) Set the meter factor to the correct value for the probe being used. Wait approximately 30 minutes for the system to warm up before proceeding.
6) Adjust the system zero before measuring flow. In the electronic box, pushing down the locking ring and turning the knob sets the zero. There are several ways to ensure there is no flow through the flowmeter while zeroing the probe. One of the best ways is have the top of the flowmeter out of the water at the top of the well with the electrodes still submerged. An easy way to do this is to slowly raise the probe in the water until the display starts to drift (this will happen when the electrodes are out of the water). Then slowly lower the probe until the display starts to move back towards zero. At this point, the electrodes are in the water, but there is no flow through the probe since the top of the probe is out of the water.
7) Select the time constant according to the amount of scatter in the data. If the readings are stable a time constant of 1 may be used. However, if the readings are varying, a time constant of 10 or 20 may make it easier to read the display and the analog output will be more stable.
8) Flow can now be read off the display or from the analog output. Note: the analog output is 1 volt = 1 liter per minute for the ½-inch probe and 1 volt = 4 liters per minute for the 1-inch probe.
9) Move the probe up or down the well in the range to be measured, stopping to take measurements at set intervals. Wait for the disturbance created by moving the probe to subside before taking a reading.
10) When measurements are completed save the files and shut off the power to the probe before removing it from the water.
11) Remove the flowmeter cable when measurements completed for the day and the device is to be stored. Caution must be used when removing the cable from the flow-meter. Rocking the connector when removing the cable can bend or break the pins on the flow-meter. Broken pins are not repairable. A tool is provided for aiding in the cable removal. Push the tool between the rubber connector and flow meter while

pulling straight on the cable. It is easier to do if two people help. The flat side of the tool should be against the rubber

There are three problems that rarely occur, but have been encountered with the EBF in the field:

1) In the presence of large ground voltages, ground currents can flow through the system and disrupt flow measurements. This can happen around factories with heavy machinery running and sometimes under high-voltage power lines. This usually can be overcome by running the EBF on an isolated power supply such as a gasoline-powered generator.
2) Another potential problem occurs in wells in zones with no flow, where the groundwater has relatively high concentrations of chemical contamination. A reaction occurs between the electrodes and the contaminated, stagnant water causing the EBF to drift to a value above zero. Even a very small flow of a few milliliters per minute eliminates this problem. This problem can be confirmed by slowly moving the probe up or down, thus simulating a flow.
3) A more common problem is to lower the probe into the mud at the bottom of the well and have the electrodes become coated with mud. If this condition is suspected, rapidly move the probe up and down to wash off the electrodes.

Wire-wrapped stainless-steel screens present a problem. Neither a collar nor a packer will seal properly in these pipes. However, measurements can still be made by using a collar and calibrating the flow bypassing the probe. The low-end sensitivity and accuracy will be reduced, but useful measurements can be obtained. One method is to size the collar for the joints in the screen. To do this, place the probe with the collar just below a joint and take a measurement, then place the probe in the joint and compare the flow. Different flow rates can be compared by varying the pump or injection rate. However, care must be exercised in selecting the joint. It should not be in an inflow zone (the flow above and below the joint should be the same). A joint can be recognized by the increase in drag when pulling the probe/collar assembly through the joint.

A6.5 Decontamination Procedures

Equipment decontamination procedures are intended to reduce the potential for sample contamination and cross-contamination between wells. Decontamination of the groundwater level measuring equipment and well sounding equipment will consist of wiping the line with a disposable towel moistened with deionized (DI) water. When water levels are measured or a well sounded, the wetted portion of the sounding tape, water level line, or wire will be washed with a potable water-detergent solution and rinsed with DI water.

Portable bladder pumps, flow-through cells, and EBF will be cleaned between uses at each well. Bladder pumps, flow-through cell, and EBF will be disassembled per manufactures instructions and cleaned by washing with a Liquinox and water solution. The bladder pump, flow-through cell, and EBF will then be triple rinsed, with the last rinse being a DI water rinse. Tubing used will be new and dedicated to wells for future sampling events. Tubing will be stored in sealed plastic bags in a cool, dry and secured location.

Equipment will be decontaminated in a pre-designated area on plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas. Cleaned small equipment will be stored in plastic bags. Materials to be stored more than a few hours will also be covered.

A6.6 Surveying

Table A-1 identifies wells to be surveyed in the NHOU study area. Wells identified were either surveyed to National Geodetic Vertical Datum of 1929 (NGVD29), have not been surveyed within the past 10 years, or are newly installed monitoring wells and piezometers. For these wells, the coordinates and top of well casing reference point elevation of each monitoring well will be surveyed by a California-licensed Land Surveyor using a global positioning system (GPS) instrument and referenced to a recognized survey monument. The top of casing elevation (north face), and the rim of the well box elevation will be surveyed to 0.01-foot accuracy using NAVD88. The longitude and latitude of each monitoring well (i.e., horizontal coordinates) will be surveyed to eight decimal place accuracy using NAD83. The data will be consistent with California GeoTracker coordinate system used to define the location of monitoring wells throughout the SFV. The top of casing and rim of well box will be marked (north face) for wells being resurveyed. For newly installed wells, the top of casing will be notched (north face).

A7.0 SAMPLE CONTAINERS, PRESERVATION, AND STORAGE

Sample containers will be provided by the selected analytical laboratory. The size, type, and number of sample container(s) for each chemical analysis are presented in Table A-3. The containers will be new and pre-cleaned.

The required sample preservatives for each analytical method are listed in Table A-3. Some of the analyses currently selected require preservatives, and the sample bottles will have the appropriate preservatives before shipment by the laboratory to AMEC. The preservation criteria for VOCs ($pH < 2$) will be checked by the laboratory upon receipt of the samples. If the pH is greater than 2 for a specific sample, the analytical hold time will be reduced to 7 days instead of the usual 14 days.

Each sample will be stored in a shipping cooler immediately after the sample is taken, sealed, and labeled. If possible, samples will be shipped to the laboratory the same day that they are obtained. Shipping will be by courier or overnight shipping. If a sample or samples cannot be shipped the same day, the samples will be stored in the shipping cooler overnight for courier delivery the following day. Samples will be shipped to the laboratory within 24 hours from the time they are obtained. If the samples are stored overnight, additional ice will be added as appropriate to maintain the proper temperature in the shipping cooler.

A8.0 DISPOSAL OF RESIDUAL MATERIALS

Liquid in the form of purged groundwater will be brought to the surface during groundwater monitoring sampling activities. In addition, liquid used for decontamination of sampling equipment will also be generated during sampling activities. These liquids will be placed into appropriately sized tanks. A sticker/label that reads ‘This Container On Hold Pending Analysis’ will be affixed to the outside of each tank once liquid is first placed in them. The sticker/label will detail the appropriate AMEC contact information. If the waste is found to be hazardous, the label will be changed to read “Hazardous Waste”.

Personal protective equipment and disposable sampling equipment used during this project will be placed in a trash bag and placed in a municipal refuse container. IDW drums will be stored in a designated area to be determined before sampling activities.

The AMEC Field Coordinator will document the unique tank Identification Number (included with each tank), dates of liquid placed in tank and the date when the tank was sampled for waste characterization on the appropriate field form (Appendix A-1).

One grab sample will be collected from the vertical and horizontal center of each tank for liquid waste characterization purposes. The sample will be collected from the center of the tank in laboratory-provided clean sample containers, labeled, entered into chain-of-custody protocol, placed in ice-chilled cooler, picked up by courier or shipped priority overnight, to a California state-certified laboratory for analysis. Liquid samples will be analyzed for the constituents listed in Table A-3.

Analytical results will be provided simultaneously to the IDW hauler to begin the shipment approval process. The Task Manager will work collaboratively with the IDW hauler to determine waste characteristics. The analytical results will be compared to 40 CFR 261 and California Code of Regulations Title 22, Division 4.5, Chapter 11 to determine hazard characteristics. The profile will be sent to Honeywell and Lockheed Martin, or their authorized delegee, for signing following the acceptance between the Task Manager and IDW hauler.

Once liquid waste is generated, the following procedures will be as follows:

1. Waste will be sampled in accordance with the procedure described above.
2. Samples will be sent to the laboratory for analysis.
3. Analytical results will be sent to the Task Manager.
4. The Task Manager will send the analytical results to the IDW hauler.
5. The Task Manager will work with the IDW hauler to characterize the waste.
6. The Field Team Leader will coordinate a desired pick-up date with the IDW hauler.
7. The IDW hauler will prepare the waste profile and send it to the Task Manager for review.
8. The profile will be sent to Honeywell and Lockheed Martin, or their authorized delegee, for signing and a copy will be sent electronically to the Task Manager for filing.

9. A Uniform Hazardous Waste Manifest (hazardous only) or non-hazardous manifest will be prepared and sent electronically to the Task Manager for review.
10. If the waste is hazardous, a Land Disposal Restriction Notification will be shipped along with the Uniform Hazard Waste Manifest.
11. The Task Manager will contact Honeywell and Lockheed Martin to inform them that a manifest has been reviewed and will be sent to them for signing.
12. The signed manifest will be sent back to the Task Manager or Field Team Leader.
13. The Task Manager or Field Team Leader will date the manifest and confirm quantities in the field at the time of shipment.

The procedures for document retention are as follows:

1. Profiles and manifests will be sent to Honeywell and Lockheed Martin for signing.
2. AMEC, on behalf of Honeywell and Lockheed Martin, will send copies of the signed manifest to the Department of Toxic Substances Control (DTSC) within 30 days of the shipment date.
3. The signed manifests will be sent from the disposal facility to AMEC, on behalf of Honeywell and Lockheed Martin, within 35 days of the shipment.
4. If the signed manifest is not received within 45 days, an exception report will need to be filed with the DTSC.
5. Copies of signed manifests and corresponding profiles with supporting analytical data will be sent to the Task Manager for filing.

A9.0 SAMPLE DOCUMENTATION AND SHIPMENT

Various field records and procedures will be used to document the sampling event and the handling and shipping of samples. The following paragraphs describe the forms, records, and procedures used during the sampling event.

A9.1 Field Notes

A9.1.1 Daily Field Records

The Field Task Leader and other field sampling team members will maintain field records to provide a daily record of significant events, observations, and measurements during sampling. All information pertinent to sampling will be recorded on a Daily Field Record form or on activity-specific data forms (Appendix A-1). Each day's field record entries will be signed and dated and will include the following information:

- Date and time of entry, and weather and environmental conditions during the field activity
- Project name and number
- Location of sampling activity
- Names of field crew members
- Names of site visitors
- Sample media (e.g., groundwater)
- Sample collection method (e.g., portable pump)
- Number of samples taken.

When activity-specific data forms are used, they will include the following additional information:

- Investigation location
- Sampler's initials
- Sampling medium
- Sampling method.

The following information will be recorded either on a Daily Field Record form or on the activity-specific forms:

- Volume and number of samples taken
- Date and time of collection
- Sample depth
- Sample identification number(s), including well name and/or number
- Sample destination (for example, laboratory)
- Water-level measurement data

- Field observations
- Field measurements (e.g., pH, temperature, and conductivity)
- Sample handling (preservation).

All entries will be made using indelible ink; any entries requiring changes will be made by striking a line through the entry and entering the correct information. The person making the entry will initial and date the correction. Unused portions of pages will be crossed out, signed, and dated at the end of each workday.

A9.1.2 Activity-Specific Forms

In addition to the Daily Field Record form, the following forms may be utilized to document field activities. Example forms are included as Appendix A-1 to this FSP.

- Well Sampling and/or Development Record – Well purging and groundwater sampling notes and field measurements of water quality parameters will be summarized on this form. Water level data will also be recorded on this form.
- Chain-of-Custody Record – Sample collection information identifying sample identification, sample collector, date, time, requested analyses, preservation, container type and size, laboratory name and address, shipping method, special handling requirements, and the names of the persons relinquishing and receiving the samples will be recorded on this form.
- Sample Control Log – Contains a list of all samples collected and includes the date and time sampled, sample number, applicable chain-of-custody form number, analyses requested, the date delivered to the laboratory, the date results are due, and the initials of the person completing the log.
- Field Instrument Calibration Sheet – Information regarding the calibration of field instruments will be recorded on this form, including the equipment type and manufacturer, model number, serial number, calibration standard, instrument reading, date and time calibrated, and the name of the person performing the calibration.

A9.1.3 Photographs

Photographs may be taken to document representative field procedures. When a photograph is taken, the date, time, weather conditions (if applicable), subject, purpose for the photograph, and photograph number will be recorded on a Daily Field Record form. Site-specific photographs will be taken for project records before the beginning of field work begins and after it is completed.

A9.2 Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. A copy of the sample label is included in Appendix A-1. The samples will have preassigned, identifiable, and unique numbers. Sample identification naming conventions are addressed in detail in Section 3.1.2 of the SAP. At a minimum, each sample collected at the site will be labeled with the following information:

- Unique sample identification number as discussed in the SAP

- Date and time of collection
- Initials and signature of person collecting sample
- Analyses requested
- Preservation
- Any other information pertinent to the sample.

All information pertaining to a particular sample is referenced by its identification number that is recorded on the sample container, in the field notes, and on the sample chain-of-custody form. After a sample is collected, the sample label will be completed in waterproof ink and secured to the sample container.

A9.3 Sample Chain-of-Custody Forms

All sample shipments for analyses will be accompanied by a chain-of-custody record. A copy of the form is found in Appendix A-1. Form(s) will be completed and sent with the samples for each laboratory and each shipment (i.e., each day). If multiple coolers are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each cooler.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone’s physical possession, in someone’s view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of AMEC. The sampling team leader or designee will sign the chain-of-custody form in the “relinquished by” box and note date, time, and air bill number. A copy will be retained in AMEC project files.

A9.4 Packaging and Shipment

Samples will be transported as soon as feasible after sample collection to the laboratory for analysis. The following procedures are to be used when packing and transporting samples to the laboratory:

1. When ice is used, pack it in sealed, double-thick Ziploc bags. Seal the drain plug of the cooler with fiberglass tape to prevent melting ice from leaking out of the cooler.
2. Line the bottom of the cooler with bubble wrap to prevent breakage during shipment.
3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of the sample bottles with indelible ink.
4. Affix sample labels onto the containers with clear tape.
5. Wrap all glass sample containers in bubble wrap to prevent breakage.
6. Seal all sample containers in heavy-duty plastic Ziploc bags.
7. Place samples in a sturdy cooler(s) lined with a large plastic trash bag. Enclose the appropriate chain-of-custody form(s) in a Ziploc bag affixed to the underside of the cooler lid.
8. Fill empty space in the cooler with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment.

9. Pack ice used to cool samples in sealed double-thick Ziploc bags and place it on top and around the samples to chill them to the correct temperature.
10. Tape each ice chest securely shut with fiberglass strapping tape, and affix custody seals firmly to the front, right, and back of each cooler.

A10.0 QUALITY CONTROL

This section presents the field QC checks that will be performed during field investigations, including a discussion of field QC samples with frequency and acceptance criteria and field corrective action procedures. A discussion of laboratory QC samples and laboratory corrective action is presented in Section 3.0. of the QAPP.

A10.1 Field Quality Control Samples

The type and frequency of field QC samples to be collected during field investigations are described below and shown in Table A-4.

A10.1.1 Assessment of Field Contamination (Blanks)

Field contamination is assessed through the collection of equipment blanks, field blanks, trip blanks, and temperature blanks.

A10.1.1.1 Equipment Blanks

Equipment rinsate blanks will be collected to evaluate field sampling and decontamination procedures by pouring high-performance liquid chromatography (HPLC) organic-free (for organics) or DI water (for inorganics) over the decontaminated sampling equipment.
One equipment rinsate blank will be collected per matrix each day that sampling equipment is decontaminated in the field. Equipment rinsate blanks will be obtained by passing water through or over the decontaminated sampling devices used that day. The rinsate blanks are analyzed for the same analytes as the corresponding samples collected that day.

The equipment rinsate blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. A separate sample number and station number will be assigned to each sample, and it will be submitted blind to the laboratory.

A10.1.1.2 Field Blanks

Field blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sampling due to ambient conditions, from sample containers, or from source water used for decontamination or rinsing. Field blank samples will be obtained by pouring HPLC organic-free water (for organics) and/or DI water (for inorganics) into a sampling container at the sampling point. The field blanks that are collected will be analyzed for the same analytes as the corresponding samples collected that day.

The field blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. A separate sample number and station number will be assigned to each sample, and it will be submitted blind to the laboratory.

A10.1.1.3 Trip Blanks

A minimum of one trip blank will be submitted to the laboratory for analysis with every shipment of samples for VOC analysis. Trip blanks will be provided by the laboratory and shipped with the empty sampling containers to the site or sampling area before sampling begins. The sealed trip blanks are not opened in the field and are shipped to the laboratory in the same cooler with the samples collected for volatile analyses. The trip blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. A separate sample number and station number will be assigned to each trip sample, and it will be submitted blind to the laboratory.

A10.1.1.4 Temperature Blanks

For each cooler that is shipped or transported to an analytical laboratory, a 40 mL volatile organic analysis (VOA) vial will be included that is marked "temperature blank." This blank will be used by the sample custodian to check the temperature of samples upon receipt.

A10.1.2 Assessment of Field Variability (Field Duplicate or Co-located Samples)

Duplicate or "blind" field samples collected for the purpose of assessing the precision of the primary laboratory. Duplicate field samples will be collected at an approximate rate of one duplicate sample per 10 primary samples for each chemical analysis (i.e., 10 percent duplicate samples).

Duplicate samples will be preserved, packaged, and sealed in the same manner as the primary samples. A separate sample number and station number will be assigned to each duplicate, and it will be submitted blind to the laboratory.

A10.2 Background Samples

Not applicable.

A10.3 Field Screening and Confirmation Samples

Not applicable.

A10.4 Laboratory Quality Control Samples

The laboratory will analyze QC samples as required by the specific analytical methods and the laboratory's internal QA program. The laboratory will be alerted as to which sample is to be used for MS/MSD analysis by a notation on the sample container label and the chain-of-custody record or packing list.

A11.0 FIELD VARIANCES

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this FSP. When appropriate, the AMEC Project Manager will be notified and a verbal approval will be obtained before implementing the changes. The AMEC Project Manager will notify the USEPA of major modifications or variances to the field program. Modifications to the procedures presented in this FSP will be documented on the Daily Field Record form and on other task-specific forms as applicable. Significant modifications will be documented in the final report for the sampling event.

A12.0 FIELD HEALTH AND SAFETY PROCEDURES

The field work will be performed in accordance with the site-specific health and safety plan (HASP) prepared as a separate submittal for this work. Subcontractors will be responsible for their own health and safety and must follow the project HASP (AMEC, 2012c), at a minimum.

A13.0 REFERENCES

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Quantum Engineering Corporation (QEC), 1998. Operating Instructions for the Electromagnetic Borehole Flowmeter. February.

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TABLES

Table A-1 Groundwater Monitoring and Sampling Program
North Hollywood Operable Unit
Los Angeles County, California

Well N/Ame	Bottom of A-Zone Contact (depth bgs.)[1]	Bottom of B-Zone Contact (depth bgs.)[1]	Screen Interval (ft. BTOC)	Screen Interval (ft. BTOC)	Assumed Representative Screen Zone(s)			Semi Annual Depth Discrete Monitoring Well Sampling [2]	Sample Depth Configuration	Vertical Profiles	Vertical Flow Logging	Surveying	Quarterly Water Levels [7]
					A-Zone	B-Zone	Below B-Zone						
4909C	345.7	430.7		230-240, 290-300, 390-400, 480-490	X	X	X	X	[8]				
4909F	340	N/A		138-348	X	X		X	[9]				
4918A	400.58	N/A		230-240, 290-300, 390-400, 480-490	X	X		X	[9]				
4919D	346.2	431.2		230-240, 290-300, 390-400, 480-490	X	X	X	X [2]	[8]				
4928A	383.78	N/A		225-433	X	X		X	[9]				
GW-18B	342.28	405.28		400-450		X	X	X	[10]				
GW-19B	338.96	405.96		400-450		X	X	X	[10]				
LA1-CW05	284.75	358.75		336-376		X	X	X	[10]				
LC1-CW01	342.94	418.94		461-491			X		N/A			X	X
LC1-CW02	343.02	N/A		382-392		X			[11]			X	X
LC1-CW03	343.19	N/A		259-280	X				[12]			X	X
NH-10	346.8	407.8		160-535	X	X	X	X	[8]				
NH-C01-325	366.08	N/A		275-325	X				[12]			X	X
NH-C01-450	366.15	N/A		400-450	X	X		X [4]	[9]			X	X
NH-C01-660	366.24	459.24		630-660			X		N/A			X	X
NH-C01-780	366.27	459.27		740-780			X		N/A			X	X
NH-C02-220	268.52	N/A		170-220	X				[12]			X	X
NH-C02-325	268.73	N/A		275-325		X			[11]			X	X
NH-C02-520	268.85	343.85		470-520			X		N/A			X	X
NH-C02-681	268.97	343.97		641-681			X		N/A			X	X
NH-C03-380	321.28	N/A		340-380		X			[11]			X	X
NH-C03-580	321.41	382.41		540-580			X		N/A			X	X
NH-C03-680	321.46	382.46		640-680			X		N/A			X	X
NH-C03-800	321.62	382.62		760-800			X		N/A			X	X
NH-C05-320	349.33	N/A	270-320	270-320 [4]	X				[12]		X	X	X
NH-C05-460	349.19	448.19	390-460	390-460 [4]		X			[11]		X	X	X
NH-C08-295	337.88	N/A		245-295	X				[12]				X
NH-C09-310	329.83	N/A		250-310	X				[12]				X
NH-C10-280	**320.74**	N/A	220-280	220-280 [4]	X				[12]		X		X
NH-C10-360	**320.74**	N/A	310-360	310-360 [4]	X	X		X	[9]		X		X
NH-C11-295	317.86	N/A		235-295	X				[12]				X
NH-C12-280	**326.17**	N/A		210-280	X				[12]				X
NH-C12-360	**326.17**	N/A		310-360	X	X		X	[9]				X
NH-C13-385	**342.59**	N/A		335-385	X	X		X	[9]				X

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Table A-1 Groundwater Monitoring and Sampling Program
North Hollywood Operable Unit
Los Angeles County, California

Well N/Ame	Bottom of A-Zone Contact (depth bgs.)[1]	Bottom of B-Zone Contact (depth bgs.)[1]	Screen Interval (ft. BTOC)	Screen Interval (ft. BTOC)	Assumed Representative Screen Zone(s)			Semi Annual Depth Discrete Monitoring Well Sampling [2]	Sample Depth Configuration	Vertical Profiles	Vertical Flow Logging	Surveying	Quarterly Water Levels [7]
					A-Zone	B-Zone	Below B-Zone						
NH-C14-250	306.2	N/A		200-250	X			X	[12]				X
NH-C15-240	**290.59**	**379.04**		180-240	X				[12]				X
NH-C15-330	**290.59**	**379.11**		270-330	X	X			[9]				X
NH-C16-320	**359.61**	N/A	250-300	250-300[4]	X				[12]		X		X
NH-C16-390	**359.61**	N/A	340-390	340-390[4]	X	X		X[6]	[9]		X		X
NH-C17-255	**286.03**	N/A		185-255	X				[12]				X
NH-C17-339	**286.03**	**358.27**		279-339				X	N/A				X
NH-C18-270	**329.38**	**406.77**		220-270				X	N/A				X
NH-C18-365	**329.38**	N/A		305-365	X	X		X	[9]				X
NH-C19-290	**337.55**	N/A	230-290	230-290	X			X[4]	[12]	X[6]	X		X
NH-C19-360	**337.55**	N/A	300-360	300-360	X	X		X	[9]	X[6]	X		X
NH-C20-380	**342.35**	N/A		320-380	X	X		X	[9]				X
NH-C21-260	**310.8**	**388.1**		210-260	X			X	[12]				X
NH-C21-340	**310.8**	**388.31**		280-340	X	X		X	[9]				X
NH-C22-360	**367.87**	**462.34**		300-360	X				[12]				X
NH-C22-460	**367.87**	**462.62**		390-460		X			[11]				X
NH-C22-600	**367.87**	**462.5**		550-600			X		N/A				X
NH-C23-310	**340**	**399.66**	250-310	250-310[4]	X			X	[12]	X[6]	X		X
NH-C23-400	**340**	**399.65**	340-400	340-400[4]		X		X	[11]	X[6]	X		X
NH-C24-305	**335**	N/A		245-305	X			X	[12]				X
NH-C24-410	**335**	N/A		340-400		X			[11]				X
NH-C25-290	334.7	N/A		240-290	X				[12]				X
NHE-1	**329.1**	N/A		190-276	X			X	[12]				
NH-VPB-02	314.5	N/A		241.6-261.6	X				[12]			X	X
NH-VPB-03	284.55	N/A		200.05-220.35	X				[12]			X	X
NH-VPB-05	267.26	N/A		185.16-205.46	X				[12]			X	X
NH-VPB-06	339.93	N/A		287.43-307.73	X				[12]			X	X
NH-VPB-07	349.28	N/A		270.58-290.88	X				[12]			X	X
NH-VPB-08	280.25	N/A		205-225.55	X				[12]			X	X
NH-VPB-09	379.86	N/A		271.06-291.46	X				[12]			X	X
NH-VPB-10	357.12	N/A		305.42-325.72	X				[12]			X	X
NH-VPB-11	358.64	N/A		301.14-321.44	X				[12]			X	X
PST-MW-1P	319.69	N/A		207-287	X			X[6]	[12]				
PST-MW-2P	321.09	N/A		204-284	X			X	[12]				
PZ-NHE-3 (Shallow)	324.86	N/A		250-270	X				[12]			X	X
PZ-NHE-3 (Deep)	324.86	N/A		305-325	X				[12]			X	X
PZ-NHE-5 (Shallow)	305	N/A		230-250	X				[12]			X	X
PZ-NHE-5 (Deep)	305	N/A		275-295	X				[12]			X	X
PZ-NHE-7 (Shallow)	291	N/A		230-250	X				[12]			X	X

Table A-1 Groundwater Monitoring and Sampling Program
North Hollywood Operable Unit
Los Angeles County, California

Well N/Ame	Bottom of A-Zone Contact (depth bgs.)[1]	Bottom of B-Zone Contact (depth bgs.)[1]	Screen Interval (ft. BTOC)	Screen Interval (ft. BTOC)	Assumed Representative Screen Zone(s)			Semi Annual Depth Discrete Monitoring Well Sampling [2]	Sample Depth Configuration	Vertical Profiles	Vertical Flow Logging	Surveying	Quarterly Water Levels [7]
					A-Zone	B-Zone	Below B-Zone						
PZ-NHE-7 (Deep)	291	N/A		285-305	X				12			X	X

Notes:
N/A Not Applicable
1. Bolded depths from well e-log. All other depths from interpolated surface of contact.
2. Semi annual samples will be aN/Alyzed for constituents listed in Table A.3.
3. Collect duplicate and MS/MSD sample.
4. Collect duplicate sample.
5. Interval to be profiled.
6. See Section 6.3.4 of FSP for PDB deployment depth criteria.
7. Total depths of wells will be sounded during first quarterly event.
8. Collect A-Zone sample near top-of-screen or static water level (within 3 feet if practicable). Collect two B-Zone samples near bottom of A-Zone contact and bottom of the B-Zone contact (within 3 feet of each contact if practicable).
9. Collect A-Zone sample near top-of-screen or static water level (within 3 feet if practicable). Collect B-Zone sample near middle of bottom-of-screen and bottom of A-Zone contact.
10. Collect two B-Zone samples near top-of-screen and bottom of B-Zone contact (within 3 feet of each if practicable).
11. Collect two B-Zone samples near top-of-screen and bottom-of-screen (within 3 feet of each if practicable).
12. Collect A-zone sample near top-of-screen or static water level (within 3 feet if practicable).

Table A-2 Method Performance Objectives—Acceptance Criteria
North Hollywood Operable Unit
Los Angeles County, California

Method Performance Objective	Type of Quality Control Sample	Frequency	Acceptance Criteria
Precision			
Field	Duplicate field sample	1 per 10 samples	Relative percent difference, RPD <30
Laboratory	Laboratory control samples (LCS) and laboratory control duplicate (LCSD) samples	1 per batch of 20 samples per matrix	RPD <20
	Matrix spike (MS) and matrix spike duplicate (MSD) samples	1 per batch of 20 or fewer investigative samples per matrix	RPD <20
	Unspiked duplicate samples	1 per batch of 20 samples per matrix	RPD <20
Accuracy			
Field	Trip blanks	1 per cooler of volatile organic compounds (VOC) samples	U.S. Environmental Protection Agency (USEPA) National Functional Guidelines Protocol [1,2]
	Equipment rinsate blank	1 per day per equipment type (non-dedicated equipment)	USEPA National Functional Guidelines Protocol [1,2]
	Temperature blank	1 per cooler with chilled samples	< 4±2 degrees centigrade
	Field blank	1 per water source per sampling event	USEPA National Functional Guidelines Protocol [1,2]
Laboratory	Matrix spike (MS) samples	1 per batch of 20 or fewer investigative samples per matrix	Percent recovery, %R, less than compound specific limit (refer to Laboratory Quality Assurance Manual)
	Laboratory control samples (LCS)	At least once with each analytical batch, with a minimum of 1 for every 20 samples	%R less than compound specific limit (Refer to Laboratory Quality Assurance Manual)
	Method blanks	At least once with each analytical batch, with a minimum of 1 for every 20 samples	No compound should be detected above its respective Reporting Limit in laboratory method blanks
	Preparation blanks	At least once with each analytical batch, with a minimum of 1 for every 20 samples	No compound should be detected above its respective Reporting Limit in laboratory preparation blanks

Table A-2 Method Performance Objectives—Acceptance Criteria
North Hollywood Operable Unit
Los Angeles County, California

Method Performance Objective	Type of Quality Control Sample	Frequency	Acceptance Criteria
Laboratory (cont'd)	Surrogates		%R less than compound specific limit (refer to Laboratory Quality Assurance Manual)
Representativeness	Not applicable	Not applicable	Numerical goals cannot be used to evaluate this subjective measure.
Completeness	Not applicable	Not applicable	90% completeness
Comparability	Not applicable	Not applicable	Comparable if the same procedures for collecting and analyzing the samples are used, if the samples comply with the same QA/QC procedures, and if the units of measurement are the same
Sensitivity	Not applicable	Not applicable	Reporting limits (RLs) below or equal to the task-specific target analysis goals or concentrations

Notes:
1. USEPA, 2008, Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review; U.S. Environmental Protection Agency Office of Emergency and Remedial Response, EPA-540-R-08-01, June.
2. USEPA, 2010, Contract Laboratory Program National functional Guidelines for Inorganic Superfund Data Review, OSWER 9240, EPA 540-R-10-011, January.

Table A-3 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Target Analytes	Analytical Method	Sample Volume; Container	Preservation	MDL[1]	Reporting Limits[1]	Holding Time
Volatile Organic Compounds	EPA 8260	(3) 40 mL VOAs	Cool to 4±2º C pH < 2 HCL	0.133 - 10 µg/L	0.5 – 20 µg/L	14 days
	EPA 524.2	(3) 40 mL VOAs	Cool to 4±2º C pH <2 HCL	0.09 - 12 µg/L	0.5 – 5.0 µg/L	14 days
1,2,3-Trichloropropane	SRL 524M -TCP	(3) 40 mL VOAs	Cool to 4±2º C HCL	0.0025 µg/L	0.005 µg/L	14 days
1,4-Dioxane	EPA 8270C	1 Liter amber glass	Cool to 4±2º C	0.284 µg/L	1 µg/L	7 days
	EPA 522	2 Liter amber glass	Cool to 4±2º C $NaHSO_4$	0.01 µg/L	0.07 µg/L	14 days
n-nitrosodimethylamine (NDMA)	EPA 1625CM	1 Liter amber glass	Cool to 4±2º C	0.00932µg/L	0.002 µg/L	7 days
	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00028 µg/L	0.002 µg/L	14 days
N-Nitrosodibutylamine (NDBA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00059 µg/L	0.002 µg/L	14 days
N-Nitrosodi-n-propylamin(NDPA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00035 µg/L	0.002 µg/L	14 days
N-Nitrosodiethylamine (NDEA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00072 µg/L	0.002 µg/L	14 days
N-Nitrosomethylethylamin(NMEA)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00028 µg/L	0.002 µg/L	14 days
N-Nitrosopyrollidine (NPYR)	EPA 521	2 Liter amber glass	Cool to 4±2º C $Na_2S_2O_3$	0.00066 µg/L	0.002 µg/L	14 days

Table A-3 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Target Analytes	Analytical Method	Sample Volume; Container	Preservation	MDL[1]	Reporting Limits[1]	Holding Time
Perchlorate	EPA 314.0	100 mL poly	Cool to 4±2º C Filtered	0.356 µg/L	2 µg/L	28 days
Total Chromium	EPA 200.8	500 mL poly	Cool to 4±2º C pH < 2 HNO3	0.293 µg/L	1 µg/L	6 months
Hexavalent Chromium	EPA 218.6	500 mL poly	Cool to 4±2º C	0.041 µg/L	0.2 µg/L	24 hours
Cations Ca, Mg, Na, K, Fe	EPA 200.7	500 mL poly	Cool to 4±2º C pH < 2 HNO3	0.00336 – 0.103 mg/L	0.1 – 0.5 mg/L	6 months
Anions Nitrate, Nitrite, Cl, SO_4, Total Nitrate/Nitrite	EPA 300.0	500 mL poly	Cool to 4±2º C pH < 2	0.159 – 0.296 mg/L	0.1 – 1 mg/L	28 days Nitrate - 48 hours
Total Hardness	200.7	250 mL poly	Cool to 4±2º C pH < 2 HNO3	0.989 mg/L	2 mg/L	6 months
Alkalinity	SM2320B	500 mL poly	Cool to 4±2º C	0.850 mg/L	1 mg/L	14 days
Total Dissolved Solids	SM2540C	500 mL poly	Cool to 4±2º C	0.820 mg/L	10 mg/L	7 days

Notes:
1. MDLs and Reporting Limits were provided by CalScience Environmental Laborotories, Inc, from Garden Grove, California.

:

Table A-3 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Abbreviations

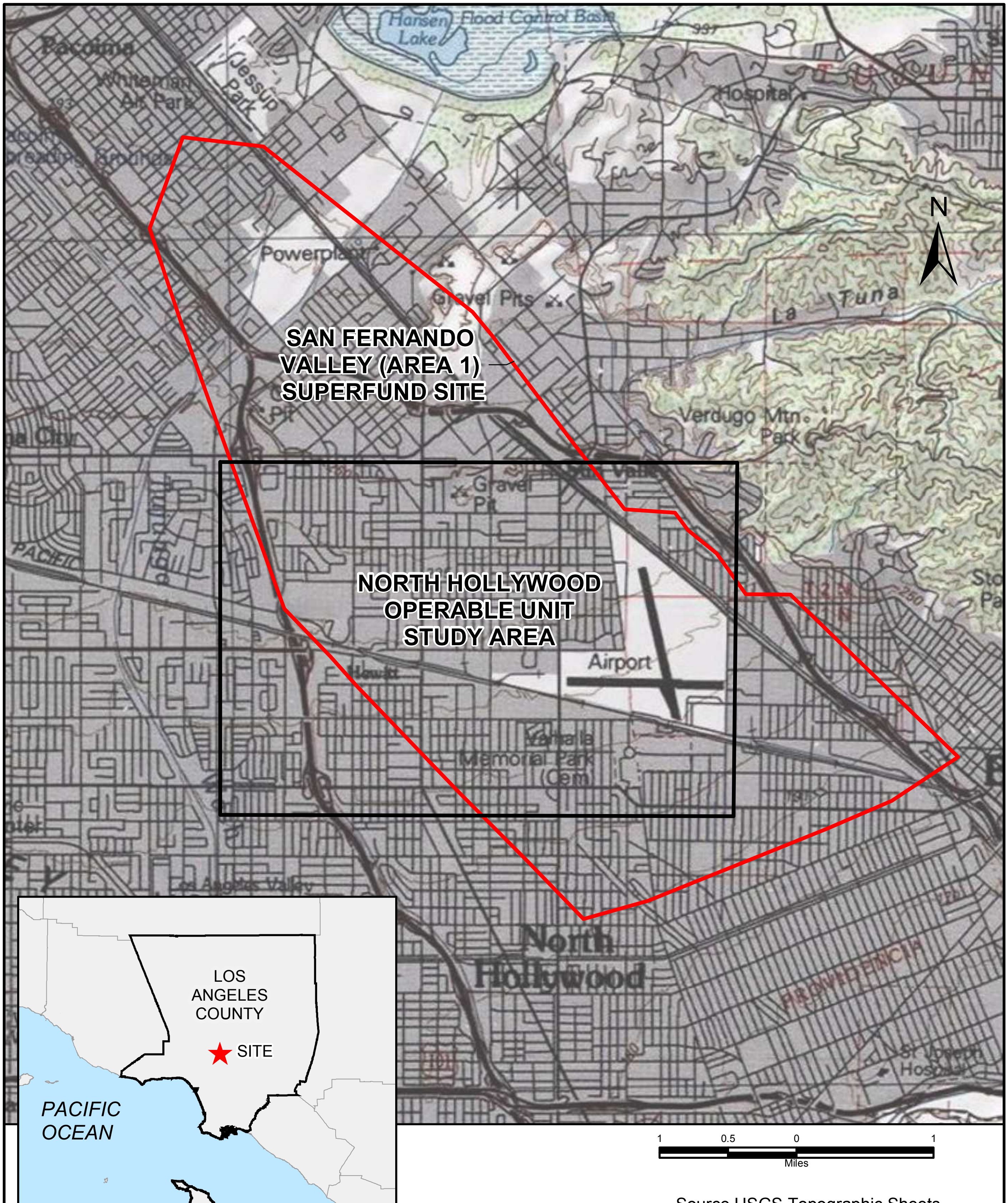
Ca = Calcium
Cl = Chloride
EPA = U.S. Environmental Protection Agency
Fe = Iron
HCL = hydrochloric acid
HNO3 = Nitric Acid
K = Potassium
MCL = Maximum Contaminant Level (Cal/EPA)
Mg = Magnesium
mg/L = milligrams per liter
mL = milliliter
Na = Sodium
NO_3-N = Nitrate
NO_2-N = Nitrite
SM = Standard Methods
SO_4 = Sulfate
VOA = Volatile Organic Analysis
μg/L = micro grams per liter

Table A-4 Field Quality Control Samples
North Hollywood Operable Unit
Los Angeles County, California

Type of Quality Control Sample	Frequency	Acceptance Criteria
Trip blanks	1 per cooler of VOC samples	USEPA National Functional Guidelines Protocol
Equipment rinsate blank	1 per day per equipment type (non-dedicated equipment)	USEPA National Functional Guidelines Protocol
Temperature Blank	1 per cooler with chilled samples	< 4±2 degrees centigrade
Field blank	1 per water source per sampling event	USEPA National Functional Guidelines Protocol
Duplicate	1 per 10 samples	Relative percent difference, RPD <30

Abbreviations:
RPD = relative percent difference
VOCs = volatile organic compounds
USEPA = U.S. Environmental Protection Agency

FIGURES



Source USGS Topographic Sheets

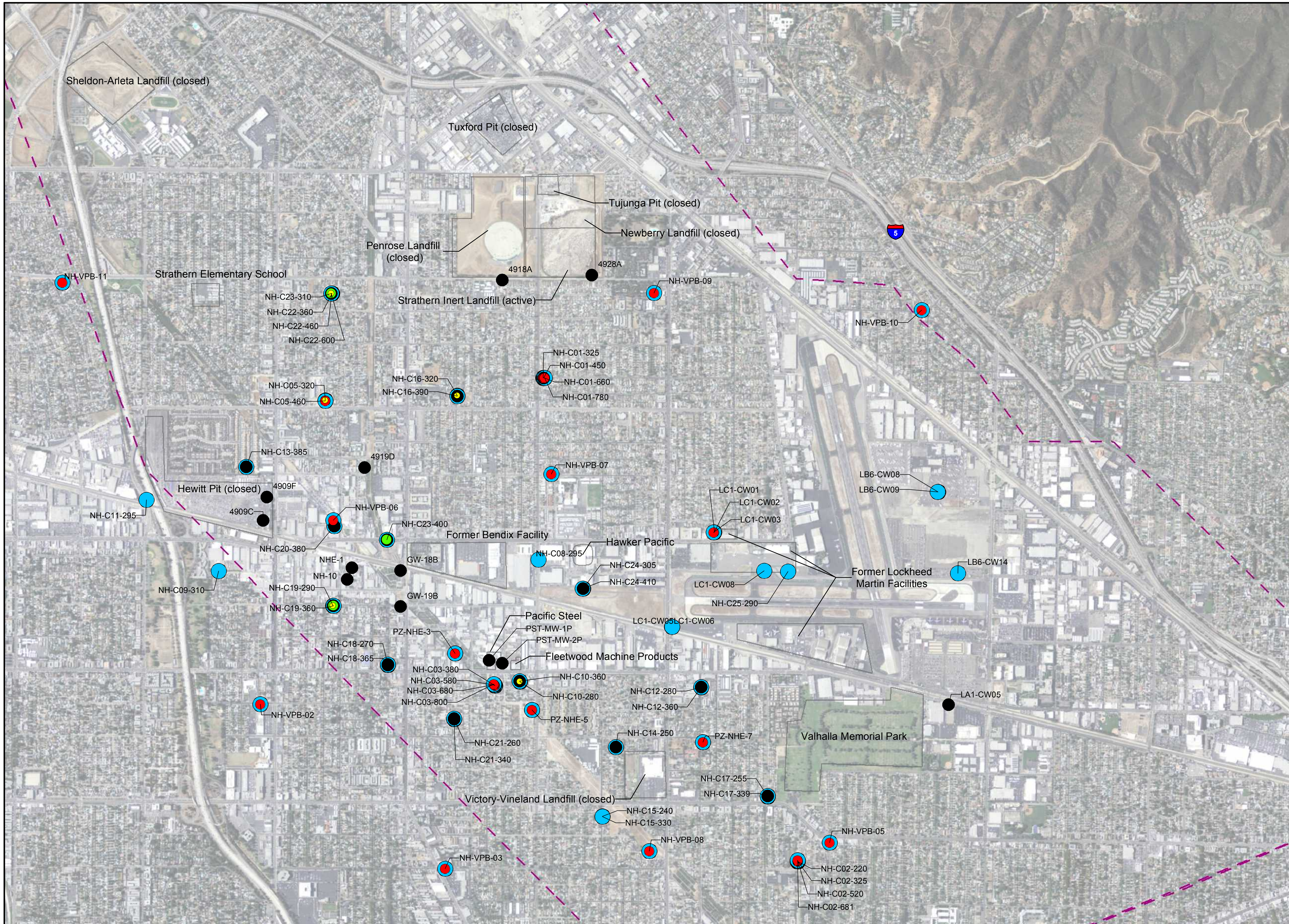
amec

Site Vicinity Map
Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

APPENDIX
A-1

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
TJH	4088115718		4/2012		

Thursday, August 23, 2012 9:43:53 AM
P:\4088\115718_NHOU\GIS\Projects\FSP(A)\FigureA-1-VicinityMap.mxd



EXPLANATION

- Vertical Flow Logging Wells
- Vertical Profile Wells
- Surveying Wells
- Depth-Discrete Sampling Wells
- Quarterly Water-Level Wells
- Approximate Boundary San Fernando Valley Investigation Area 1

N

0 2,000 4,000
Feet

DRAWN: TJH	PROJECT NO: 4088115718		
REV:	SCALE: AS SHOWN		
CHECKED:	APPROVED:		
DATE: 4/2012	DATE: 4/2012		

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Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Groundwater Monitoring Well and Survey Locations

APPENDIX
A-2

Thursday, August 23, 2012 9:47:20 AM
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APPENDIX A-1

Field Record Forms

BIN/TANK INVENTORY

Project:__________________________________ Project Number:________________________________

Well ID/Location:_______________________________

Fill Date	End Fill Date	Bin/Tank Identification	Contents/Details	Sampling Date	Comments

DAILY FIELD RECORD

Project and Task Number:	Date:
Project Name:	Weather:
Location:	Field Activity:
Recorded By:	

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

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DAILY FIELD RECORD (continued)

Page ___ of ___

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

AMEC
Environment & Infrastructure, Inc.

Project Name:	Operator:	Date:
Project Number:	Task Number:	Calibration Start Time:

Multi-Probe Calibration Log

Instrument Information

multi-probe make: /	turbidimeter make:
multi-probe serial # (stamped on back of unit):	turbidimeter serial #:
multi-probe rental ID (N/A if AMEC unit):	turbidimeter rental ID (N/A if AMEC unit):
last calibration date:	last calibration date:
service/receive date:	service/receive date:

Calibration Solution Information

conductivity 1000µS/cm Lot:	pH10 standard lot:
conductivity 1000µS/cm expiration:	pH10 standard expiration:
pH7 standard lot:	Zobel standard lot #:
pH7 standard expiration:	Zobel expiration:

Parameter Calibrations

Function	Uncal	Temp.	Initial Reading	Calibrated To	Further Information
pH - pH7 standard	❑	°C	pH	pH7.0	Calibrate pH7 **before** pH10
pH – pH10 standard	❑	°C	pH	pH10.0	
ORP - Zobel solution	❑	°C	mV	mV	See Zobel Solution Values chart, below.
sp. conductance – 1000µS/cm	❑	°C	µS/cm	1000µS/cm	1mS/cm=1000µS/cm. OK range: ±10% (±100µS/cm).
dissolved oxygen (% saturation)	❑	°C	%	100%	barometric pressure:__________mmHg (from YSI 556)
turbidity – 0 or 10 NTU solution	NA	NA			

Zobel Solution Values

Temperature °C	Zobel Solution Value, mV
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5

Comments:

Signature of Operator: Completion Time:

HEALTH & SAFETY PID MONITORING

Project Name: ______________________________

____

____

Project Number: ______________________

Date: ______________________________

Measured by: ______________________

PID MEASUREMENTS

Concentrations in ppm

Location: ____________		Location: ____________		Location: ____________	
Time	**Measurement**	**Time**	**Measurement**	**Time**	**Measurement**

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PASSIVE-DIFFUSION BAG (PDB) SAMPLING RECORD

Project/Task No. :	Project Name:
Well ID:	Well Diameter:
Field Personnel:	Date of Sampling:
PDB Diameter:	PDB Length:
Depth to Water:	<Depth to Top of Screen?

Γ Yes, [Depth of PDB Top] remains unchanged

Γ No, [Depth of PDB Top] = ([Depth to Water]+[Depth to Bottom of Screen])/2 – [PDB Length]/2

PDB INSTALLATION DATE

PDB RETRIEVAL **Sample ID:**

Depth of PDB Top (feet below TOC)	Time	Comments (headspace, condition of PDB upon retrieval, slimy or not)

PDB FIELD DUPLICATE **Duplicate ID:**

Depth of PDB Top (feet below TOC)	Time	Comments (headspace, condition of PDB upon retrieval, slimy or not)

PDB INSTALLATION

Depth of PDB Top (feet below TOC)	Time	Comments (condition of PDB upon installation)

FIELD PARAMETERS

Date	Time	Sampling Depth (feet)	Temp (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	PDB Status[1]

[1] Note if pre-PDB installation, PDB in well, or post-PDB retrieval (A, B, or C).

Date	Time	Sampling Depth (feet)	Temp (°C)	pH (units)	Specific Electrical Conductance (μS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	PDB Status[1]

[1] Note if pre-PDB installation (A), PDB in well (B), or post-PDB retrieval (C).

[1] Note if pre-PDB installation, PDB in well, or post-PDB retrieval (A, B, or C).

PHOTOGRAPH LOG

Project Name: ______________________________

____

____

Project No. ______________________________

Roll No. ______________________________

Photo No.	Date	Subject, Location, and Direction of View	Taken by

CHAIN-OF-CUSTODY RECORD

PROJECT NAME:			DATE:	PAGE OF
PROJECT NUMBER:	LABORATORY NAME:	CLIENT INFORMATION:	REPORTING REQUIREMENTS:	
RESULTS TO:	LABORATORY ADDRESS:			
TURNAROUND TIME:				
SAMPLE SHIPMENT METHOD:	LABORATORY CONTACT:		GEOTRACKER REQUIRED YES NO	
	LABORATORY PHONE NUMBER:		SITE SPECIFIC GLOBAL ID NO.	

SAMPLERS (SIGNATURE):

DATE	TIME	SAMPLE NUMBER	ANALYSES															CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	TOTAL NUMBER OF CONTAINERS:
SIGNATURE:			SIGNATURE:			SAMPLING COMMENTS:
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			
SIGNATURE:			SIGNATURE:			
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			
SIGNATURE:			SIGNATURE:			
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			

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SAMPLE CONTROL LOG

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Project Name: ______________________________ **Laboratory:** ______________________________

Project and Task No.: ______________________________ Page ____ of ____

Sampling Date	Sampling Time	Sample Number (ID)	C.O.C. Number	Analyses Requested	Turnaround Time, Sample Location, Handling Notes, Chain-of-Custody Remarks, etc. (Duplicate, Blank info, etc.)	Date Sent to Lab	Date Results Due


SAMPLE ID:
amec
Project No: ______ . ______ . ______
Project Name: ______
Time (24hr): ______ Date: ____/____/____
Analysis: ______
Preservative: ______
Remarks: ______
Recorder: ______
AMEC Environment & Infrastructure -- 2101 Webster Street, Oakland, CA 94612 -- (510) 663-4100

WATER LEVEL MONITORING RECORD

Project Name: ______________________________ Project and Task Number: __________________________

Date: _____________ Measured by: __________________ Instrument Used: __________________________

Note: For your convenience, the following abbreviations may be used.

P = Pumping　　I = Inaccessible　　D = Dedicated Pump

ST = Steel Tape　　ES = Electric Sounder　　MP = Measuring Point　　WL = Water Level

Well No.	Time	MP Elevation (feet)	Water Level Below MP (feet)	Water Level Elevation (feet)	Previous Water Level Below MP	Remarks

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: ______________________

Sample ID: __________ **Duplicate ID:** __________

Sample Depth: ______________________

Project and Task No.: ______________________

Project Name: ______________________

Date: ______________________

Sampled By: ______________________

Method of Purging: ______________________

Method of Sampling: ______________________

Initial Depth to Water: ______________________

Depth to Water after Sampling: ______________________

Total Depth to Well: ______________________

Well Diameter: ______________________

1 Casing/Borehole Volume: ______________________
(Circle one)

4 Casing/Borehole Volumes: ______________________
(Circle one)

Total Casing/Borehole Volumes Removed: ______________________

Time	Intake Depth	Rate (ml/min)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (μS/cm)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Remarks (color, turbidity, and sediment)

pH CALIBRATION (choose two)					Model or Unit No.:
Buffer Solution	pH 4.0	pH 7.0	pH 10.0		
Field Temperature °C					
Instrument Reading					

SPECIFIC ELECTRICAL CONDUCTANCE (SEC) – CALIBRATION				Model or Unit No.:
KCl Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C		
Field Temperature °C				
Instrument Reading				

ORP/REDOX CALIBRATION		DISSOLVED OXYGEN CALIBRATION		Notes:
Standard Solution (mV)		Altitude / Salinity %		
Field Temperature °C		Field Temperature °C		
Instrument Reading (mV)		Instrument Reading (mg/L)		
Model or Unit No.:		Model or Unit No.:		

APPENDIX B

Drilling/Piezometer Installation Field Sampling Plan

TABLE OF CONTENTS

Page

TABLES

FIGURES

APPENDIX

ABBREVIATIONS AND ACRONYMS

1,2,3-TCP	1,2,3-trichloropropane
AMEC	AMEC Environment and Infrastructure, Inc.
AOC	Agreement and Order on Consent
bgs	below ground surface
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHG	Certified Hydrogeologist
CIH	Certified Industrial Hygienist
COC	chemical of concern
CFR	Code of Federal Regulations
CSM	conceptual site model
DI	deionized
DigAlert	Underground Service Alert of Southern California
DO	dissolved oxygen
DQIs	Data Quality Indicators
DQOs	Data Quality Objectives
DTSC	Department of Toxic Substances Control
EDD	electronic data deliverable
FSP	Field Sampling Plan
HASP	Health and Safety Plan
Honeywell	Honeywell International, Inc.
HPLC	high-performance liquid-chromatography
IDW	investigation-derived waste
LADWP	Los Angeles Department of Water and Power
Lockheed Martin	Lockheed Martin Corporation
MCL	Maximum Contaminant Level
mL	milliliter
NDMA	n-nitrosodimethylamine
NHE	North Hollywood extraction (well)
NHOU	North Hollywood Operable Unit
NHOU	North Hollywood Operable Unit
ORP	oxidation reduction potential
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCE	tetrachloroethene
PE	Principal Engineer
PG	Principal Geologist
pH	potential hydrogen
PID	photoionization detector
PMP	Project Management Professional
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan

QC	Quality Control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SC	specific conductivity
SFV	San Fernando Valley
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
VOA	volatile organic analysis
VOCs	volatile organic compounds

B1. INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC), has prepared this Field Sampling Plan (FSP) on behalf of Honeywell International, Inc. (Honeywell) and Lockheed Martin Corporation (Lockheed Martin) to present the rationale, field methods and procedures, analytical requests, and quality assurance/quality control (QA/QC) procedures for planned Second Interim Remedy activities for the North Hollywood Operable Unit (NHOU) in compliance with the U.S. Environmental Protection Agency's (USEPA) Interim Action Record of Decision (ROD) dated September 30, 2009. The Second Interim Remedy is intended to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect water supply production well fields, and address emerging chemicals. This FSP addresses activities for drilling and piezometer installation recommended by the Final Data Gap Analysis (AMEC, 2012a) and described in the Final Phase 1 Pre-Design Investigation Work Plan (AMEC, 2012b).

The organization of this FSP follows the outline presented in the USEPA Sampling and Analysis Plan Guidance and Template (USEPA, 2000). This FSP is an appendix to the Sampling and Analysis Plan (SAP), which provides additional information about the Second Interim Remedy for the NHOU, historical information, the study area setting, and the objectives of the Phase 1 Pre-Design Investigation.

B1.1 Sampling Area

The Site is known as the North Hollywood Operable Unit study area, which is part of the San Fernando Valley (Area 1) Superfund Site.

B1.2 Sampling Area Location

The NHOU is located in the community of North Hollywood (a district of the City of Los Angeles) (Figure B-1). The NHOU is approximately 15 miles northwest of downtown Los Angeles and west of the City of Burbank, California.

B1.3 Responsible Agency

The work described in this FSP will be conducted by AMEC under contract by Honeywell and Lockheed Martin. The lead regulatory agency is the USEPA, Region IX.

B1.4 Project Organization

Title/Responsibility	Name	Phone Number
USEPA Project Manager	Matt Salazar	415.972.3982
Honeywell Project Manager	Benny DeHghi	310.512.2296
Lockheed Martin Project Manager	Carolyn Monteith	228.813.2211
AMEC Staff:		
Principal in Charge	Warren Chamberlain, PG, CHG, PE	510.663.3984
Project Manager	Michael Taraszki, PG, CHG, PMP	510.663.4100
Engineering Manager	Robert Hartwell, PE	773.693.6030
Lead Modeler	Jeff Weaver	970.764.4070
Quality Assurance Manager	Margaret K. (Peggy) Peischl, PE	510.663.4100
Health and Safety Manager	Donald Kubik, Jr., CIH, PG	510.663.4100
Field Team Leader	Damian Hriciga, PG	510.663.3988

B1.5 Statement of the Specific Problem

The results of the Data Gap Analysis indicate that additional geologic, geophysical, hydraulic, and groundwater data are needed to ensure that the Second Interim Remedy design will meet remedial action objectives (RAOs) and comply with California Department of Public Health (CDPH) 97-005 requirements. The critical groundwater data gaps covered by this specific FSP consist of the following:

- Performance monitoring wells and piezometers have not been installed and monitored to demonstrate the size and shape of the existing NHOU extraction well capture area, specifically with regard to the A-Zone and B-Zone.
- Depth-discreet groundwater analytical data in the vicinity of the extraction wells is not available.
- Insufficient data are available to determine the geological and hydrogeological distinction between the A-Zone and the B-Zone.

B1.6 Schedule

The work described in this FSP is expected to be completed by PER SCHEDULE IN Appendix D, per the revised project schedule included in the *Final Phase 1 Pre-Design Investigation Work Plan*. Before drilling and piezometer installation begins, the Field Team Leader will confirm that required access agreements are completed, qualified subcontractors are available to perform the work, secure locations are identified for temporarily storing investigation-derived waste (IDW), and arrangements for disposal of IDW are confirmed.

B2. BACKGROUND

This section provides an overview of the location, previous investigations, and the current understanding of the site conditions.

B2.1 Site Description

The NHOU comprises approximately 4 square miles of contaminated groundwater underlying an area of mixed industrial, commercial, and residential land use in the community of North Hollywood (a district of the City of Los Angeles). The NHOU is approximately 15 miles northwest of downtown Los Angeles, immediately west of the City of Burbank, and has approximate Site boundaries of Sun Valley and Interstate 5 to the north, State Highway 170 and Lankershim Boulevard to the west, the Burbank Airport to the east, and Burbank Boulevard to the south.

The work described in this FSP will be conducted adjacent to existing extraction wells NHE-3, NHE-5, and NHE-7 as shown on Figures B-2, B-4, and B-6.

B2.2 Operational History

The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8), a collector line, and a central treatment system consisting of an air-stripping treatment system to remove volatile organic compounds (VOCs) from the extracted groundwater, two activated carbon filters to remove VOCs from the air stream, a chlorination system, and ancillary equipment. The treated groundwater is discharged into a Los Angeles Department of Water and Power (LADWP) blending facility where it is combined with water from other sources before entering the LADWP water supply system. The existing NHOU Extraction and Treatment System began operation in December 1989 and remains in operation today. As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHOU system, and NHE-5 has not operated since 2008.

B2.3 Previous Investigations/Regulatory Involvement

This section presents a brief summary of the previous investigations and regulatory involvement for the NHOU that occurred from 1984 through 2011. For additional details, consult the SAP or documents identified in the references section.

The NHOU was proposed by the USEPA in 1984 in response to the discovery in the late 1970s of trichloroethene (TCE) and tetrachloroethene (PCE) in groundwater from production wells in the San Fernando groundwater basin and throughout much of the eastern portion of the San Fernando Valley. In 1989, LADWP constructed the existing NHOU Extraction and Treatment System.

The USEPA conducted a series of five-year reviews for the NHOU interim remedy (USEPA, 1993, 1998, 2003, 2008) and concluded that the TCE and PCE groundwater plume was migrating vertically and laterally beyond the remedy's zone of hydraulic control. A separate evaluation by LADWP (2003) also raised concerns regarding detections of total chromium and hexavalent chromium in extraction well NHE-2 of the NHOU interim remedy.

The USEPA's groundwater monitoring program for the San Fernando groundwater basin started in 1993, and groundwater samples have been collected on either a quarterly, semiannual, or annual basis. The USEPA has identified new chemicals in NHOU groundwater in excess of maximum contaminant levels (MCLs) or state notification levels, including hexavalent chromium; 1,4-dioxane; 1,2,3-trichloropropane (1,2,3-TCP); and other selected emerging chemicals (including perchlorate and n-nitrosodimethylamine [NDMA]). The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals. The USEPA issued a Record of Decision (ROD) on September 30, 2009 (USEPA, 2009), referred to as the Second Interim Remedy, with the intent to to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect production well fields, and address emerging chemicals.

An Agreement and Order on Consent (AOC), dated February 21, 2011, was executed between the USEPA, Honeywell, and Lockheed Martin to conduct pre-design data acquisition, establish RAOs, and describe remedial design activities associated with the ROD (USEPA, 2011). Available data were reviewed to refine the NHOU conceptual site model (CSM) and identify critical data gaps; and recommendations for additional work were presented to the USEPA in the Final Data Gap Analysis (AMEC, 2012a). The work described in this FSP is based on recommendations presented in the Final Data Gap Analysis report and has been prepared consistent with requirements stated in the AOC.

B2.4 Geological and Hydrogeological Information

The geology and hydrogeology in the area of the NHOU are described in detail in the Final Data Gap Analysis report (AMEC, 2012a), which also includes a refined CSM. The planned groundwater sampling described in this FSP will be conducted in the hydrogeologic units referred to as the A-Zone and the B-Zone.

B2.5 Environmental and/or Human Impact

Although the existing NHOU Extraction and Treatment System has reduced contaminant migration in the groundwater and removed substantial VOC mass from the aquifer, VOC concentrations remain above MCLs in groundwater. In addition, declining water table and changing groundwater pumping patterns in the San Fernando Valley (SFV) groundwater basin and the discovery of VOC contamination in new areas have demonstrated that the existing NHOU Extraction and Treatment System is not capable of fully containing the VOC plume. The USEPA has also identified new chemicals in NHOU groundwater in excess of MCLs or state notification levels, including hexavalent chromium; 1,4-dioxane; 1,2,3-TCP; and other selected emerging chemicals (including perchlorate and NDMA). The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals.

B3. PROJECT DATA QUALITY OBJECTIVES

B3.1 Project Task and Problem Definition

The objective of drilling boreholes to be completed as piezometers is to provide observation points with which to evaluate the performance of adjacent NHOU extraction wells and collect depth-discrete groundwater samples for laboratory analysis. Additionally, geological and geophysical data collected during drilling will be evaluated to provide better understanding of the A-Zone and B-Zone. The drilling and piezometer installation locations are detailed on Figures B-2, B-4, and B-6; and schematic cross-section diagrams showing the relationships between the piezometers to be installed, the adjacent extraction wells, and the A-Zone and the B-Zone are illustrated on Figures B-3, B-5, and B-7. Table B-1 summarizes piezometers to be installed and grab sampling depths within each boring. Table B-2 lists the chemical or physical analyses for each sample. The planned work includes the following tasks:

1. Use mud rotary drilling techniques to advance and geologically log one borehole into the B-Zone and one borehole in to the A-Zone adjacent to extraction wells NHE-3, NHE-5, and NHE-7.
2. Collect soil samples from the A-Zone and soil and groundwater samples from the B-Zone during drilling of the deeper borehole for laboratory analyses.
3. Perform geophysical logging of the deeper boreholes to confirm the depth of the contact between the A-Zone and the B-Zone.
4. Complete each borehole as a piezometer to monitor depths that correlate to the midpoint of the saturated screen interval of the adjacent extraction well and a depth between the bottom of the screen of the adjacent extraction well and the bottom of the A-Zone.
5. Develop each piezometer to remove drilling fluids and fine-grained material from the screen, filter pack, and borehole wall, and remove formation material that may have entered the piezometer and filter pack.

B3.2 Data Quality Objectives

Data quality objectives (DQOs) are both qualitative and quantitative statements that define the type, quality, and quantity of environmental data appropriate for the intended application. In addition to the information presented in this section, Quality Assurance Project Plan (QAPP) components of the SAP provide other information regarding overall DQOs. The task-specific DQOs for the groundwater sampling program were developed consistent with USEPA guidance (USEPA, 2006) and the following seven-step process:

1. State the Problem. Concisely describe the problem to be studied.
2. Identify the Decision. Identify the decision that will solve the problem using data.
3. Identify the Inputs to the Decision. Identify the information needed and the resulting measurements that need to be made in order to support the decision.
4. Define the Study Boundaries. Specify the conditions (time periods, spatial areas, and situations) to which the decision will apply and within which the data will be collected.

5. Develop a Decision Rule. Define the conditions by which the decision-maker will choose among alternative risk management actions. This is usually specified in the form of an “if…then…” statement.
6. Specify Acceptable Limits on Decision Errors. Define in statistical terms the decision-maker’s acceptable error rate based on the consequence of making an incorrect decision.
7. Optimize the Sampling Design. Evaluate the results of the previous steps and develop the most resource-efficient design for data collection that meets all of the DQOs.

The results of the DQO steps, based on the purpose and scope for the work described in this FSP, are summarized below:

1. State the Problem.
   a) Performance monitoring wells or piezometers have not been installed and monitored to demonstrate the size and shape of the existing NHOU extraction well capture area, specifically, with regard to the A-Zone and B-Zone.
   b) Depth-discrete groundwater analytical data are not available near the extraction wells.
   c) Insufficient data are available to determine the geological and hydrogeological distinction between the A-Zone and B-Zone.
2. Identify the Decision.
   a) Where should piezometers be located adjacent to extraction wells NHE-3, NHE-5, and NHE-7 with respect to the extraction well and other existing infrastructure?
   b) What is the depth of the contact between the A-Zone and B-Zone near the extraction wells?
   c) How should the piezometers be constructed to evaluate the capture area of the adjacent extraction well and provide groundwater monitoring data representative of the surrounding formation?
   d) What are the physical properties and organic carbon content of sediments in the A-Zone and B-Zone?
   e) What is the vertical extent of chemical of concern (COC) distribution near NHOU extraction wells that may require capture?
   f) What COCs are present in groundwater in the B-Zone below the extraction wells?
   g) How efficient are the existing NHOU extraction wells?
3. Identify the Inputs to the Decision.
   a) Site reconnaissance observations and LADWP input regarding suitable piezometer installation locations near extraction wells NHE-3, NHE-5, and NHE-7.

b) Geological and geophysical logging data from the deeper borings to determine the depth of the contact between the A-Zone and B-Zone.

c) Physical testing results (e.g., grain size, hydraulic conductivity) from A-Zone and B-Zone soil samples to evaluate hydraulic properties and to further distinguish the A-Zone from the B-Zone.

d) Analytical results of B-Zone grab groundwater samples collected from within the deeper borings.

e) Analytical data from grab groundwater samples collected following piezometer development.

f) Drawdown data and development observations at existing NHOU extraction wells.

4. Define the Study Boundaries.

a) Each location will include one deep boring advanced into the B-Zone adjacent to NHOU extraction wells NHE-3, NHE-5, and NHE-7 as illustrated on Figures B-2 through B-7.

b) Deep borings will have a total depth of up to 400 feet.

c) Geological and geophysical logging will be performed, and grab groundwater samples will be collected from the deeper borings as illustrated on Figures B-2 through B-7 and listed in Tables B-1 and B-2.

d) A shallower borehole will be advanced at each location to a depth determined upon evaluation of observations from the deep boreholes.

e) Piezometers will be installed in the borings to monitor discrete depths within the A-Zone as illustrated on Figures B-2 through B-7.

f) Drilling, piezometer installation, and development activities are anticipated to have a duration of approximately 20 days.

5. Develop a Decision Rule. The applicable decision rules are as follows:

a) Borings will not be advanced within 3 feet of a known underground utility. If an underground utility is determined to be within 3 feet of a proposed location, a new location will be established.

b) Geological and geophysical logs will be used to determine the location of the contact between the A-Zone and B-Zone which will determine the final screen depths for the piezometers. If there is not enough depth between to the bottom of the adjacent extraction well and the bottom of the A-Zone to install the deeper piezometer of the proposed pair, the deeper piezometer will be constructed in the B-Zone.

c) If additional data gaps are identified or unanticipated chemicals are detected, the need for additional investigation will be evaluated.

6. Specify acceptable limits on decision errors.

a) The SAP and this FSP have been prepared based on the sample locations and data gaps previously identified in the Final Data Gap Analysis report (AMEC, 2012a). The predominant quantitative variability is measurement error. The measurements to be made include:

i) Distance between the boring locations and known utilities.

ii) Distance of the borings from the adjacent extraction wells. Too great a distance could result in installing the piezometer beyond the radius of influence of the extraction well. Too small a distance could impact extraction well performance by drilling fluids introduced into the formation.

iii) Depths the borings are advanced to and the depths at which soil and groundwater samples are collected from within the boring.

iv) Depth of placement of annular materials as the piezometers are constructed, length of screen and total depth of well.

v) Laboratory measurements of chemical concentrations in groundwater and physical properties of soil and groundwater.

b) Variability introduced by the measurement of the distance between the boring locations and known utilities could result in unsafe drilling conditions and/or damage to existing infrastructure.

c) Variability introduced by the measurement of the distance between the piezometer locations and the extraction wells could result in the piezometers being located beyond the radius of influence of the extraction wells. The consequence of too great a distance would be that the piezometer would not yield performance data for the extraction well.

d) Variability introduced by measurement of the depth of the boring could result in unknown sample collection depths and improperly constructed piezometers. The consequence would be misinterpretation of the collected data.

e) Variability introduced by measurement of the depth of placement of annular materials could result in improperly constructed piezometers. The consequence would be inability to collect representative groundwater samples and/or misinterpretation of the collected data.

f) Variability introduced by sampling, sample handling, and chemical analysis could result in a conclusion that the concentration of a COC in B-Zone groundwater is higher or lower than it is. The consequence of deciding the groundwater quality of the B-Zone incorrectly could be the improper design of extraction well modifications.

7. Optimize the Sampling Design.

a) Preliminary piezometer construction, sampling locations, number of samples, and analytical methodologies are proposed herein. As described in DQO Step 5, additional investigation may be proposed based on the findings of the anticipated work. The results of the sampling, with any modifications that were generated based on the DQO process, will be further described in the report of findings.

B3.3 Data Quality Indicators

Data quality indicators (DQIs) refer to QC criteria established for various aspects of data gathering, sampling, or analysis. The QC requirements are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). The PARCCS parameters and calculation equations, as appropriate, are described in the SAP. The DQIs, type of QC sample, frequency requirement, and acceptance criteria are presented in Table B-3. Field precision will be assessed on the basis of reproducibility by multiple measurements.

B3.4 Data Review and Validation

Overall QA activities are described in the SAP and are included herein by reference. This section of the FSP provides a description of the QA activities that are specific for the anticipated drilling and piezometer installation task:

- Geological and geophysical logs will be reviewed and approved by a California-licensed Professional Geologist.
- Soil and groundwater analytical samples collected during drilling will be grab samples for screening purposes and will not be expected to be reproducible. The laboratory will report the results in reports consistent with a Region IX Tier 2 data package. Grab samples will not undergo third party validation.
- The usability of the data will be assessed by comparing the data to the review criteria and DQOs presented in Section 3.2.
- If the data are sufficient to achieve project objectives, the Project Manager will release the data and work can proceed. If the data are insufficient, corrective action will be required.
- If additional data are needed beyond the scope of the activities outlined in this FSP, the USEPA Project Manager will be notified within 30 days of their completion by written memorandum.

B3.5 Data Management and Assessment Oversight

Data management and assessment oversight for drilling and piezometer installation includes steps that will be taken to confirm that data are transferred accurately from collection to analysis to reporting. These steps include measures to review the data collection process, including field notes, laboratory reports, and preparation of the final report for this work. Data management and assessment activities, including responsible team members, are described in this section of this FSP and in Sections 3.0 and 4.0 of the SAP.

Data collected for the drilling and piezometer installation program will be reviewed as part of the QA/QC process. The flow of data for the project will be as follows:

- Field data sheets and geological log forms (or their electronic equivalents) will be forwarded by the Field Task Leader to the AMEC Project Manager. The Field Task Leader and the AMEC Project Manager will review the data sheets. The review will include verification of the use of procedures in accordance with the SAP and this FSP.
- Groundwater and soil samples will be sent directly from the field to the selected laboratory. Copies of chain-of-custody forms and other field datasheets will be

forwarded to AMEC. The Field Task Leader will review these forms and datasheets. The AMEC Project Manager will confirm with the Field Task Leader that the data have been reviewed and approved.

- Laboratory results, including electronic data deliverables (EDDs) and complete laboratory reports (as hard copies or PDF format), will be sent to the AMEC Project Manager. The AMEC Project Manager or appropriate technical designee will review this information.

In accordance with the AOC, the following interim submittals will be made to the USEPA Project Manager:

Relative Deadline	Submittal
Within 60 calendar days of sample shipment to the laboratory, or 14 days of receipt of analytical results from the laboratory, whichever occurs first	All analytical data, whether or not validated
Within 90 calendar days of the sample shipment to the laboratory	All validated analytical data in an approved electronic format

In compliance with the AOC Statement of Work Section 4.3.5, a Data Usability Evaluation and Field QA/QC submittal will be prepared to:

- State the criteria used to review and validate data, in an objective and consistent manner.
- Describe how the results obtained from the task were reconciled with the requirements defined by the data user or decision maker.
- Outline the methods used to analyze the data and determine possible anomalies or departures from assumptions established in the planning phase of data collection.
- Describe the methods used for field QA/QC.

In compliance with the AOC Statement of Work Section 4.3.6, a Data Reduction, Tabulation, and Evaluation submittal will be prepared to:

- Tabulate, evaluate and interpret the data;
- Present data in an appropriate format for final data tables;
- Design and set up an appropriate database for pertinent information collected that will be used during the performance of the work;
- Submit electronic database in a format compatible with USEPA's existing database; and
- Submit processed data tables to the USEPA.

The Data Usability Evaluation and Field QA/QC, as well as the Data Reduction Tabulation, and Evaluation deliverables, will be submitted to the USEPA 90 days after completion of the groundwater sampling program.

B4. SAMPLING RATIONALE

The boring and piezometer installation locations and depth were selected to provide observations points with which to evaluate the size and shape the NHE-3, NHE-5, and NHE-7 extraction well capture areas. The results will be used to evaluate the capture areas of the NHOU extraction well network. The grab sampling depths within the borings were selected to fill data gaps regarding physical properties of the A-Zone and the B-Zone, and regarding groundwater quality in the B-Zone.

Physical properties of soil samples were selected to further understanding of the hydraulic properties of the A-Zone and the B-Zone, specifically. Ground water samples will be analyzed for COCs that the adjacent extraction wells are intended to capture for treatment. The extraction wells were originally installed to treat VOCs, but must be adapted as part of the remedial design to address 1,4-dioxane, total chromium, hexavalent chromium, and other emerging chemicals potentially from greater depths than existing extraction wells were designed to capture. Table B-2 presents a list of the properties and analytes for the sampling. Details of sampling methods, chemical analyses, and QA/QC sampling are presented in Sections 6.0 through 11.0.

B5. REQUEST FOR ANALYSES

B5.1 Analyses Narrative

As enumerated in Table B-1, one grab groundwater sample will be collected from the B-Zone in each of the three deep borings to be advanced. The groundwater analytical program will include those analytes listed in Table B-2. Laboratory analyses will be completed on a standard turn-around time basis. As enumerated in Table B-1, up to two soil samples will be collected from the A-Zone and up to two soil samples will be collected from the B-Zone in each of the three deep borings to be advanced. Soil physical properties to be measured will include those parameters listed in Table B-2. Physical laboratory tests will be completed on a standard turn-around-time basis.

B5.2 Analytical Laboratory

Soil and groundwater analysis will be contracted to a California-certified laboratory (or laboratories) at a date no later than one month before sampling activities. The laboratory's QA manual will be included as an addendum to the SAP.

In general, all analyses will use USEPA-approved methods or other recognized standard methods. The laboratory analyses to be performed for the sampling event are listed in Table B2.

B6. FIELD METHODS AND PROCEDURES

Borehole logging, sampling, and well installation procedures, methods, and equipment anticipated for this work are described in this section. Decontamination procedures and corrective action procedures are also described. Refer to Section 7.0 for sampling tracking and shipping information.

B6.1 Field Equipment

B6.1.1 List of Equipment Needed

Sampling tools and equipment that may be used to produce data during the implementation of the work include, but are not limited to:

- Personal protective equipment (PPE) as indicated by the Health and Safety Plan (HASP)
- Quart-sized plastic bags for soil cuttings collection before logging
- Indelible markers for labeling samples
- Coolers, groundwater sample containers, and ice
- Teflon squares and tape for sealing soil samples collected in brass tubes
- Munsell soil color chart
- Bucket and water for rinsing samples before logging
- Camera for documentation
- Steel measuring tape
- Electric sounder
- FSP.

B6.1.2 Calibration of Field Equipment

The field equipment that may be used and will need calibration consists of the following:

- Electric sounder;
- Photoionization detector (PID)
- Multiparameter water quality meter (temperature, pH, specific conductivity [SC], oxidation reduction potential [ORP], and dissolved oxygen [DO])
- Turbidimeter.

Proper maintenance, calibration, and operation of each instrument will be the responsibility of field personnel assigned to a particular field activity. Instruments and equipment used during the field investigations will be maintained, calibrated, and operated according to the manufacturer's guidelines and recommendations. Field equipment requiring regular calibration will be calibrated at least once per day. Relevant manuals will be kept with field personnel during the performance of field activities. Equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Items found to be inoperable will be taken out of use, and a note stating the time and date of this action will be made in the daily field records. An equipment calibration daily log form for selected equipment is provided in Appendix B-1.

B6.2 Final Boring Location Determination

Field staff will perform a site walk with permission from the LADWP to determine the final locations for PZ-NHE3, PZ-NHE-5, and PZ-NHE-7. Locations approximately 30 to 50 feet away from extraction wells NHE-3, NHE-5, and NHE-7 on LADWP property will be selected and marked in white paint based on the following criteria:

- Coordination for access with LADWP
- Physical access for drilling equipment
- Minimization of disturbance to surrounding residences
- Location of existing infrastructure including extraction well conveyance piping
- Buried and overhead utilities.

Before beginning work, well and encroachment permits will be acquired from the LADWP, Environmental Health Division, County of Los Angeles, and the City of North Hollywood, as necessary. All activities associated with proposed boreholes will be performed in coordination with the LADWP, pursuant to a formal access agreement with Honeywell and Lockheed Martin.

Underground Service Alert of Southern California (DigAlert) will be notified at least 48 hours before any digging and an independent subsurface utility locator will be contracted to verify the selected locations are clear of underground utilities by at least 3 feet. If the underground utilities are identified within 3 feet of a boring location, a new location will be selected.

B6.3 Borehole Advancement and geological logging

The field geologist under the supervision of a California-licensed professional geologist will oversee a California-licensed drilling subcontractor as each borehole is advanced at the approximate locations illustrated on Figures B-2, B-4, and B-6. Each boring will be excavated to 5 feet below ground surface (bgs) using hand tools or a combination of hand tools, an air knife, and vacuum to verify the absence of underground utilities. Personnel at the drilling location will wear proper PPE as described in the HASP, and a PID will be used to monitor the breathing zone during drilling. Only potable water will be used to mix drilling fluids.

Eight-inch-diameter borings will be advanced using a truck-mounted mud rotary drilling rig, and the field geologist will monitor and record the following information:

- The rate of drill string advancement
- Notable changes in the rate of advancement of the drill string
- Observations made by the driller regarding the nature of the subsurface
- Viscosity of the drilling fluid (i.e., bentonite mud).
- Mud weight, viscosity, sand content, water loss, filter cake and pH.

The drilling subcontractor will provide the field staff with soil cuttings samples in plastic bags from the fluid return at a minimum of 5-foot intervals. The cuttings will be logged in general accordance with the Unified Soil Classification System (USCS) as described in ASTM Standard D-2488. The form to be used to record the geological log is included in Appendix B-1. Geological logs will be reviewed by a California-licensed Professional Geologist. The deeper boring of each pair will be advanced to an anticipated depth of no more than 400 feet bgs (Table

B-1). The shallower boring will be advanced to a depth consistent with the final design of the piezometer to be installed based on the findings at the deeper borehole.

Soil cuttings, drilling fluid (i.e. bentonite mud), and formation water brought to the surface during drilling will be managed as described in Section 8.0.

B6.4 Soil Sample Collection

The field geologist will direct the drilling subcontractor regarding soil sample collection depths (Table B-1). The driller will use 94-millimeter wire-line coring methods to collect the three shallowest samples at each boring. The driller will use a slide hammer to advance the sampling barrel into the undisturbed formation below the boring, and will retrieve the barrel and deliver the soil samples contained in 2-inch brass sleeves to the field geologist to be sealed and labeled as described in Section 9.2. The fourth and deepest soil sample from each boring will be collected by the driller using SimulProbe technology, which is capable of collecting soil and groundwater samples simultaneously. As with the previous soil samples, the driller will use a slide hammer to advance the sampling barrel into the undisturbed formation below the boring, and will retrieve the barrel and deliver the soil samples contained in 2-inch brass sleeves to the field staff to be sealed and labeled as described in Section 9.2. Groundwater sampling is discussed below.

B6.5 Groundwater Sampling

The field geologist will direct the drilling subcontractor regarding groundwater sample collection depths (Table B-1). The driller will collect the single groundwater sample from each boring simultaneously with the deepest soil sample using SimulProbe technology as noted above. SimulProbe uses stainless steel canisters initially pressurized with nitrogen gas to collect the groundwater sample. The tool (including the soil sampling barrel) will be advanced into the undisturbed formation below the boring, then raised to expose a screen at which point the nitrogen is vented from the canisters drawing in groundwater. The driller will deliver the water sample to the field geologist and assist in decanting the sample into the appropriate containers as listed in Table B-2. The samples will be labeled as described in Section 9.2, chilled, and delivered to the laboratory under chain of custody protocols as described in Section 9.1.2.

B6.6 Geophysical Logging

A geophysical logging subcontractor procured by the drilling subcontractor will log each borehole after the total depth has been reached and the drilling fluid has been circulated to remove suspended sediments. The field geologist will oversee the geophysical logging which will include at a minimum:

- Caliper
- Resistivity (short and long normal, 16 and 64 inches, respectively)
- Spontaneous potential logs
- Natural gamma
- Sonic logs.

B6.7 Piezometer Installation

Before the piezometer installation, geological and geophysical logs will be reviewed by the AMEC Project Manager and discussed with USEPA for consensus regarding piezometer designs. Upon determination of final piezometer construction specifications (including filter pack, screen aperture size, and screen depth interval), a single piezometer will be installed in each boring. Anticipated designs are illustrated on Figures B-3, B-5, and B-7, and are listed in Table B-1. The bottom of the deeper boring of each pair will be grouted through the B-Zone interval as appropriate using 20 percent high-solids bentonite grout from the total depth to approximately 5 feet below the total depth of the piezometer to be installed through a tremie pipe.

Before piezometer construction begins, the sections of blank casing and screen to be installed will be inventoried and measured to the nearest 0.1 foot to ensure that the well will be constructed to the correct total depth. The field geologist will oversee construction as the drilling subcontractor assembles the piezometer and suspends it in the boring to ensure it does not bend as the annular materials are placed. Stainless steel centralizers will be placed above and below the screen and at a 40-foot interval above the screen. Once the piezometer is suspended in the boring, the driller will measure the total depth within the well to ensure correct placement and the integrity of the piezometer casing.

Annular materials will be placed from the bottom of the borehole to the top through a tremie pipe. An appropriate grain size for each filter pack will have been determined from the laboratory grain size analysis performed on the soil samples and the screen manufacturer's recommendations. The filter pack will be place in the annular space from approximately 2 feet below the screen to 2 feet above the screen. As the filter pack is placed, the well will be swabbed in 5-foot increments to promote uniform settling of the sand. Two feet of transition sand will be placed above the filter pack and 3 feet of hydrated bentonite chips will be placed above the transition sand to form a transition seal. A sanitary seal will be placed from above the bentonite chips to approximately 2 feet bgs consisting of Portland cement with no more than five percent bentonite gel added. The amounts of all annular materials used will be recorded. Once the piezometer has been fully constructed, the driller will measure the total depth within the piezometer to verify the integrity of the casing and measure sediment accumulated at the bottom. Each piezometer will be completed in a flush-mounted traffic-rated well box.

B6.8 Development Activities

B6.8.1 Piezometer Development

When the piezometer installation is complete and the cement sanitary seal has cured for a minimum of 24 hours, the piezometer will be developed by surging, bailing, and pumping and/or airlifting. The objectives of piezometer development are to remove sediment that may have accumulated during piezometer installation, to consolidate the filter pack around the piezometer screen, and to enhance the hydraulic connection between the target zone and the piezometer. In most instances, a bailer will be used to remove sediment and turbid water from the bottom of the well. A surge block may then be used within the entire screened interval to flush the filter pack of fine sediment. Surging will be conducted slowly to reduce disruption to the filter pack and screen. The piezometer will be bailed again to remove sediment drawn in by the surging process until suspended sediment is reduced.

Following bailing and surging, the well may be further developed using airlift or pumping methods. If pumping is used, the well will be developed at a higher pumping rate than the anticipated rate of future purging. Electrical conductance, pH, and temperature will be measured during development until each parameter stabilizes to within 10 percent change in three consecutive measurements; turbidity will also be measured but will not be used as a criterion for development. Drawdown and recovery will be measured during and at the end of the development process, respectively, using an electric sounder. Groundwater parameters, times, and pumping rates and volumes will be recorded on development forms included in Appendix B-1).

Water and suspended sediments purged during development will be managed as described in Section 8.0.

B6.8.2 Post-Development Groundwater Sampling

Grab groundwater samples will be collected from each piezometer immediately following development and analyzed for all of the COCs as listed in Table B-2. The samples will be collected and preserved in the appropriated containers as listed in Table B-2, labeled as described in Section 9.2, chilled, and delivered to the laboratory under chain-of-custody protocols as described in Section 9.1.2.

B6.8.3 NHOU Extraction Well Development

Before pumping tests begin at the NHE wells discussed in the Aquifer Testing FSP (SAP Appendix C), NHOU extraction wells NHE-3, NHE-5, and NHE-7 will be rehabilitated by a subcontractor (as yet to be determined) under the supervision of AMEC field personnel. The existing pump will be temporarily removed from each extraction well and a video log survey will be performed. Based on the results of the video log, redevelopment of the well may be performed; specific techniques will be dependent upon the video log survey but chemical treatment is not included in this scope of work. Water and suspended sediments purged during development of extraction wells will be managed as described in Section 8.0.

B6.9 Decontamination Procedures

Equipment decontamination procedures are intended to reduce the potential for sample contamination and cross-contamination between drilling locations. Decontamination of the drilling and sampling equipment will be performed with a high-pressure washer and the rinsate will be containerized. Sampling equipment will be cleaned by washing with a Liquinox™ (or equivalent) and water solution and then rinsing three times, with the last rinse being a DI water rinse.

B6.10 Surveying

The coordinates and top of casing elevation of each piezometer will be surveyed by a California-licensed Land Surveyor. Several existing wells will be surveyed as part of the Phase 1 Pre-Design Investigation and new piezometers will be surveyed during that event as discussed in Section 6.7 of the Groundwater Sample Collection FSP (SAP Appendix A).

B7. SAMPLE CONTAINERS, PRESERVATION, AND STORAGE

Groundwater sample containers will be provided by the selected analytical laboratory. The size, type, and number of sample container(s) for each chemical analysis are presented in Table B-2. Soil sample containers (i.e., brass tubes) will be provided by the drilling subcontractor. The containers will be new and pre-cleaned.

The required sample preservatives for each analytical method are listed in Table B-2. Soil samples will not require preservation, but will be sealed with Teflon squares and tape to retain moisture. Some of the analyses currently selected require preservatives, and the sample bottles will have the appropriate preservatives before shipment by the laboratory to AMEC. The preservation criteria for VOCs (pH < 2) will be checked by the laboratory upon receipt of the samples. If the pH is greater than 2 for a specific sample, the analytical hold time will be reduced to 7 days instead of the usual 14 days.

Each sample will be stored in a shipping cooler immediately after the sample is taken, sealed, and labeled. If possible, samples will be shipped to the laboratory the same day that they are obtained. Shipping will be by courier or overnight shipping. If a sample or samples cannot be shipped the same day, the samples will be stored in the shipping cooler overnight for courier delivery the following day. Samples will be shipped to the laboratory within 24 hours from the time they are obtained. If the samples are stored overnight, additional ice will be added as appropriate to maintain the proper temperature in the shipping cooler.

B8. DISPOSAL OF RESIDUAL MATERIALS

The following IDW may be generated during this Phase 1 Pre-Design Investigation:

- Soil cuttings
- Drilling fluid (i.e., bentonite mud)
- Groundwater
- Decontamination rinsate.

B8.1 Containment and Labeling

Soil cuttings and drilling fluid will be segregated and placed in lined steel roll-off bins at a location near the boring. Groundwater removed during drilling will be temporarily contained in Department of Transportation-approved 55-gallon drums or temporary storage tanks. Solids will be separated from drilling fluids (drilling mud) and the drilling fluids will be temporarily stored in a holding tank. Roll-off soil bins and purged groundwater drums or tanks will be labeled for content, date generated, and boring identification and temporarily stored at or near the drilling location. These IDWs will be characterized and properly disposed of in accordance with applicable regulations. PPE will be discarded as municipal trash. All bins, drums, and or storage tanks will be labeled with an identification number, contents, date, and project number and will indicate "pending analysis." An inventory worksheet for each type of container will be maintained. Soil bins will remain closed when not being filled.

Containers will be labeled as "on hold pending analysis" when the first waste is discharged to them. The sticker/label will detail the appropriate AMEC contact information. If the waste is found to be hazardous the label will be changed to read "Hazardous Waste". Containers will be documented in the daily field notes which will record the following information:

- Contents
- Fill date
- Container serial number
- Sampling date.

PPE and disposable sampling equipment used during this project will be placed in a trash bag and placed in a municipal refuse container.

B8.2 Characterization Sampling

B8.2.1 Soil Sampling

One composite soil sample will be obtained from each bin containing solid waste as follows: soil will be collected from each corner and the center of the bin, approximately 1 foot below the surface and contained in a glass jar. Additionally, a grab sample will be collected from the horizontal and vertical center of the bin for VOC analysis using either En Core or Terracore methods of collection and preservation.

The composite soil sample will be analyzed for Title 22 Metals using EPA Method 6020 (7471a for mercury). The grab sample will be analyzed for VOCs using EPA Method 8260B/5035B.

B8.2.2 Water Sampling

One water sample will be collected from the vertical and horizontal center of each tank. Samples will be placed in appropriate containers as listed in Table B-2 and managed according to Section 9.0. Samples will be analyzed for VOCs using EPA Method 8026 and Title 22 Metals using EPA Methods 6000/7000.

B8.3 Waste Profiling and Documentation

Analytical results will be provided simultaneously to the IDW Hauler to begin the shipment approval process. The Task Manager will work collaboratively with the IDW hauler to determine waste characteristics. The analytical results will be compared to 40 CFR 261 and California Code of Regulations Title 22, Division 4.5, Chapter 11 to determine hazard characteristics. The profile will be sent to Honeywell for signature following the acceptance between the Task Manager and IDW Hauler.

Analytical results will be in mg/kg for total concentrations for solid waste. The guidance set forth in December 21, 1995 60 FR 66389 will be used which will allow the total concentration of the constituent to be divided 20 to provide a Toxicity Characteristic Leaching Procedure (TCLP) level. If the total amount divided by 20 is near or exceeding the regulatory TCLP value, the Task Manager will determine whether the value is such that additional analytical is necessary and a TCLP will be performed, or the waste will be given a hazardous designation based upon the compound's regulatory limit.

Once the waste is generated, the procedures are as follows:

- Waste will be sampled in accordance with the procedure described above
- Samples will be sent to the laboratory for analysis
- Analytical results will be sent to the Task Manager
- The Task Manager will send the analytical results to the IDW hauler
- The Task Manager will work with IDW hauler to characterize the waste
- The Field Team Leader will coordinate desired pick-up date with the IDW hauler
- The IDW hauler will prepare the waste profile and send it to the Task Manager for review
- The profile will be sent to Honeywell and Lockheed Martin, or their authorized delegee, for signature and a copy will be sent electronically to the Task Manager for filing
- A Uniform Hazardous Waste Manifest (hazardous only) or nonhazardous manifest will be prepared and sent electronically to the Task Manager for review
- If the waste is hazardous, a Land Disposal Restriction Notification will be shipped along with the Uniform Hazard Waste Manifest
- The Task Manager will inform Honeywell that a manifest has been reviewed and will be sent to Honeywell for signing
- The signed manifest will be sent back to the Task Manager or Field Team Leader
- The Task Manager or Field Team Leader will date the manifest and confirm quantities in the field at the time of shipment.

The procedures for document retention are as follows:

- Profiles and manifests will be sent to Honeywell and Lockheed Martin for signing
- AMEC, on behalf of Honeywell and Lockheed Martin, will send the signed manifests and profiles to the Department of Toxic Substances Control (DTSC) within 30 days of the shipment date
- The signed manifests will be sent from the disposal facility to AMEC, on behalf of Honeywell and Lockheed Martin, within 35 days of the shipment
- If the signed manifest is not received within 45 days an exception report will need to be filed with the DTSC
- Copies of signed manifests and corresponding profiles with supporting analytical data will be sent to the Task Manager for filing.

B9. SAMPLE DOCUMENTATION AND SHIPMENT

Various field notes and procedures will be used to document the collection of samples for physical and chemical analyses and the handling and shipping of soil and groundwater samples. The following paragraphs describe the forms, notes, and procedures used during the sampling event.

B9.1 Field Notes

B9.1.1 Daily Field Notes

The Field Task Leader and other field sampling team members will maintain field notes to provide a daily record of significant events, observations, and measurements during sampling. All information pertinent to sampling will be recorded on a Daily Field Record form or on activity-specific data forms (Appendix B-1). Each day's field notes entries will be signed and dated and will include the following information:

- Date and time of entry, and weather and environmental conditions during the field activity
- Project name and number
- Location of drilling or sampling activity
- Names of field crew members
- Names of site visitors
- Sample media (e.g., groundwater) and depth of collection
- Sample collection method (e.g., SimulProbe)
- Number of samples taken.

Geological logs will include the following information:

- Drilling dates
- Drilling location
- Name of the driller
- Times at which depths are reached
- Description of soil core and cutting in general accordance with the USCS
- Observations regarding drilling progress
- Observations made by the driller
- Periodic evaluations of drilling fluid parameters
- Sampling depths.

When activity-specific data forms are used, they will include the following additional information:

- Investigation location
- Sampler's initials
- Sampling medium

- Sampling method.

The following information will be recorded either in the daily field notes or on the activity-specific forms:

- Volume and number of samples taken
- Date and time of collection
- Sample depth
- Sample identification number(s), including well name and/or number
- Sample destination (for example, laboratory)
- Water-level measurement data
- Field observations
- Field measurements (e.g., pH, temperature, and conductivity)
- Sample handling (preservation).

All entries will be made using ink; any entries requiring changes will be made by striking a line through the entry and entering the correct information. The person making the entry will initial and date the correction. Unused portions of pages will be crossed out, signed, and dated at the end of each workday.

B9.1.2 Activity-Specific Forms

In addition to the Daily Field Record form, the following forms may be utilized to document field activities. Example forms are included as Appendix B-1 to this FSP.

- Geological Log. Borehole logging and sample collection data will be recorded on this form.
- Piezometer Construction Log. Final piezometer construction details, including dimensions and annular materials will be recorded on this form.
- Well Development Record. Well purging and field measurements of water quality parameters will be summarized on this form. Water level data will also be recorded on this form.
- Chain-of-Custody Record. Sample collection information identifying sample identification, sample collector, date, time, requested analyses, preservation, container type and size, laboratory name and address, shipping method, special handling requirements, and the names of the persons relinquishing and receiving the samples will be recorded on this form.
- Sample Control Log. Contains a list of all samples collected and includes the date and time sampled, sample number, applicable chain-of-custody form number, analyses requested, the date delivered to the laboratory, the date results are due, and the initials of the person completing the log.
- Field Instrument Calibration Sheet. Information regarding the calibration of field instruments will be recorded on this form, including the equipment type and manufacturer, model number, serial number, calibration standard, instrument

reading, date and time calibrated, and the name of the person performing the calibration.

B9.1.3 Photographs

Photographs may be taken to document representative field procedures. When a photograph is taken, the date, time, weather conditions (if applicable), subject, purpose for the photograph, and photograph number will be recorded on a Daily Field Record form. Site-specific baseline photographs will be taken for project records before field work begins and after it is completed.

B9.2 Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. A copy of the sample label is included in Appendix B-1. The samples will have preassigned, identifiable, and unique numbers. Sample identification naming conventions are addressed in detail in Section 3.1.2 of the SAP. At a minimum, each sample collected at the site will be labeled with the following information:

- Sample identification number
- Date and time of collection
- Initials and signature of person collecting sample
- Analyses requested
- Preservation
- Any other information pertinent to the sample.

All information pertaining to a particular sample is referenced by its identification number that is recorded on the sample container, in the field notes, and on the sample chain-of-custody form. After a sample is collected, the sample label will be completed in waterproof ink and secured to the sample container.

B9.3 Sample Chain-of-Custody Forms

All sample shipments for analyses will be accompanied by a chain-of-custody record. A copy of the form is found in Appendix B-1. Form(s) will be completed and sent with the samples for each laboratory and each shipment (i.e., each day). If multiple coolers are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each cooler.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of AMEC. The sampling team leader or designee will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number. A copy will be retained in AMEC project files.

B9.4 Packaging and Shipment

Samples will be transported as soon as feasible after sample collection to the laboratory for analysis. The following procedures are to be used when packing and transporting analytical samples to the laboratory:

1. When ice is used, pack it in sealed double-thick Ziploc bags. Seal the drain plug of the cooler with fiberglass tape to prevent melting ice from leaking out of the cooler.

2. Line the bottom of the cooler with bubble wrap to prevent breakage during shipment.
3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of the sample bottles with indelible ink.
4. Affix sample labels onto the containers with clear tape.
5. Wrap all glass sample containers in bubble wrap to prevent breakage.
6. Seal all sample containers in heavy-duty Ziploc bags. Write the sample numbers on the outside of the plastic bags with indelible ink.
7. Place samples in a sturdy cooler(s) lined with a large plastic trash bag. Enclose the appropriate chain-of-custody forms in a Ziploc bag affixed to the underside of the cooler lid.
8. Fill empty space in the cooler with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment.
9. Pack ice used to cool samples in sealed double-thick Ziploc bags and place it on top and around the samples to chill them to the correct temperature.
10. Tape each ice chest securely shut with fiberglass strapping tape and affix custody seals firmly to the front, right and back of each cooler.

B10. QUALITY CONTROL

This section presents the field QC checks that will be performed during field investigations, including a discussion of field QC samples with frequency and acceptance criteria and field corrective action procedures. A discussion of laboratory QC samples and laboratory corrective action is presented in Section 3.0 of the SAP.

B10.1 Field Quality Control Samples

The type and frequency of field QC samples to be collected during field investigations are described below and shown in Table B-4.

B10.1.1 Assessment of Field Contamination (Blanks)

Field contamination is assessed through the collection of equipment blanks, field blanks, trip blanks, and temperature blanks.

B10.1.1.1 Equipment Blanks

Equipment rinsate blanks will be collected to evaluate field sampling and decontamination procedures by pouring high-performance liquid chromatography (HPLC) organic-free (for organic analyses) or deionized (DI) water (for inorganic analyses) over the decontaminated sampling equipment. One equipment rinsate blank will be collected per matrix each day that sampling equipment is decontaminated in the field. Equipment rinsate blanks will be obtained by passing water through or over the decontaminated sampling devices used that day. The rinsate blanks are analyzed for the same analytes as the corresponding samples collected that day.

The equipment rinsate blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. A separate sample number and station number will be assigned to each sample, and it will be submitted blind to the laboratory.

B10.1.1.2 Field Blanks

Field blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sampling due to ambient conditions, from sample containers, or from source water used for decontamination or rinsing. Field blank samples will be obtained by pouring HPLC organic-free water (for organic analyses) and/or DI water (for inorganic analyses) into a sampling container at the sampling point. The field blanks that are collected will be analyzed for the same analytes as the corresponding samples collected that day.

The field blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. A separate sample number and station number will be assigned to each sample, and it will be submitted blind to the laboratory.

B10.1.1.3 Trip Blanks

A minimum of one trip blank will be submitted to the laboratory for analysis with every shipment of samples for VOC analysis. Trip blanks will be provided by the laboratory and shipped with the empty sampling containers to the sampling area before sampling begins. The sealed trip blanks are not opened in the field and are shipped to the laboratory in the same cooler with the samples collected for volatile analyses. The trip blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. A separate sample number and station number will be assigned to each trip sample, and it will be submitted blind to the laboratory.

B10.1.1.4 Temperature Blanks

For each cooler that is shipped or transported to an analytical laboratory, a 40 mL volatile organic analysis (VOA) vial will be included that is marked “temperature blank.” This blank will be used by the sample custodian to check the temperature of samples upon receipt.

B10.2 Laboratory Quality Control Samples

The laboratory will analyze QC samples as required by the specific analytical methods and the laboratory’s internal QA program.

B11. FIELD VARIANCES

As conditions in the field may vary, it may become necessary to implement minor modifications to drilling, piezometer installation, and sampling as presented in this FSP. When appropriate, the AMEC Project Manager will be notified and a verbal approval will be obtained before implementing the changes. The AMEC Project Manager will notify the USEPA of major modifications or variances to the field program. Modifications to the procedures presented in this FSP will be documented on the Daily Field Record form and on other task-specific forms as applicable. Significant modifications will be documented in the final report.

B12. FIELD HEALTH AND SAFETY PROCEDURES

The field work will be performed in accordance with the site-specific HASP prepared as a separate submittal for this work. Subcontractors will be responsible for their own health and safety and must, at a minimum, follow the project HASP (AMEC, 2012c).

B13. REFERENCES

AMEC Environment & Infrastructure, Inc. (AMEC), 2012a. Final Data Gap Analysis, North Hollywood Operable Unit, Second Interim Remedy, Groundwater Remediation System Design. March 14.

_____, 2012b. Phase 1 Pre-Design Investigation Work Plan, North Hollywood Operable Unit, Second Interim Remedy, Groundwater Remediation System Design. September 10.

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Los Angeles Department of Water and Power (LADWP), 2003. Final Evaluation of the North Hollywood Operable Unit and Options to Enhance Its Effectiveness.

U.S. Environmental Protection Agency (USEPA), 1993. NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____, 1998. NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____ 2000. Sampling and Analysis Plan Guidance and Template, USEPA R9QA/002.1, April.

_____, 2003. Third NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____, 2006 Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA QA/G-4, USEPA/240/B-06/001). February.

_____, 2008. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08/01, June.

_____, 2008. NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____, 2009. EPA Superfund Interim Action Record of Decision, North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund Site, Los Angeles County, California. EPA ID: CAD980894893. September 30.

_____, 2011, Administrative Settlement Agreement and Order on Consent for Remedial Design, CERCLA Docket No. 2011-01, in the matter of North Hollywood Operable Unit, San Fernando Valley (Area I), Superfund Site, Los Angeles, California, February 21.

TABLES

Table B-1 Piezometer Construction and Sample Depths
North Hollywood Operable Unit
Los Angeles County, California

Well Name	Well Diameter (inches)	Casing and Screen Material	Anticipated Screen Top (feet bgs)	Anticipated Screen Bottom (feet bgs)	Anticipated Soil Sampling Depths (feet bgs)[1]	Anticipated Grab Groundwater Sampling Depth (feet bgs)[1,2]	Filter Pack and Screen Size	Anticipated Depth to B-Zone
PZ-NHE-3 (Shallow)	3	Sched 80 PVC	250	270	NS	NS	TBD	325
PZ-NHE-3 (Deep)	3	Sched 80 PVC	305	325	260, 315, 340, 360	360	TBD	325
PZ-NHE-5 (Shallow)	3	Sched 80 PVC	230	250	NS	NS	TBD	305
PZ-NHE-5 (Deep)	3	Sched 80 PVC	275	295	240, 285, 315, 335	335	TBD	305
PZ-NHE-7 (Shallow)	3	Sched 80 PVC	230	250	NS	NS	TBD	320
PZ-NHE-7 (Deep)	3	Sched 80 PVC	285	305	240, 295, 330, 350	350	TBD	320

Notes:
1. Soil and groundwater samples will each be analyzed for all analytes on Table B-2
2. Groundwater samples will be collected from each piezometer immediately following development and analyzed for all analytes on Table B-2

Abbreviations:
bgs = below ground surface
TBD = to be determined
NS = not sampled

Table B-2 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Target Analytes	Analytical Method	Sample Volume; Container	Preservation	MDL	Reporting Limits	Holding Time
Groundwater Chemical Analyses						
Volatile Organic Compounds	EPA 8260	(3) 40 mL VOAs	Cool to 4±2º C pH < 2 HCL	0.133 - 10 µg/L	0.5 – 20 µg/L	14 days
1,2,3-Trichloropropane	SRL 524M -TCP	(3) 40 mL VOAs	Cool to 4±2º C HCL	0.0025 µg/L[1]	0.005 µg/L	14 days
1,4-Dioxane	EPA 8270C	1 Liter Amber Glass	Cool to 4±2º C	0.284 µg/L[1]	1 µg/L	7 days
n-nitrosodimethylamine (NDMA)	EPA 1625CM	1 Liter Amber Glass	Cool to 4±2º C	0.00932 µg/L[1]	0.002 µg/L	7 days
Perchlorate	EPA 314.0	100 mL poly	Cool to 4±2º C Filtered	0.356 µg/L	2 µg/L	28 days
Total Chromium	EPA 200.8	500 mL poly	Cool to 4±2º C pH < 2 HNO3	0.293 µg/L	1 µg/L	6 months
Hexavalent Chromium	EPA 218.6	500 mL poly	Cool to 4±2º C	0.041 µg/L	0.02 µg/L	24 hrs
Cations Ca, Mg, Na, K, Fe	EPA 200.7	500 mL poly	Cool to 4±2º C pH < 2 HNO3	0.00336 – 0.103 mg/L	0.1 – 0.5 mg/L	6 months
Anions: Nitrate, Nitrite, Cl, SO_4,Total Nitrate/Nitrite	EPA 300.0	500 mL poly	Cool to 4±2º C pH < 2	0.159 – 2.84 mg/L	0.1 – 10 mg/L	28 days Nitrate - 48 hrs
Total Hardness	200.7	250 mL poly	Cool to 4±2º C pH < 2 HNO3	0.989 mg/L	2 mg/L	6 months
Alkalinity	SM2320B	500 mL poly	Cool to 4±2º C	0.850 mg/L	1 mg/L	14 days
Total Dissolved Solids	SM2540C	500 mL poly	Cool to 4±2º C	0.820 mg/L	10 mg/L	7 days

Table B-2 Sample Analytical Method Information
North Hollywood Operable Unit
Los Angeles County, California

Target Analytes	Analytical Method	Sample Volume; Container	Preservation	MDL	Reporting Limits	Holding Time
Soil Physical Analyses						
Hydraulic Conductivity	API RP40	2-inch Brass Tube	None	N/A	N/A	N/A
Grain Density	API RP40	2-inch Brass Tube	None	N/A	N/A	N/A
Dry Bulk Density	ASTM 2937	2-inch Brass Tube	None	N/A	N/A	N/A
Total Porosity	API RP40	2-inch Brass Tube	None	N/A	N/A	N/A
Air Filled Porosity	API RP40	2-inch Brass Tube	None	N/A	N/A	N/A
Moisture Content and Total Pore Fluid Saturation	ASTM D2216	2-inch Brass Tube	None	N/A	N/A	N/A
Fraction Organic Carbon	Walkey-Black	2-inch Brass Tube	None	N/A	N/A	N/A

Notes:
1. MDLs and Reporting Limits were provided by CalScience Environmental Laborotories, Inc, from Garden Grove, California.

Abbreviations:
Ca = Calcium
Cl = Chloride
EPA = U.S. Environmental Protection Agency
Fe = Iron
HCL = hydrochloric acid
HNO3 = Nitric Acid
K = Potassium
MCL = Maximum Contaminant Level (Cal/EPA)
Mg = Magnesium
mg/L = milligrams per liter
mL = milliliter
Na = Sodium
N/A= Not Applicable
NO_3-N = Nitrate
NO_2-N = Nitrite
SM = Standard Methods
SO_4 = Sulfate
VOA = Volatile Organic Analysis
µg/L = micro grams per liter

Table B-3 Method Performance Objectives—Acceptance Criteria
North Hollywood Operable Unit
Los Angeles County, California

Method Performance Objective	Type of Quality Control Sample	Frequency	Acceptance Criteria
Precision			
Field	Duplicate field sample	1 per 10 samples	Relative percent difference, RPD <30
Laboratory	Laboratory control samples (LCS) and laboratory control duplicate (LCSD) samples	1 per batch of 20 samples per matrix	RPD <20
	Matrix spike (MS) and matrix spike duplicate (MSD) samples	1 per batch of 20 or fewer investigative samples per matrix	RPD <20
	Unspiked duplicate samples	1 per batch of 20 samples per matrix	RPD <20
Accuracy			
Field	Trip blanks	1 per cooler of volatile organic compounds (VOC) samples	U.S. Environmental Protection Agency (USEPA) National Functional Guidelines Protocol [1,2]
	Equipment rinsate blank	1 per day per equipment type (non-dedicated equipment)	USEPA National Functional Guidelines Protocol [1,2]
	Temperature blank	1 per cooler with chilled samples	< 4±2 degrees centigrade
	Field blank	1 per water source per sampling event	USEPA National Functional Guidelines Protocol [1,2]
Laboratory	Matrix spike (MS) samples	1 per batch of 20 or fewer investigative samples per matrix	Percent recovery, %R, less than compound specific limit (refer to Laboratory Quality Assurance Manual)
	Laboratory control samples (LCS)	At least once with each analytical batch, with a minimum of 1 for every 20 samples	%R less than compound specific limit (Refer to Laboratory Quality Assurance Manual)
	Method blanks	At least once with each analytical batch, with a minimum of 1 for every 20 samples	No compound should be detected above its respective Reporting Limit in laboratory method blanks

Table B-3 Method Performance Objectives—Acceptance Criteria
North Hollywood Operable Unit
Los Angeles County, California

Method Performance Objective	Type of Quality Control Sample	Frequency	Acceptance Criteria
Laboratory (cont'd)	Preparation blanks	At least once with each analytical batch, with a minimum of 1 for every 20 samples	No compound should be detected above its respective Reporting Limit in laboratory preparation blanks
	Surrogates		%R less than compound specific limit (refer to Laboratory Quality Assurance Manual)
Representativeness	Not applicable	Not applicable	Numerical goals cannot be used to evaluate this subjective measure.
Completeness	Not applicable	Not applicable	90% completeness
Comparability	Not applicable	Not applicable	Comparable if the same procedures for collecting and analyzing the samples are used, if the samples comply with the same QA/QC procedures, and if the units of measurement are the same
Sensitivity	Not applicable	Not applicable	Reporting limits (RLs) below or equal to the task-specific target analysis goals or concentrations

Notes:

1. USEPA, 2008, Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review; U.S. Environmental Protection Agency Office of Emergency and Remedial Response, EPA-540-R-08-01, June.
2. USEPA, 2010, Contract Laboratory Program National functional Guidelines for Inorganic Superfund Data Review, OSWER 9240, EPA 540-R-10-011, January

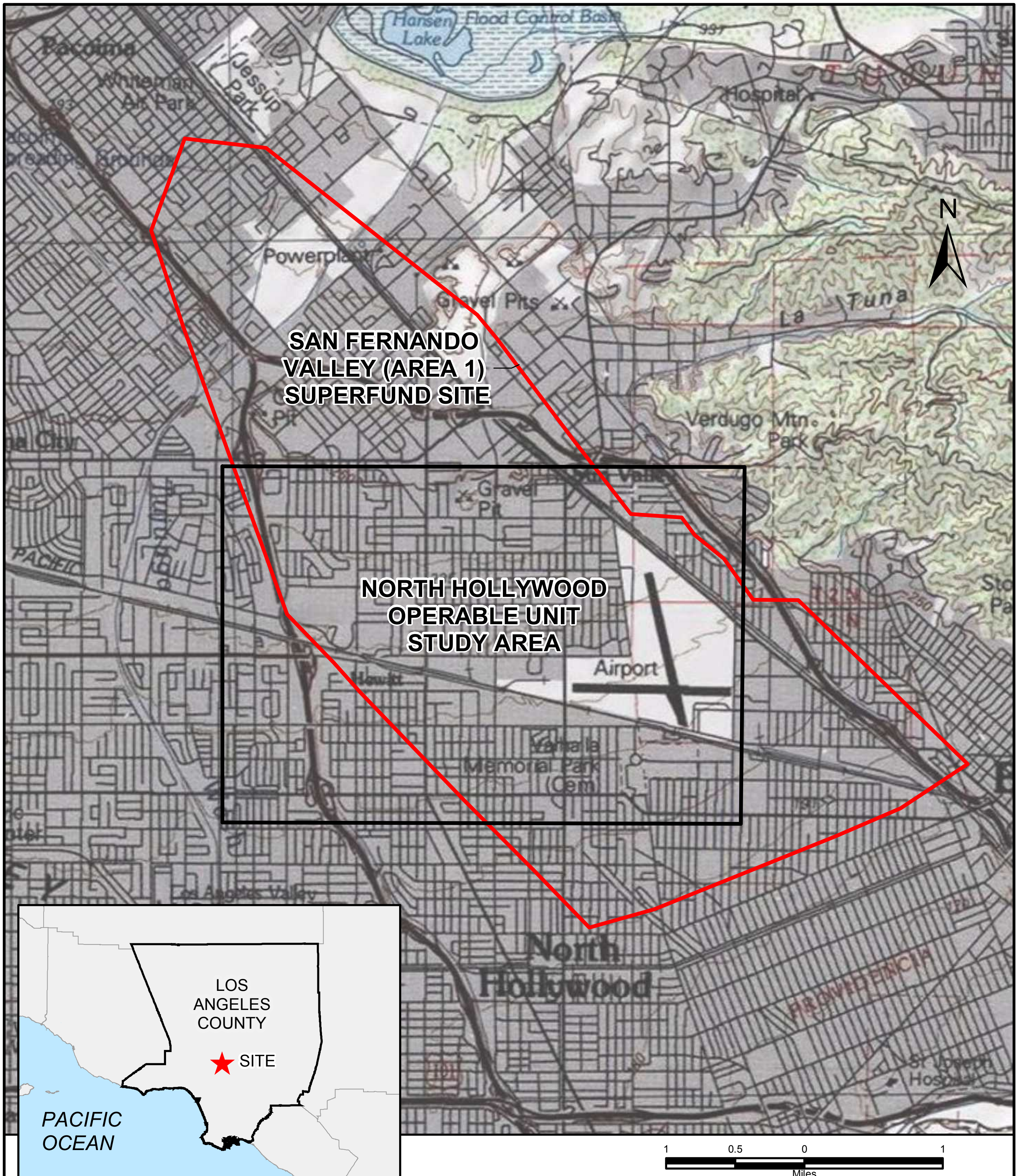
Table B-4 Field Quality Control Samples
North Hollywood Operable Unit
Los Angeles County, California

Type of Quality Control Sample	Frequency	Acceptance Criteria
Trip blanks	1 per cooler of VOC samples	USEPA National Functional Guidelines Protocol
Equipment rinsate blank	1 per day per equipment type (non-dedicated equipment)	USEPA National Functional Guidelines Protocol
Temperature Blank	1 per cooler with chilled samples	< 4±2 degrees centigrade
Field blank	1 per water source per sampling event	USEPA National Functional Guidelines Protocol
Duplicate	1 per 10 samples	Relative percent difference, RPD <30

Abbreviations:

RPD = relative percent difference
VOCs = volatile organic compounds
USEPA = U.S. Environmental Protection Agency

FIGURES



Source USGS Topographic Sheets

amec	**Site Vicinity Map** Phase I Pre-Design Investigation Sampling and Analysis Plan North Hollywood Operable Unit Second Interim Remedy Groundwater Remediation System Design				FIGURE **B-1**
DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
TJH	4088115718		4/2012		

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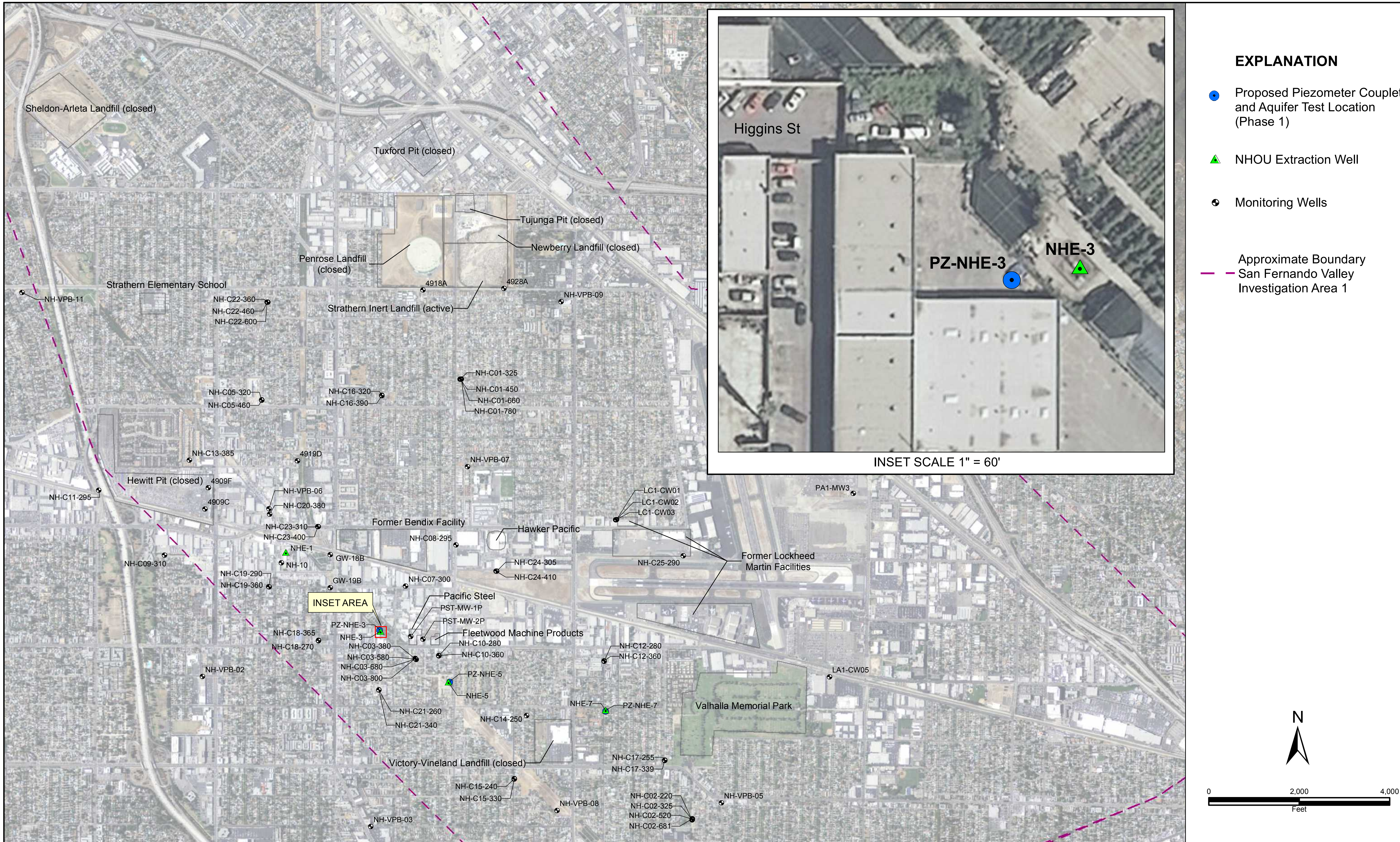

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REV:		SCALE:	AS SHOWN
CHECKED:		APPROVED:	
DATE:	4/2012	DATE:	4/2012

amec

Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Proposed PZ-NHE-3
Area Detail Map

FIGURE
B-2

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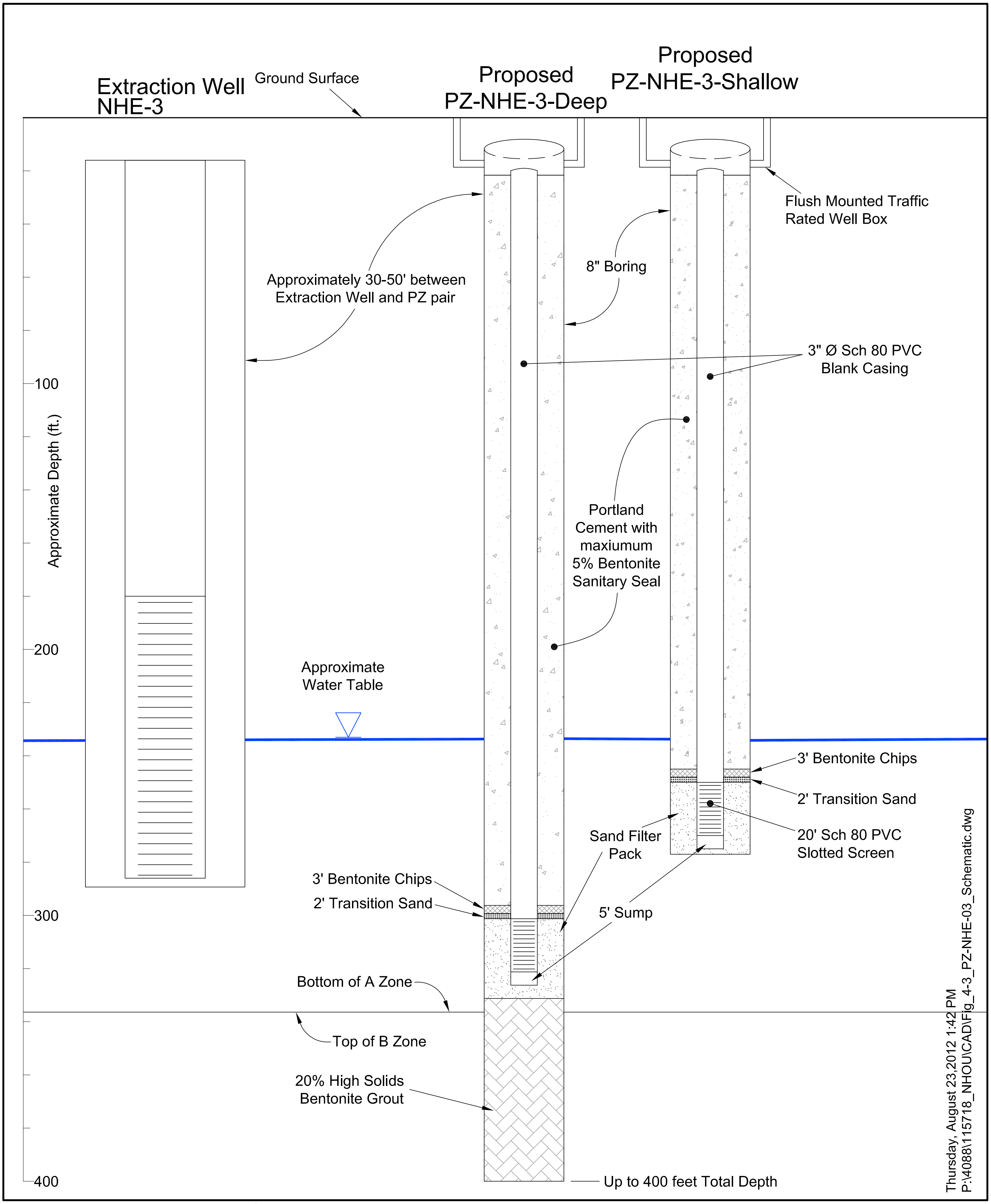

Proposed PZ-NHE-3 Schematic Diagram
Phase 1 Pre-Design Investigation
Sampling and Analysis Plan
North Hollywood Operable Unit
North Hollywood, California

FIGURE
B-3

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
PCB	4088115718	DH	4/2012	MDT	4/2012

EXPLANATION

- Proposed Piezometer Couplet and Aquifer Test Location (Phase 1)
- NHOU Extraction Well
- Monitoring Wells
- Approximate Boundary San Fernando Valley Investigation Area 1

N

0 2,000 4,000
Feet

DRAWN: TJH	PROJECT NO: 4088115718		
REV:	SCALE: AS SHOWN		
CHECKED:	APPROVED:		
DATE: 4/2012	DATE: 4/2012		

amec

Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Proposed PZ-NHE-5
Area Detail Map

FIGURE
B-4

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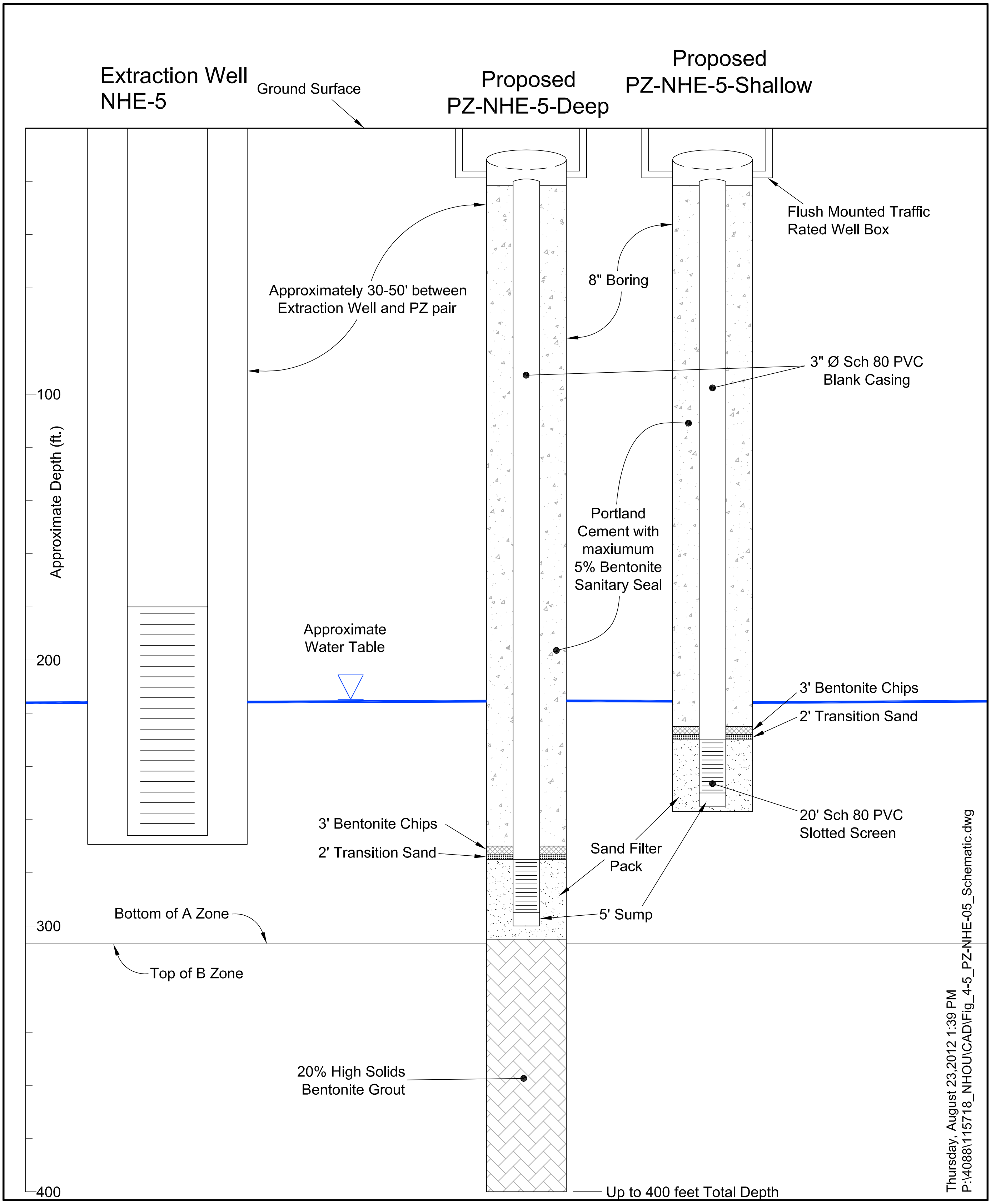

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Proposed PZ-NHE-5 Schematic Diagram

Phase 1 Pre-Design Investigation
Sampling and Analysis Plan
North Hollywood Operable Unit
North Hollywood, California

FIGURE

B-5

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
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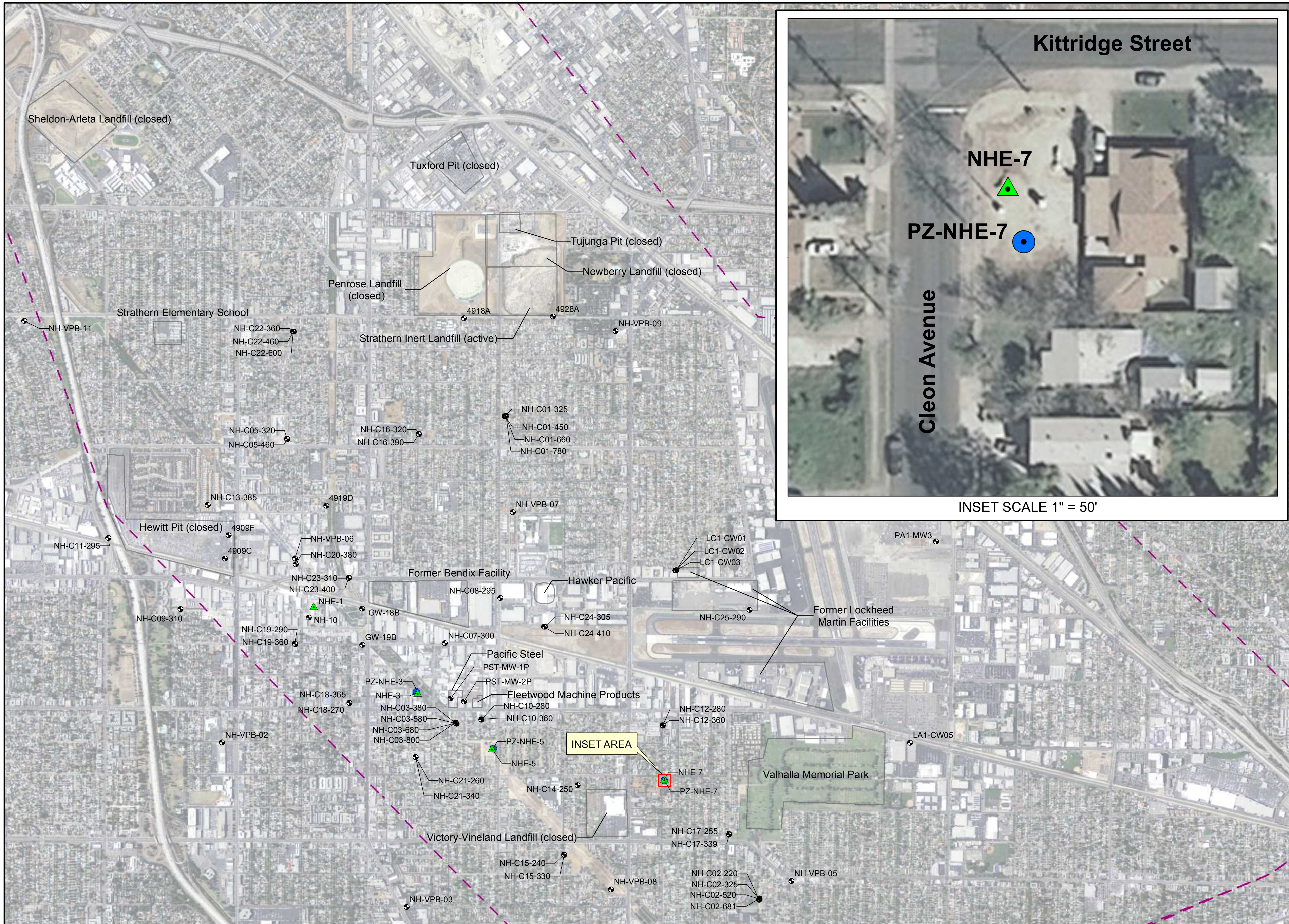

EXPLANATION

- Proposed Piezometer Couplet and Aquifer Test Location (Phase 1)
- NHOU Extraction Well
- Monitoring Wells
- Approximate Boundary San Fernando Valley Investigation Area 1

N

0 2,000 4,000
Feet

DRAWN: TJH	PROJECT NO: 4088115718		
REV:	SCALE: AS SHOWN		
CHECKED:	APPROVED:		
DATE: 4/2012	DATE: 4/2012		

amec

Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Proposed PZ-NHE-7
Area Detail Map

FIGURE
B-6

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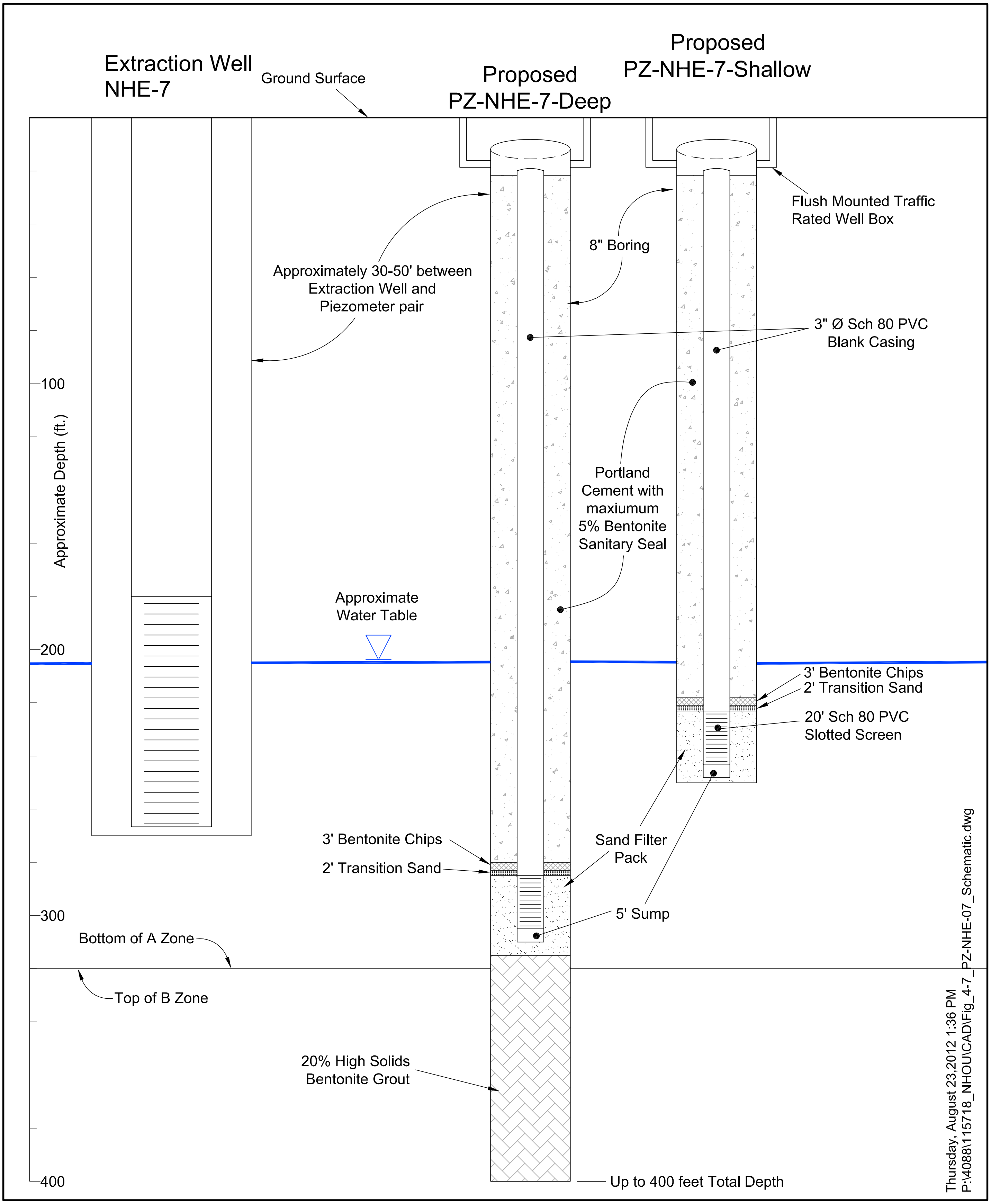

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Proposed PZ-NHE-7 Schematic Diagram
Phase 1 Pre-Design Investigation
Sampling and Analysis Plan
North Hollywood Operable Unit
North Hollywood, California

FIGURE
B-7

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
PCB	4088115718	DH	4/2012	MDT	4/2012

APPENDIX B-1

Field Record Forms

PROJECT:	Log of Boring No.	
BORING LOCATION:	ELEVATION AND DATUM:	
DRILLING CONTRACTOR:	DATE STARTED:	DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH:	MEASURING POINT:
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST	COMPL
SAMPLING METHOD:	LOGGED BY:	
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter. Surface Elevation:	REMARKS
						Hand augered to OVM = MinRAE 2000 PID calibrated with 100 ppm isobutylene standard. OVM = MinRAE 2000 PID calibrated with 100 ppm isobutylene standard.

Project No.	**AMEC Environment & Infrastructure**	Figure

FIELD WELL CONSTRUCTION SUMMARY

Well ID: ____________________ **Project Name:** ____________________

Project/Task No.: ____________________ **Location:** ____________________

AMEC Personnel: ____________________

DRILLING SUMMARY

Drilling Contractor: ____________________ Driller: ____________________

Drilling Method: ____________________ Drill Rig: ____________________

Drilling Fluid: ____________________ Drill Bit(s): ____________________

BORING AND WELL CASING DEPTH MEASUREMENTS

Pilot Boring: Depth Interval BGS ________ Diameter ________ Depth Interval BGS ________ Diameter ________

Reamed Boring: Depth Interval BGS ________ Diameter ________ Depth Interval BGS ________ Diameter ________

Total Depth BGS of Well Casing: ____________ Depth of Perforated Interval BGS: ____________

Total Depth of Well Below TOC: ____________ Depth of Perforated Interval Below TOC: ____________

WELL DESIGN Geologic Log ☐ Geophysical Log ☐ Sieve Analysis ☐

Codes: B = Bentonite Seal C = Casing CC = Conductor Casing
CL = Centralizer EC = End Cap F = Filter G = Grout
N = Native Fill S = Screen TS = Transition Seal

Casing/Screen			**Annular Materials**		
Feet – **BGS**		**Code**	**Feet** – **BGS**		**Code**
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		
–			–		

Filter Material: ____________________

Seal (B/TS): ____________________

Grout: ____________________

Native Material:

Surface Finish:

Centralizers:

Other: ____________________

CONSTRUCTION TIME LOG

Task	**Start**		**Finish**	
	Date	**Time**	**Date**	**Time**
Drilling				
Conductor Casing				
Geophys.				
Casing				
Filter				
Seal (B/TS)				
Grout				
Other				

Well Casing: ____________________
C1

C2

Well Screen: ____________________
S1

S2

Conductor Casing: CC1 ____________
CC2

Project No. **Figure No.**

FIELD WELL CONSTRUCTION SUMMARY
WELL CASING INSTALLATION

Well ID: ____________________ Project/Task No.: ____________________

I. Section Measurements: (to 0.01 of a foot)

Well casing sections (A)

________ ________ ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________ ________

________ ________ ________ ________ ________ ________ ________ ________

Total = __________ (1)

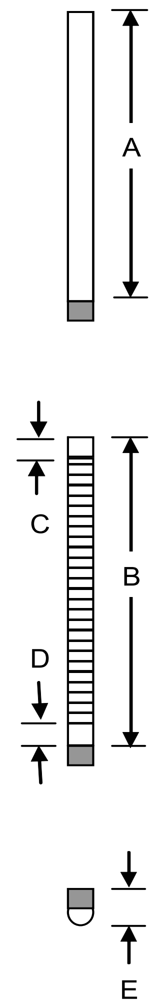
Well screen sections (B)

________ ________ ________ ________ ________ Total = __________ (2)

Length from top of screen section to top perforation (C) = __________ (3)

Length from bottom of screen section to bottom perforation (D) = __________ (4)

Length of bottom endcap + tailpipe (measured inside of cap) (E) = __________ (5)



II. Total Measurements Referenced to GS: (to 0.01 of a foot)

Total length of well casing (1+2+5) = __________ (6)

Total length of perforated interval (2-3-4) = __________ (7)

Temporary height/depth of top of casing AGS (+) / BGS (–)

(1) Desired depth to top of screen interval _________ (8a) (1+3-8a) = __________ (9a)

or (2) Desired depth to bottom of screen interval _________ (8b) (1+3+7-8b) = __________ (9b)

Actual height/depth of top of casing after installation (to 0.01 of a foot) = __________ (9c)

Total depth of well (BGS) (to 0.10 of a foot) (6-9c) = __________ (10)

Depth of perforated interval (BGS) (to 0.10 of a foot) Bottom (10-5-4) = __________ (11)

Top (11-7) = __________

III. Surface Completion: (to 0.10 of a foot)

Top of casing adjustments: Casing removed (–) / added (+)

________ ________ ________ ________ Total = __________ (12)

Final TOC: AGS (+) / BGS (–) (9c-12) = __________ (13)

Total Depth of Well below TOC (to 0.10 of a foot) (6-12) = __________ (14)

Depth of Perforated Interval below (TOC) (to 0.10 of a foot) Bottom (14-5-4) = __________ (15)

Top (15-7) = __________

Note: All measurements of well casing and screen sections to be to the nearest 0.01 ft. All final measurements referenced to ground surface and top of casing are to be to the nearest 0.10 ft.

GS = ground surface AGS = above ground surface BGS = below ground surface TOC = top of casing

FIELD WELL CONSTRUCTION SUMMARY
ANNULAR MATERIALS VOLUME CALCULATIONS WORKSHEET

amec

Project: ______________________ **Date:** ______________________

Location: ______________________ **Project/Task No:** ______________________

Well I.D.: ______________________

Filter Pack Volume Calculations (Filter Pack and Transition Seal)

Filter Pack/Granular Transition Seal Description (Brand and Gradation)	Bottom Depth (feet)	Top Depth (feet)	Total Length of Filter Pack Interval (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Lbs. of Sand per Linear Foot of Annulus	Total Volume of Filter Pack (cubic feet)	Calculated Number of 100 lb. Bags of Sand Required	Number of 100 lb. Bags of Sand Used

Annular Seal Volume Calculations (Bentonite Seal)

Bentonite Seal Description	Bottom Depth (feet)	Top Depth (feet)	Length of Bentonite Seal Interval (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Lbs. of Bentonite Chips/Pellets per Linear Foot of Annulus	Total Volume of Bentonite Seal (cubic feet)	Calculated Number of 50 lb. Bags/Pails of Bentonite Required	Number of 50 lb. Bags/Pails of Bentonite Used

Annular Seal Volume Calculations (cement/bentonite grout, neat cement grout, bentonite grout, sand-cement grout, etc.)
See attached **GROUTING FORM** for detailed grout slurry data.

Annular Seal Description (Include Cement Type -- e.g., I, II, V)	Bottom Depth (feet)	Top Depth (feet)	Length of Annular Seal Interval (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Calculated Total Volume of Grout for Annular Seal (gallons or ft^3 or yd^3 -- circle one)	Total Volume of Grout Used in Annular Seal (gallons or ft^3 or yd^3 -- circle one)

Miscellaneous Data and Conversions

1 gallon water = 8.34 pounds
1 cubic foot water = 62.4 pounds
1 cubic foot water = 7.48 gallons water
1 sack of sand = 1 cubic foot and approximately 100 pounds
1 sack of cement (wet) = 0.5 cubic foot = 3.75 gallons
1 pail of bentonite pellets = approximately 50 pounds
1 sack of cement (dry) = 1 cubic foot and approximately 96 pounds

FIELD WELL CONSTRUCTION SUMMARY
GROUTING FORM

Project Name: ______________________ Project/Task Number: ______________________

Site Name: ______________________ Date: ______________________

Location: ______________________ Well/Boring ID: ______________________

Batch Number	TIME			BATCH MIXTURE					BATCH VOLUME		CUMULATIVE VOLUME				
	Begin Mixing	End Mixing	End Pumping	# Sacks Cement	Water (gallons)	Bentonite (lbs)	Sand (lbs)	Grout Weight (lbs/gal)	cu. ft.	gallons	cu. ft.	gallons	Calculated Grout Level (ft bgs)	Measured Grout Level (ft bgs)	Tremie Pipe Depth (ft bgs)

SURFACE COMPLETION DETAILS FOR WELLS

Well ID: ______________________ Project/Task No.: ______________________

Surface Flush Mount Completion (to 0.10 of a foot)

Well Box Manufacturer: ______________________ Model No. ______________________

Well Box: Diameter: ________ Length ________ Bolt Type: Diameter ________ (fractions of an inch, e.g., 5/8) # Bolts: _____

Well Vault: Dimensions: Length ________ x Width ________ x Height ________

Bolt Type: Diameter ________________ (fractions of an inch, e.g., 5/8) # Bolts: ________________

Notes:

Above Grade Surface Completion (to 0.10 of a foot)

Steel Protective Cover: Length ________ Diameter or Width ________ (circle one) Height AGS ________ Depth BGS ________

Cap Type (check one): Locking Hinged _____ Locking Slip Cap _____

Annular Space (check appropriate): Mortar Collar ____ Sand ____ Other ________ Drainage Hole ____ Height AGS _____

Concrete Pad Dimensions: Length ________ x Width ________ x Thickness ________

Steel Protective Bollards: # of ______ Length ________ Diameter or Width _______ (circle one) Height AGS _______ Depth BGS _______

Radial Distance of Steel Protective Bollard from Well ____________________

AGS = above ground surface

BGS = below ground surface

Notes:

FIELD WELL CONSTRUCTION SUMMARY NOTES

ORIGINAL
File with DWR Get new number

Page ___ of ___

Owner's Well No. ____________

Date Work Began ____________, Ended ____________

Local Permit Agency ____________

Permit No. ____________ Permit Date ____________

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. XXXXXXX

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ____________ FLUID ____________

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*

TOTAL DEPTH OF BORING ________ (Feet)

TOTAL DEPTH OF COMPLETED WELL ________ (Feet)

WELL OWNER

Name ____________

Mailing Address ____________

CITY STATE ZIP

WELL LOCATION

Address ____________

City ____________

County ____________

APN Book ______ Page ______ Parcel ______

Township ______ Range ______ Section ______

Latitude ____ DEG. MIN. SEC. NORTH Longitude ____ DEG. MIN. SEC. WEST

LOCATION SKETCH

NORTH

WEST

EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

___ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ________ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ________ (Ft.) & DATE MEASURED ________

ESTIMATED YIELD * ________ (GPM) & TEST TYPE ________

TEST LENGTH ________ (Hrs.) TOTAL DRAWDOWN ________ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE: CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ____________

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME ____________
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS CITY STATE ZIP

Signed ____________ WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

AMEC Environment & Infrastructure

WELL DEVELOPMENT FORM

Job Number: ______________________

Project: ______________________ Development Method ______________

Personnel: ______________________ Total Depth: ______________________

Time	Depth to water ft.	Gallons Removed	Turbidity (Ntu)	pH	Temp C	Electrical Conductivity	D.O. mg/liter	Redox Mv	Recovery Rate Inches/min.	Recovery Rate gpm

Subtotal Gallons Removed: ______________________

Total Gallons Removed: ______________________

Reviewed by ________________

Well No. ___________________________

Date: ______________________________

Reviewed by _______________

CHAIN-OF-CUSTODY RECORD

PROJECT NAME:

DATE:

PAGE OF

PROJECT NUMBER:

LABORATORY NAME:

CLIENT INFORMATION:

REPORTING REQUIREMENTS:

RESULTS TO:

LABORATORY ADDRESS:

TURNAROUND TIME:

SAMPLE SHIPMENT METHOD:

LABORATORY CONTACT:

GEOTRACKER REQUIRED YES NO

LABORATORY PHONE NUMBER:

SITE SPECIFIC GLOBAL ID NO.

SAMPLERS (SIGNATURE):

DATE	TIME	SAMPLE NUMBER	ANALYSES															CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

TOTAL NUMBER OF CONTAINERS:

SAMPLING COMMENTS:

amec

SAMPLE CONTROL LOG

amec

Project Name: ______________________________ **Laboratory:** ______________________________

Project and Task No.: ________________________ Page ____ of ____

Sampling Date	Sampling Time	Sample Number (ID)	C.O.C. Number	Analyses Requested	Turnaround Time, Sample Location, Handling Notes, Chain-of-Custody Remarks, etc. (Duplicate, Blank info, etc.)	Date Sent to Lab	Date Results Due

FIELD INSTRUMENT CALIBRATION SHEET

Project Name: ______________________ **Project Number:** ______________

Date: ______________________

Equipment Type: ______________________

Manufacturer: ______________________

Model Number: ______________________ **Serial Number:** ______________

Calibration (as necessary, minimum twice per day):

Calibration #1 **Time:** ______________

Calibration Standard: ______________________

Instrument Reading: ______________________

Calibration #2 **Time:** ______________

Calibration Standard: ______________________

Instrument Reading: ______________________

Calibration #3 **Time:** ______________

Calibration Standard: ______________________

Instrument Reading: ______________________

Calibration #4 **Time:** ______________

Calibration Standard: ______________________

Instrument Reading: ______________________

Date of Last Calibration: ______________ Date(s) Instrument Used: ______________

Name of person(s) who calibrated instruments: ______________________

Calibration Standards Used:

(1) ______________________

(2) ______________________

(3) ______________________

(4) ______________________

Source of Calibration Standards: ______________________

Misc. Comments:

____

____

Calibrated by: ______________________


SAMPLE ID:
amec
Project No: ______ . ______ . ______
Project Name: ______
Time (24hr): ______ Date: ____/____/____
Analysis: ______
Preservative: ______
Remarks: ______
Recorder: ______
AMEC Environment & Infrastructure -- 2101 Webster Street, Oakland, CA 94612 -- (510) 663-4100

APPENDIX C

Aquifer Testing Field Sampling Plan

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TABLE

FIGURES

APPENDIX

ABBREVIATIONS AND ACRONYMS

1,2,3-TCP	1,2,3-trichloropropane
ABS	acrylonitrile, butadiene, and styrene
AMEC	AMEC Environment and Infrastructure, Inc.
AOC	Agreement and Order on Consent
CDPH	California Department Public Health
CHG	Certified Hydrogeologist
CIH	Certified Industrial Hygienist
CSM	conceptual site model
DQIs	Data Quality Indicators
DQOs	Data Quality Objectives
DTW	depth-to-water
FSP	Field Sampling Plan
HASP	Health and Safety Plan
Honeywell	Honeywell International, Inc.
IDW	investigation-derived waste
gpm	gallon(s) per minute
LADWP	Los Angeles Department of Water and Power
Lockheed Martin	Lockheed Martin Corporation
MCL	Maximum Contaminant Level
NDMA	n-nitrosodimethylamine
NHE	North Hollywood extraction (well)
NHOU	North Hollywood Operable Unit
ORP	oxidation reduction potential
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCE	tetrachloroethene
PE	Principal Engineer
PG	Principal Geologist
PMP	Project Management Professional
psi	pounds per square inch
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SFV	San Fernando Valley
TCE	trichloroethylene
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds

C1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) has prepared this Field Sampling Plan (FSP) on behalf of Honeywell International, Inc. (Honeywell) and Lockheed Martin Corporation (Lockheed Martin) to present the rationale, field methods and procedures, analytical requests, and quality assurance/quality control (QA/QC) procedures for planned Second Interim Remedy activities for the North Hollywood Operable Unit (NHOU) in compliance with the U. S. Environmental Protection Agency's (USEPA) Interim Action Record of Decision (ROD) dated September 30, 2009. The Second Interim Remedy is intended to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect water supply production well fields, and address emerging chemicals. This FSP addresses activities for aquifer testing recommended by the Data Gap Analysis (AMEC, 2012a) and described in the Phase 1 Pre-Design Investigation Work Plan (AMEC, 2012b).

The organization of this FSP follows the outline presented in the USEPA Sampling and Analysis Plan Guidance and Template (USEPA, 2000). This FSP is an appendix to the Sampling and Analysis Plan (SAP), which provides additional information about the Second Interim Remedy for the NHOU, historical information, the study area setting, and the objectives of the Phase 1 Pre-Design Investigation.

C1.1 Sampling Area

The Site is known as the North Hollywood Operable Unit, which is part of the San Fernando Valley (area 1) Superfund Site.

C1.2 Sampling Area Location

The NHOU is located in the community of North Hollywood (a district of the City of Los Angeles; Figure C-1). The NHOU is approximately 15 miles northwest of downtown Los Angeles and immediately west of the City of Burbank, California.

C1.3 Responsible Agency

The work described in this FSP will be conducted by AMEC under contract by Honeywell and Lockheed Martin. The lead regulatory agency is the USEPA, Region IX.

C1.4 Project Organization

Title/Responsibility	Name	Phone Number
USEPA Project Manager	Matt Salazar	415.972.3982
Honeywell Project Manager	Benny DeHghi	310.512.2296
Lockheed Martin Project Manager	Carolyn Monteith	228.813.2211
AMEC Staff:		
Principal in Charge	Warren Chamberlain, PG, CHG, PE	510.663.3984
Project Manager	Michael Taraszki, PG, CHG, PMP	510.663.4100
Engineering Manager	Robert Hartwell, PE	773.693.6030
Lead Modeler	Jeff Weaver	970.764.4070
Quality Assurance Manager	Margaret K. (Peggy) Peischl, PE	510.663.4100
Health and Safety Manager	Donald Kubik, Jr., CIH, PG	510.663.4100
Field Team Leader	Sean Culkin, PG	510.663.4100

C1.5 Statement of the Specific Problem

The results of the Final Data Gap Analysis indicate that additional groundwater data are needed to ensure that the Second Interim Remedy design will meet remedial action objectives (RAOs) and comply with California Department of Public Health (CDPH) 97-005 requirements (AMEC, 2012a). The following critical data gaps are covered by this specific FSP:

- Existing aquifer test data are insufficient to estimate hydraulic parameters specific to the A-Zone or B-Zone, which are needed to accurately simulate groundwater flow directions, North Hollywood extraction well (NHE) hydraulic capture areas, and influent pumping rates to the new treatment system
- The existing numerical groundwater flow model does not include reliable depth-discrete hydraulic parameters, particularly hydraulic conductivity. Simulation results may be made more reliable by evaluating lateral and vertical hydraulic properties informed by aquifer test results and the updated conceptual site model (CSM).

C1.6 Schedule

The work described in this FSP is anticipated to be completed in multiple testing events, in accordance with the NHOU project schedule included in Appendix D. Before testing begins, the Field Team Leader will confirm that required access agreements are completed, qualified subcontractors are available to perform the work, secure locations are identified for temporarily storing investigation-derived waste (IDW), and arrangements for disposal of IDW are confirmed.

C2.0 BACKGROUND

This section provides an overview of the location, previous investigations, and the current understanding of the site conditions.

C2.1 Site or Sampling Area Description

The NHOU comprises approximately 4 square miles of contaminated groundwater underlying an area of mixed industrial, commercial, and residential land use in the community of North Hollywood (a district of the City of Los Angeles) (Figure C.1). The NHOU is approximately 15 miles northwest of downtown Los Angeles immediately west of the City of Burbank, and has approximate site boundaries of Sun Valley and Interstate 5 to the north, State Highway 170 and Lankershim Boulevard to the west, the Burbank Airport to the east, and Burbank Boulevard to the south (Figure C.2).

The work described in this FSP will be conducted at existing monitoring wells within the NHOU study area. The NHOU groundwater monitoring well network is shown on Figure C.2.

C2.2 Operational History

The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8); a collector line; and a central treatment system consisting of an air-stripping treatment system to remove volatile organic compounds (VOCs) from the extracted groundwater, two activated carbon filters to remove VOCs from the air stream, a chlorination system, and ancillary equipment. The treated groundwater is discharged into a Los Angeles Department of Water and Power (LADWP) blending facility where it is combined with water from other sources before entering the LADWP water supply system. The existing NHOU Extraction and Treatment System began operation in December 1989 and remains in operation today. As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHE Extraction and Treatment System, and NHE-5 has not operated since 2008.

C2.3 Previous Investigations/Regulatory Involvement

This section presents a brief summary of the previous investigations and regulatory involvement for the NHOU that occurred from 1984 through 2011. For additional details, consult the main Quality Assurance Project Plan (QAPP) text or documents identified in the references section (Section C13.0).

The NHOU was proposed by the USEPA in 1984 in response to the discovery in the late 1970s of trichloroethene (TCE) and tetrachloroethene (PCE) in groundwater from production wells in the San Fernando groundwater basin and throughout much of the eastern portion of the San Fernando Valley (SFV). In 1989, LADWP constructed the existing NHOU Extraction and Treatment System.

The USEPA conducted a series of five-year reviews (USEPA, 1993, 1998, 2003, 2008) and concluded that the TCE and PCE groundwater plume was migrating vertically and laterally beyond the remedy's zone of hydraulic control. A separate evaluation by LADWP (2003) also raised concerns about detections of total chromium and hexavalent chromium in extraction well NHE-2 of the NHOU interim remedy.

The USEPA's groundwater monitoring program for the San Fernando groundwater basin started in 1993, and groundwater samples have since been collected on either a quarterly, semiannual, or annual basis. The USEPA has identified new contaminants in NHOU groundwater in excess of maximum contaminant levels (MCLs) or state notification levels, including hexavalent chromium; 1,4-dioxane; 1,2,3-trichloropropane (1,2,3-TCP); and other select emerging chemicals (including perchlorate and n-nitrosodimethylamine [NDMA]). The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals. The USEPA issued a ROD on September 30, 2009 (USEPA, 2009), referred to as the Second Interim Remedy, with the intent to upgrade and expand the existing NHOU groundwater remediation system to improve containment, protect production well fields, and address emerging chemicals.

An Agreement and Order on Consent (AOC), dated February 21, 2011, was executed between the USEPA, Honeywell, and Lockheed Martin to conduct pre-design data acquisition, establish RAOs, and describe remedial design activities associated with the ROD (USEPA, 2011). Available data were reviewed to refine the NHOU CSM and identify critical data gaps. Recommendations for additional work were presented to the USEPA in the *Final Data Gap Analysis* (AMEC, 2012a). The work described in this FSP is based on the recommendations presented in the *Final Data Gap Analysis* report and has been prepared consistent with requirements stated in the AOC.

Hydraulic properties of the North Hollywood and Burbank areas have been estimated via various aquifer tests and other methodologies, and are described in Section 3.2.2 of the *Final Data Gap Analysis* (AMEC, 2012a).

C2.4 Geological and Hydrogeological Information

The geology and hydrogeology in the area of the NHOU are described in detail in the *Final Data Gap Analysis* report (AMEC, 2012a), which also includes a refined CSM. The planned groundwater sampling and testing described in this FSP will be conducted in the hydrogeologic units referred to as the A-Zone and B-Zone.

C2.5 Environmental and/or Human Impact

Although the existing NHOU Extraction and Treatment System has reduced contaminant migration in the groundwater and removed substantial VOC mass from the aquifer, VOC concentrations remain above MCLs in groundwater. In addition, declining water table and changing groundwater pumping patterns in the SFV groundwater basin and the discovery of VOC contamination in new areas have demonstrated that the existing NHOU Extraction and Treatment System is not capable of fully containing the VOC plume. The USEPA has also identified emerging chemicals in NHOU groundwater in excess of MCLs or state notification levels, including hexavalent chromium; 1, 4-dioxane; 1,2,3-TCP; and other select emerging contaminants (including perchlorate and NDMA). The existing NHOU Extraction and Treatment System was not designed to treat chromium (in any form) or the emerging chemicals.

C3.0 PROJECT DATA QUALITY OBJECTIVES

C3.1 Project Task and Problem Definition

The objective of aquifer testing is to better understand the hydraulic properties (particularly hydraulic conductivity and storage) of the NHOU study area, specifically within the A- and B-Zones. Better understanding of the lateral and vertical distribution of hydraulic parameters will be used to improve the CSM, capture zone analyses, and groundwater flow model. Table C-1 summarizes the wells to be tested, which are also shown on Figure C-2. The planned work includes the following tasks:

1. Slug tests will be performed at 14 wells screened within in the A- or B-Zones to estimate hydraulic parameters.
2. Perform aquifer pumping tests at three NHE extraction wells (NHE-3, NHE-5, and NHE-7) while monitoring the response to the pumping test in up to 10 observation wells to estimate well efficiency and A-Zone hydraulic parameters.

Where practicable, the slug tests will be performed via pneumatic methods. Where specific conditions, such as groundwater levels below the top of screened intervals, prevent performance of pneumatic slug tests, a physical slug test will be performed.

Aquifer tests at NHE wells will consist of a step-drawdown test to evaluate extraction well performance followed by a constant-rate discharge test with corresponding recovery tests. No groundwater sample collection is expected to occur in conjunction with the NHE pumping tests; however, if samples are collected, they will be subject to the same criteria outlined in the Groundwater Sample Collection FSA (SAP Appendix A). Procedures and methodologies for each type of slug and pumping test are described in the subsections below.

C3.2 Data Quality Objectives

Data quality objectives (DQOs) are both qualitative and quantitative statements that define the type, quality, and quantity of environmental data appropriate for the intended application. In addition to the information presented in this section, the SAP provides other information regarding overall data quality objectives. The task-specific DQOs for the aquifer test program were developed along the following seven-step process.

1. **State the Problem.** Concisely describe the problem to be studied.
2. **Identify the Decision.** Identify the decision that will solve the problem using data.
3. **Identify the Inputs to the Decision**. Identify the information needed and the resulting measurements that need to be made in order to support the decision.
4. **Define the Study Boundaries**. Specify the conditions (time periods, spatial areas, and situations) to which the decision will apply and within which the data will be collected.
5. **Develop a Decision Rule.** Define the conditions by which the decision-maker will choose among alternative risk management actions. This is usually specified in the form of an “if…then…” statement.

6. **Specify Acceptable Limits on Decision Errors.** Define in statistical terms the decision-maker's acceptable error rate based on the consequence of making an incorrect decision.
7. **Optimize the Sampling Design.** Evaluate the results of the previous steps and develop the most resource-efficient design for data collection that meets all of the DQOs.

The results of the DQO steps, based on the purpose and scope for the work described in this FSP, are summarized below:

1. State the Problem.
   a) Existing hydraulic parameter data are not specific to the A-Zone or B-Zone, which are needed to accurately simulate groundwater flow directions, NHE hydraulic capture areas, and influent pumping rates to the new treatment system.
   b) The existing numerical groundwater flow model does not include reliable depth-discrete hydraulic parameters, particularly hydraulic conductivity.
2. Identify the Decision.
   a) How do the water-bearing units, particularly the A-Zone and the B-Zone, of the NHOU study area respond to stress induced by pumping or displacement of water within a wellbore?
   b) What are the hydraulic properties, specifically hydraulic conductivity and storage, of the NHOU water-bearing units, and how are they distributed laterally and vertically?
   c) What are the pumping efficiencies of the NHOU extraction wells, and what is the size and shape of their capture zones?
3. Identify the Inputs to the Decision.
   a) Displacement data will be collected from wells subject to slug testing as summarized in Table C-1 to estimate aquifer hydraulic parameters. Electronic pressure transducers and manual measurements will be used to collect data.
   b) Drawdown data will be collected from NHE-3, NHE-5, and NHE-7 and associated piezometer locations, as well as other existing monitoring wells, as listed in Table C-1 during step-drawdown, constant-rate discharge pumping tests and recovery periods. Electronic pressure transducers and manual measurements will be used to collect data. Time-drawdown curves will be developed and analyzed via applicable analytical solutions to develop hydraulic parameter estimates and to evaluate extraction well efficiencies.
4. Define the Study Boundaries.
   a) Aquifer tests will be performed at selected wells located in the NHOU as shown on Figure C-2.
5. Develop a Decision Rule. The applicable decision rules are as follows:
   a) If pneumatic testing is not possible because of exposed well screens, physical slug tests will be performed.

b) If the LADWP will not permit use of existing pumps in NHE-3, NHE-5, and NHE-7, a temporary submersible pump capable of a flow rate of between approximately 50 and 150 gallons per minute (gpm) will be installed.

c) If unexpected drawdown responses are observed at wells subject to aquifer testing, or if drawdown data is not considered sufficient for subsequent analysis and parameter estimation, the need for additional aquifer tests will be evaluated.

6. Specify acceptable limits on decision errors.

   a) The SAP and this FSP have been prepared based on the aquifer test locations and data gaps previously identified in the *Final Data Gap Analysis* report (AMEC, 2012a). The predominant quantitative variability is inaccurate measurement and recording of drawdown.

   b) Variability introduced by inaccurate drawdown data may result in unreasonable or similarly inaccurate hydraulic parameter estimation. The consequences of this variability may affect the decisions about NHE well use and treatment system design, as well as other decisions informed by groundwater flow model results.

   c) The accuracy of drawdown data collected via aquifer tests and the reliability of parameter estimates based on these tests will be subject to review during and after the tests have been performed. Technical review will decide the consequences of suspect data and analysis, and any additional aquifer tests or corrective action will follow, if deemed necessary.

7. Optimize the Sampling Design.

   a) Aquifer test locations, number of observation wells, and aquifer test evaluation methodologies are proposed herein. As described in DQO Step 5, additional tests may be conducted after analysis and review of the collected drawdown data. The results of the tests, with any modifications that were generated based on the DQO process, will be spelled out in the report of findings.

C3.3 Data Quality Indicators

Data quality indicators (DQIs) refer to quality control criteria established for various aspects of data gathering, sampling, or analysis. Field precision will be assessed on the basis of reproducibility by multiple readings from field instruments, and technical review of collected data. Accuracy of field instruments will also be assessed through daily instrument calibration and calibration checks.

C3.4 Data Management and Assessment Oversight

Data management and assessment oversight for aquifer testing includes steps that will be taken to confirm that data are transferred accurately from collection to evaluation to reporting. These steps include measures to review the data collection process, including field records, data logs, and preparation of the final report for this work. Data management and assessment activities, including responsible team members, are described in this section of the FSP and in Sections 3.0 and 4.0 of the SAP.

Data collected for the aquifer test program will be reviewed as part of the QA/QC process. The flow of data for the project will be as follows:

- For the NHE pumping tests, field data, including manual depth-to-water (DTW) measurements, recorded pressure transducer measurements, pumping rates, totalizer readings, and information relayed by on-site subcontractors will be communicated at regular intervals to the Field Task Leader, who will review progress of the test and recommend procedural changes if necessary. The AMEC Project Manager will be informed of pumping test progress daily.
- For both slug and pumping tests, all field data sheets and data logger results will be forwarded daily to the Field Task Leader, who will review and check for errors or inconsistencies. The AMEC Project Manager will confirm with the Field Task Leader that the data have been reviewed.
- Analytical solutions for parameter estimation will be reviewed and validated by the AMEC Project Manager or his technical designee before publication or incorporation into the CSM.
- AMEC will document validated data in both electronic and hardcopy format.

In compliance with the AOC Statement of Work Section 4.3.5, a Data Usability Evaluation and Field QA/QC submittal will be prepared and will describe the following:

- The criteria used to review data in an objective and consistent manner.
- The results obtained from the task reconciled with the requirements defined by the data user or decision maker.
- The methods used to analyze the data and determine possible anomalies or departures from assumptions established in the planning phase of the aquifer testing.
- The methods used for field QA/QC.

In compliance with the AOC Statement of Work Section 4.3.6, a Data Reduction, Tabulation, and Evaluation submittal will be prepared and will include the following:

- Drawdown data that have been tabulated, evaluated and interpreted.
- Time-drawdown curves and analytical solutions presented in an appropriate format.
- A database designed and set up with information that is pertinent and usable during the performance of the work.
- Processed data tables and drawdown curves as part of the Phase I Pre-Design Investigation findings report.

C4.0 AQUIFER TEST RATIONALE

The aquifer test locations were selected to fill data gaps regarding A-Zone and B-Zone hydraulic parameters in the NHOU study area that have been identified during development of the groundwater flow model and CSMs. The NHOU extraction wells selected for slug testing in Table C-1 were selected for their locations within the A- and B-Zones and within areas of the NHOU study area that are critical for understanding groundwater flow. NHOU extraction wells were selected for pumping tests to evaluate the size and shape (lateral and vertical) of the NHOU well field capture area and to further quantify the A-Zone hydraulic parameters.

C5.0 REQUEST FOR ANALYSES

Because we do not anticipate that groundwater samples will be collected during aquifer testing activities, the analytical request process does not apply to this FSP.

C6.0 FIELD METHODS AND PROCEDURES

Procedures, methods, and equipment anticipated for physical and pneumatic slug tests, as well as step-drawdown and constant-rate discharge pumping tests are described in this section. All manual DTW readings and use of electronic pressure transducers will follow the procedures described in the Groundwater Sample Collection FSP (SAP Appendix A).

Before work begins, well and encroachment permits will be acquired from the LADWP, Environmental Health Division, County of Los Angeles, and the City of North Hollywood, as necessary. Traffic plans will be prepared in accordance with Los Angeles County Health Department requirements and the Work Area Traffic Control Handbook to access wells located in streets. Coordination with the USEPA and LADWP will also occur to avoid conflicts with other monitoring programs or activities that may be in progress, including NHOU Extraction and Treatment system operations during aquifer testing activities.

C6.1 Slug Tests

A slug test involves the nearly-instantaneous displacement of a known volume of water within the well by introducing or removing a physical slug of known dimensions, or by pressurizing the well with compressed gas and quickly releasing the pressure causing displacement of water in the well. The resulting drawdown or recovery curve can be used to estimate local hydraulic parameters such as hydraulic conductivity and storage. Unlike physical slug tests, pneumatic slug tests can vary the applied pressure to test drawdown at a number of initial displacements. However, this type of slug test may not be practicable at all wells scheduled for testing that are listed in Table C-1.

C6.1.1 Necessary Equipment

C6.1.1.1 Physical Slug Tests

The following equipment is needed to perform physical slug tests. All equipment will be decontaminated and tested before field activities begin.

- Tape measure
- Submersible transducer, datalogger, and appropriate length of cable
- Laptop computer with appropriate software and data cable connections to communicate with datalogger
- Solid slug of known volume (stainless steel, PVC, and ABS plastic are commonly used materials)
- Tripod and rope capable of quickly raising and lowering slug to anticipated depths
- Electronic DTW sounder
- Electrical tape, duct tape, and/or nylon cable ties to secure data cables
- Field forms, logbook, and pens
- Appropriate references and calculator
- Health and safety equipment as required.

C6.1.1.2 Pneumatic Slug Tests

The following equipment is needed to perform pneumatic slug tests. All equipment will be decontaminated and tested before field activities begin.

- Tape measure
- Submersible transducer, datalogger, and appropriate length of cable
- Laptop computer with appropriate software and data cable connections to communicate with datalogger
- Wellhead manifold. This is generally constructed of schedule 40 PVC and designed to attach to a 1-or 2-inch-diameter well, with adapters to fit various well sizes. The manifold includes a cable compression fitting to seal the transducer cable within the manifold, as well as a fitting for connection to the gas line. A ball valve for venting the gas and a pressure gauge are other necessary components of the manifold. The purpose of the manifold is to allow pressurization of the well, seal pressurized gas within the well, release it quickly, and allow for a transducer to record data throughout the test.
- Necessary adapters for routing compressed gas into the manifold
- Air compressor capable of supplying necessary pressure
- Generator or power source for air compressor
- Necessary power cables and gas lines for compressor and power source
- Necessary tool kit for setup and disconnection of the manifold, air lines, and other equipment
- Electronic DTW sounder
- Electrical tape, duct tape, and/or nylon cable ties to secure data cables
- Teflon tape
- Field forms, logbook, and pens
- Appropriate references and calculator
- Health and safety equipment as required.

C6.1.2 Slug Test Procedures

C6.1.2.1 Physical Slug Tests

The following general procedures may be used to collect drawdown data during physical slug tests:

1. Decontaminate the transducer, cable, and DTW sounder.
2. Collect initial water level measurements from test well over several minutes to determine static water level.
3. Connect transducer to computer and test to ensure that it is working. Select sampling interval. If high formation hydraulic conductivity is anticipated, select the highest possible sampling frequency. Select the logarithmic sampling interval to

record drawdown; it is critical to make as many measurements as possible in the early part of the test after introduction or removal of the slug. Follow the software manufacturer's instructions to ensure the correct sampling type and frequency.

4. If necessary, cover sharp edges of the well casing with tape to protect the transducer cable.
5. Estimate maximum displacement in the well based on slug dimensions and well diameter.
6. Establish and confirm with the subcontractor the length of cable that will need to be released in order to completely submerge slug.
7. Install the transducer into the well to a depth below the maximum displacement calculated above and below the anticipated slug depth. Secure the transducer cable at the surface to the top of well or another static object with tape or nylon cable ties. The transducer cable must not slip during the test.
8. Make sure the maximum anticipated displacement does not exceed the manufacturer's recommended threshold for pressure or depth for the transducer.
9. Monitor the pressure reading on the computer to ensure stable initial conditions. Measure and record a manual DTW.
10. Ensure that the slug and tripod are positioned immediately above the static water level in the well and can be raised and lowered without interfering with the transducer data cable.
11. Begin the data logger and quickly lower the slug such that it is completely submerged below the initial DTW.
12. Monitor displacement and recovery of the water level on the computer screen. This is the "falling head" component of the slug test.
13. When the water level has recovered to within 0.1 foot of initial static water level, confirm the water level with manual DTW measurements, and stop the datalogger.
14. Download data from the data logger and review the drawdown curve.
15. Reset the data logger for the second phase of slug test.
16. Begin the data logger and quickly remove the slug so that it is no longer submerged.
17. Monitor displacement and recovery of the water level on the computer screen. This is the "rising head" component of the slug test.
18. When the water level as recovered to within 0.1 foot of initial static water level, confirm the water level with manual DTW measurements, and stop the datalogger.
19. Download data from the data logger and review the drawdown curve. If user error or disturbance in the well produced unusable drawdown curves, consider re-testing the well with a different slug drop/retrieval procedure, or different datalogger settings.
20. Retrieve the slug and transducer from the well. Decontaminate the equipment.

C6.1.2.2 Pneumatic Slug Tests

The following general procedures may be used to collect drawdown data during pneumatic slug tests:

1. Decontaminate the transducer, cable, and DTW sounder.
2. Test compressor and power supply.
3. Collect initial water level measurements from test well over several minutes to determine static water level.
4. Connect the transducer to the computer and test to ensure that it is working. Select the sampling interval. If high formation hydraulic conductivity is anticipated, select the highest possible sampling frequency. Select a logarithmic sampling interval to record drawdown; it is critical to make as many measurements as possible in the early part of the test after depressurization of the well. Follow the software manufacturer’s instructions to ensure correct sampling type and frequency.
5. If necessary, cover sharp edges of the well casing with tape to protect the transducer cable, but do not impede the manifold’s ability to completely seal the well casing.
6. Estimate the maximum displacement in the well based on anticipated pressure and well diameter. Based on anticipated formation hydraulic conductivity and the speed of water level recovery, plan for at least three varying pressurizations to yield three varying initial displacements. Ensure that the maximum anticipated displacements do not cause the water level to drop below the top of the well screened interval.
7. Measure the anticipated transducer cable length and allow for some slack above the top of the wellhead manifold. Secure the transducer cable to the well box or some other static object at the surface with tape or nylon cable ties.
8. Assemble the wellhead manifold with the adapter appropriate to the well being tested and attach to the wellhead. If inflatable packers are a component of the manifold, the well pipe riser that extends to the surface from the top packer should be assembled with O-rings or Teflon tape to improve the seal between pipe sections. If necessary, thread the transducer and cable through the transducer cable compression fitting and lower the transducer into the well before fastening the manifold to the well riser.
9. Install the transducer and cable compression fitting in the top of the wellhead manifold. Be sure the compression collar is loose before tightening the cable compression fitting to avoid twisting the transducer cable. Secure the compression fitting with Teflon tape to ensure a seal.
10. Make sure the maximum anticipated displacement does not exceed the manufacturer’s recommended threshold for pressure or depth for the transducer.
11. Monitor the pressure reading on the pressure gauge to ensure stable initial conditions.
12. Check the pressure gauge to ensure that it reads nearly zero pounds per square inch (psi).
13. With the ball valve on the manifold closed, turn on the air compressor and slowly regulate airflow into the well. Observe increasing pressure on the pressure gauge

and fluctuations in water level from the transducer. Increase flow if necessary and continue to charge the well with compressed air until the desired pressure is achieved.

14. Check the seal by feeling for airflow at the wellhead manifold, or by applying small amounts of water to seals and looking for bubbles. The pressure gauge may show falling pressures as the well is charged. Note that this may result from equilibration of the water column within the formation or from a poor seal. It may be necessary to reassemble the wellhead manifold.
15. When the desired pressure is shown on the pressure gauge and is stable for approximately one minute, begin the data logger and quickly open the ball valve so that the compressed air is released as instantaneously as possible.
16. Monitor the displacement and recovery of water level on the computer screen. Check the maximum displacement against the initial anticipated displacement. This is the “rising head” component of the slug test. Because the well is charged slowly, there is no equivalent “falling head” component of a pneumatic slug test.
17. When the water level has recovered to within 0.1 foot of initial static water level, stop the datalogger.
18. Download the data from the data logger and review the drawdown curve.
19. Reset the data logger for the second phase of the slug test and repeat for subsequent desired displacements. If user error, poor seal, or non-instantaneous pressure release result in a poor drawdown curve, repeat the test with appropriate corrective action.
20. Retrieve the slug and transducer from the well. Decontaminate the equipment as described in section below.

C6.1.3 Demobilization and Data Management

After each physical or pneumatic slug test is completed, the following procedure will be implemented:

1. Save all data and disconnect the data logger and data connections. Raw data files from the data logger should be maintained in addition to the post-processed drawdown curves.
2. Replace any expendable items.
3. Return all equipment to its initial condition and report incidents of malfunction or damage.
4. Review the field forms and notes for completeness.
5. Discuss the results with and forward all data and field forms to the Field Task Manager.
6. Send the data logger and transducer to the manufacturer for service if needed.

A field form for slug tests will be used to record observations. This form is shown in Appendix C-1. All entries will be made in indelible ink. The slug test field form will include the following information:

- Site ID and well number
- Date and time of test
- Slug volume or anticipated pressure and displacement for pneumatic test
- Name and company of person performing test and all subcontractors onsite
- Test method: either rising or falling phase, or pressure in psi of pneumatic test
- Appropriate comments and observations, including feedback from subcontractors
- All DTWs recorded to within 0.01 foot
- Configuration of the data logger (e.g., sample rate, duration, transducer type).

Pressure response curves developed through physical and pneumatic slug tests will be analyzed in order to estimate local hydraulic conductivity and storage parameters. Slug test data will be input into the AQTESOLV® software package (or equivalent), which has a variety of analytical solutions available to match the observed drawdown curves. A variety of viable solutions exist, and the appropriate solution for each slug test will be chosen based on the well configuration and drawdown conditions. These methods and procedures are outlined in detail by Butler (1998).

C6.2 Aquifer Pumping Tests

Constant-rate discharge pumping tests are commonly performed over several hours or days to estimate the hydraulic conductivity, transmissivity, specific yield, and/or storativity of an aquifer unit. Pumping tests can be used to evaluate well efficiency and detect hydraulic boundaries, vertical leakage, or delayed yield effects. Before a constant-rate discharge pumping test is initiated, step-drawdown tests will often be conducted to estimate the greatest flow rate that may be sustained during a long-term test and to calculate the efficiency of the pumping well. The step-drawdown test is typically conducted over a four to eight-hour period and typically includes at least three steps of increasing pumping rate.

C6.2.1 Necessary Equipment

The following equipment is needed to perform step-drawdown and constant-rate discharge tests. All of the downhole equipment will be decontaminated and tested before and after field activities begin.

- Tape measure
- Stopwatch
- Electronic water quality meter capable of measuring pH, temperature, and conductivity
- Submersible pressure transducer, datalogger, and appropriate length of cable
- Laptop computer with appropriate software and data cable connections to communicate with datalogger
- Pump with known capacity for maximum anticipated pumping rate and power supply. The maximum anticipated flow rates for wells NHE-3 and NHE-5 is 50 gpm for the constant-rate discharge test. NHE-7 is expected to need a sustained flow rate of 100

to 150 gpm. It should be noted that the sustainable flow rates will likely be less than the maximum capacity of the test wells, but adequate for the estimation of hydraulic parameters.

- Necessary piping connection to existing NHOU treatment system conveyance
- Flow-meter and/or totalizer
- Rossum sand content tester (or equivalent)
- Electronic DTW sounder
- Electrical tape, duct tape, and/or nylon cable ties to secure data cables
- Field forms, logbook, and pens
- Appropriate references and calculator
- Health and safety equipment as required, including flashlights, headlamps, and work lamps for personnel onsite overnight.
- Field Sampling Plan

C6.2.2 Preparation for Step-Drawdown and Constant-Rate Discharge Tests

The following procedure should be performed before a step-drawdown or constant-rate discharge test is initiated:

1. Review the site Work Plan and become familiar with the location of wells to be tested and historical depths to groundwater. Anticipated drawdown estimates will be developed before testing begins and relayed to field personnel by the Field Team Leader or Project Manager.
2. Ensure that DTW sounders and transducers are decontaminated and calibrated. Consider bringing additional transducers in case of malfunctions. Calibrate the flow-meter at several known discharge rates or according to the manufacturer’s guidelines.
3. Assemble a sufficient number of field pumping test forms.
4. Before the test begins, ensure that static water levels in the vicinity of the pumping well have recovered to static or otherwise acceptable stable conditions via manual DTW readings at the test well and/or nearby wells. Because NHE-3 and NHE-7 have been operating for a long time, we anticipate that pumping at these wells should be terminated several days (up to a week) before aquifer test activities are initiated.
5. Ensure that the flow-meter and/or totalizer is installed consistent with the manufacturer’s recommended distance from the discharge point so that the conveyance line is not partially empty at that point. Typically, this distance is approximately 10 times the diameter of the conveyance pipe.
6. Ensure that a data logger recording barometric pressure is installed near the test well. The effects of barometric pressure can be accounted for in data post-processing.

7. Ensure that adequate space in the well casing exists for lowering the transducer and pump, and for taking manual DTW measurements during the test. Set the transducer depth below the pump intake, if possible, or at a depth below the maximum anticipated drawdown.
8. Assuming the existing extraction well pumps are not used during the aquifer test, install a temporary submersible pump with a check valve so water cannot flow back into the well after the pump is shut off. Set the pump intake below the anticipated maximum drawdown during the test.
9. Install the transducers in the extraction well and observation wells and secure them to each well head to prevent movement during the test. The extraction well transducer will be installed near the bottom of the well, below the submersible pump; observation well transducers will be installed approximately 15 feet below the initial depth to water. Program dataloggers with a logarithmic sampling interval to record early phases of the aquifer test at a high frequency (i.e., three readings per second) and late phases of the test at a lower frequency (i.e., one reading per 10 minutes). Consider pressure tolerances and maximum anticipated drawdown when installing observation well transducers.
10. Make sure the transducers are not set at depths below the manufacturer's recommended maximum depth. Check the maximum psi/depth ratings for downhole equipment.
11. Allow the transducer cables to stretch and uncoil before the test is initiated. The relative position of the transducer within the wellbore should not change during the test.

It is desirable to monitor pre-test water levels at the test well and observation wells for at least three days before performance of the test. This can be accomplished by using a transducer and datalogger, or by taking manual DTW measurements. This helps determine whether the aquifer is experiencing variations in head with time as a result of recharge or pumping in the area.

C6.2.3 Step-Drawdown Test Procedure

In order to properly assess the maximum yield of the extraction well, the well must be pumped at rates varying from relatively low rates to the maximum rate that the pump can produce (ideally, equivalent to what the well can produce). The discharge increments for each step will be distributed evenly through the range of well yields, and at least four steps should be utilized followed for the test. Each step may last up to two hours depending on the drawdown response to pumping. The following procedure will be used for the step-drawdown tests:

1. Check the static water level with manual DTW readings at the test well and all monitoring wells before pumping.
2. Test the pump at a variety of different operational speeds (or if flow is controlled via a valve, at various valve settings) and check the associated flow rate on the flow-meter or totalizer. Pre-determine the pump speeds or valve settings to use during the step-drawdown test. An initial flow rate of 10 gpm is expected at NHE-3 and NHE-5; an initial flow rate of 25 gpm is expected at NHE-7. Allow water levels to recover to within 90 percent of the water level in the well after this initial test phase.

3. Connect the transducer to the computer.
4. Set the appropriate sampling interval. For a step-drawdown test, this is typically a logarithmic sampling interval, with higher-frequency sampling early in the test. Most modern transducers should be able to log data every second in the early period of the test, and several times a minute throughout the length of the test. Make sure there is enough memory to achieve your desired sample frequency.
5. Record the initial totalizer value.
6. Begin the datalogger.
7. Begin pumping at the initial step. Use a stopwatch and/or flow-meter/totalizer to confirm pumping rate. Observe drawdown from the transducer. Periodically (every 10-15 minutes) perform manual DTW measurements at test and nearby observation wells and record those during each step. Check the flow rate at regular intervals (every 10-15 minutes), and record any flow rate changes during each step.
8. Download the data periodically during the pumping test from the transducer and plot these on a semi-logarithmic plot of drawdown vs. time curve. If drawdown appears stable on the plot, prepare to initiate the next step. This may take over an hour depending on site specific conditions and pumping rates.
9. Before initiating the next step, record the totalizer value. This will aid pumping rate estimates during post-processing, and repeat steps 6) through 8).
10. Initiate the next step and record the discharge rate.
11. If drawdown has stabilized at the maximum achievable pumping rate, or if drawdown in the well is declining and will reach the pump's intake level, end the step test. Allow the water level in the well to recover and continue logging data during this period. It may take several hours or more for the water level to recover to its initial depth (assuming no background pumping has occurred in the vicinity of the test well).

C6.2.4 Constant-Rate Discharge Procedure

After the step-drawdown test is completed, the sustainable discharge rate of the well will be determined from a semi-logarithmic plot of drawdown versus time. Analysis of the drawdown curves by the Field Task Manager and Project Manager will determine the sustainable pumping rate to be used in the constant-rate discharge test, and this will be relayed to field personnel. The following procedure will be used for the constant-rate discharge test.

1. Record manual DTW measurements in the test well and all observation wells to ensure that water levels have recovered to the anticipated static conditions.
2. Install transducers as described above and choose the appropriate sampling frequency of the data logger. NHOU extraction well constant-rate discharge tests are expected to last up to 72 hours, so make sure that there is adequate battery and memory space to record at the desired frequency at both the test well and monitoring wells for the entire anticipated duration. Optimally, flow conditions approaching steady-state should be established before terminating the test, when the observed drawdown values have stabilized. Some recommended sampling frequencies are listed below, but most data loggers have adequate memory for high sampling

frequency (e.g. one-second intervals or shorter) for early times, and lower frequencies for late time monitoring.

Transducer Measurement Frequencies

Elapsed Time Since Start of Test (Minutes)	Intervals Between Measurements (Minutes)
0-10	0.5-1
10-15	1
15-60	5
60-300	<10
300-1440	<10
1440-termination	<10

Note: Similar time intervals will be used during water level recovery, with short time intervals at the start of recovery.

3. Initiate pumping and confirm the pumping rate via flow-meter/totalizer readings and stopwatch.
4. Take manual DTW measurements, totalizer readings, and discharge rate checks at regular intervals (see suggested intervals in the table below) throughout the test, re-calculating flow rates at each totalizer measurement.

Manual DTW and Totalizer Measurement Frequencies

Elapsed Time Since Start of Test (Minutes)	Intervals Between Measurements (Minutes)
0-10	1
10-60	5
60-480	30
480-termination	60

Note: Similar time intervals will be used during water level recovery, with short time intervals at the start of recovery.

5. Download data from the data logger frequently and monitor drawdown on semi-logarithmic plot to determine whether drawdown is reaching steady-state conditions. If the drawdown curve at the observation wells plots as a straight line on a semi-log plot over a full log cycle of time, pumping may be stopped. However, a longer pumping duration is desirable to observe boundary affects, if any, so pumping will continue for at least 48 hours and no longer than 72 hours.
6. Measure temperature, conductivity, and pH at regular intervals (i.e., four times per day) throughout the test from a spigot or other wellhead discharge point to monitor general effluent water quality.
7. Use a Rossum sand tester (or equivalent) to quantify the amount of sand produced by pumping each extraction well; record at regular intervals throughout each test.
8. When the Field Task Manager confirms that the criteria for ending the test have been met, shut off the pump and allow water levels to recover and continue recording until water levels have recovered at least 90 percent of the original level.

C6.2.5 Demobilization and Data Management

The following procedure will be implemented after completion of the step-drawdown or constant-rate discharge test:

1) Decontaminate and/or dispose of equipment as listed in Section C6.4.
2) Save all data and disconnect the data logger and data connections. Raw data files from the data logger should be maintained in addition to post-processed drawdown curves.
3) Replace any expendable items.
4) Return all equipment to its initial condition and report incidents of malfunction or damage.
5) Review the field forms and notes for completeness.
6) Discuss the results with and forward all data and field forms to the Field Task Manager.
7) Send the data logger and transducer to the manufacturer for service if needed.

Field forms for pumping tests will be used to record observations. This form is shown in Appendix C-1. All entries will be made in indelible ink. The pumping test field form will include the following information:

- Site ID and well number
- Date and time of test
- Distance of observation wells from test well
- Test start time
- Elapsed time
- Test end time
- All totalizer readings, flow measurements, and times thereof
- Name and company of person performing test and all subcontractors onsite
- Appropriate comments and observations, including feedback from subcontractors
- All DTW measurements recorded to within 0.01 foot
- Configuration of the datalogger (e.g., sample rate, duration, transducer type, specifications, etc.).

Drawdown data from step-drawdown and constant-rate discharge pumping tests will be analyzed to estimate aquifer hydraulic properties and well efficiency. Pumping test data will be input into the AQTESOLV® software package (or equivalent), where a variety of analytical solutions are available to match the observed drawdown curves for both step and constant rate tests. Drawdown and recovery data will be plotted on log-log and/or semi-log plots and matched to straight-line or curves to solve for the applicable well function necessary to calculate hydraulic conductivity (for example).

C6.3 Calibration of Field Equipment

The following field equipment to be used on a regular basis will need calibration:

- transducer and data logger
- totalizers and flow meters
- electronic water quality meter
- pressure gauges and manifold seals
- DTW sounders.

Pressure transducers/data loggers, pressure gauges, manifold seals, totalizers, and flow-meters will be operated according to the manufacturer's guidelines, but rigorous calibration and maintenance will be the responsibility of the manufacturer/supplier of this equipment. Spot-checks of transducer accuracy can be performed in the field by measuring and marking a pre-determined length of transducer cable, lowering into the well, and monitoring the displacement from the data logger. Proper maintenance, calibration, and operation of each manual DTW sounder will be the responsibility of field personnel, who will follow the guidelines presented in the Groundwater Sample Collection FSP (SAP Appendix A). Relevant manuals will be kept with field personnel while field activities are being performed. All equipment will receive routine maintenance checks to minimize equipment breakdown in the field. Any items found to be inoperable will be taken out of use and a note stating the time and date of this action will be made in the daily field records.

C6.4 Decontamination Procedures

Equipment decontamination procedures are intended to reduce the potential for sample contamination and cross-contamination between wells. Decontamination of the groundwater level measuring equipment is described in the Groundwater Sample Collection FSP (SAP Appendix A).

Equipment will be decontaminated in a pre-designated area on pallets or plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas. Cleaned small equipment will be stored in plastic bags. Health and safety equipment will be maintained and decontaminated as described in the Groundwater Sample Collection FSP (Appendix A).

C7.0 SAMPLE CONTAINERS, PRESERVATION, AND STORAGE

Because groundwater samples are not anticipated to be collected as part of aquifer testing activities, procedures associated with for sample containers, preservation, and storage do not apply to this FSP.

C8.0 DISPOSAL OF RESIDUAL MATERIALS

Expendable materials waste (i.e., nonhazardous trash) generated as part of slug testing or pumping tests will be disposed of as described in the Groundwater Sample Collection FSP (SAP Appendix A). Water generated during constant-rate discharge tests at NHOU extraction wells will be routed through the existing treatment system.

C9.0 SAMPLE DOCUMENTATION

This section provides descriptions of the forms, records, and procedures used during the aquifer test activities.

C9.1 Field Notes

C9.1.1 Daily field notes

The Field Task Leader and other field team members will maintain field logbooks to provide a daily record of significant events, observations, and measurements during sampling. All information pertinent to the aquifer tests will be recorded in daily field notes or on the activity-specific data form shown in Appendix C-1. In addition to this specific field form, each day's field note entries will be signed and dated and will include the following information:

- Date and time of entry, and weather and environmental conditions during the field activity
- Project name and number
- Location of sampling activity
- Names of field crew members
- Names of site visitors
- Total discharge volumes
- Flow rates used in tests
- Times of specific activities
- Pumping well name, observation wells, distances from the pumping well to each of the observation wells.

All entries will be made using indelible ink; if any entry requires changes, the change will be made by drawing a line through the entry and entering the correct information. The person making the entry will initial and date the correction. Unused portions of pages will be crossed out, signed, and dated at the end of each workday.

C9.1.2 Photographs

Photographs may be taken to document representative field procedures. When a photograph is taken, the date, time, weather conditions (if applicable), subject, purpose for the photograph, and photograph number will be recorded in the daily field notes. Baseline photos will be taken before and after field activities to document original conditions at the site.

C10.0 QUALITY CONTROL

QC procedures for aquifer testing will include the calibration procedures outlined in Section C6.3, and technical review of all phases of the tests by the Field Team Leader through regular communication with field personnel. Data will be reviewed and finalized under the direction of the Project Manager, or technical designee. Because only drawdown and discharge rate data are collected during aquifer tests, the collection of specific QC data does not apply to the activities described herein.

C11.0 FIELD VARIANCES

As conditions in the field may vary, it may become necessary to implement minor modifications to aquifer test procedures as presented in this FSP. When appropriate, the AMEC Project Manager will be notified and a verbal approval will be obtained before implementing the changes. The Project Manager will notify the USEPA of major modifications or variances to the field program. Modifications to the procedures presented in this FSP will be documented in the daily field notes and on other task-specific forms as applicable. Significant modifications will be documented in the final report for the aquifer tests.

C12.0 FIELD HEALTH AND SAFETY PROCEDURES

The field work will be performed in accordance with the site-specific health and safety plan (HASP) prepared as a separate submittal for this work (AMEC, 2012c). Subcontractors will be responsible for their own health and safety and must follow the project HASP as a minimum.

C13.0 REFERENCES

AMEC Environment & Infrastructure, Inc. (AMEC), 2012a. Final Data Gap Analysis, North Hollywood Operable Unit, Second Interim Remedy, Groundwater Remediation System Design. March 14.

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Butler, J.J., 1998. The Design, Performance, and Analysis of Slug Tests: Lewis Publishers, Boca Raton, Fla.

Los Angeles Department of Water and Power (LADWP), 2003. Final Evaluation of the North Hollywood Operable Unit and Options to Enhance Its Effectiveness.

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_____, 1998. NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____, 2000. Sampling and Analysis Plan Guidance and Template, USEPA R9QA/002.1, April.

_____, 2003. Third NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____, 2008. NHOU Five-Year Review for North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund, Los Angeles County, California. September.

_____, 2009. EPA Superfund Interim Action Record of Decision, North Hollywood Operable Unit, San Fernando Valley (Area 1) Superfund Site, Los Angeles County, California. September.

_____, 2011. Administrative Settlement Agreement and Order on Consent for Remedial Design, CERCLA Docket No. 2011-01, in the matter of North Hollywood Operable Unit, San Fernando Valley (Area 1), Superfund Site, Los Angeles, California. February 21.

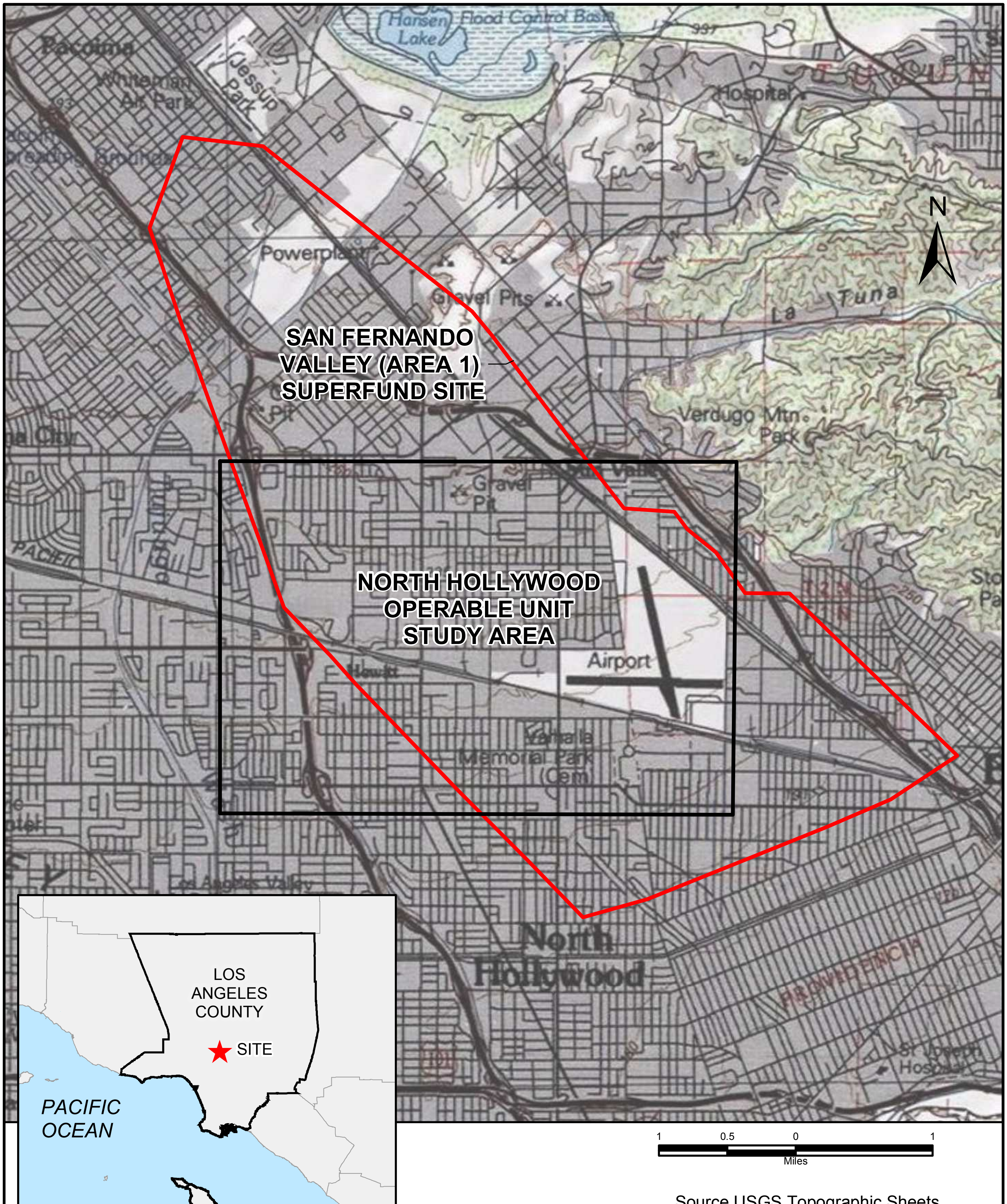
TABLE

Table C-1 List of Aquifer Test Wells
North Hollywood Operable Unit
Los Angeles County, California

Well Name	Screen Interval (ft. BTOC)	Assumed Representative Screen Zone(s)			Slug Testing[1]	Aquifer Test Observation Well	Aquifer Testing
		A-Zone	B-Zone	Below B-Zone			
NH-C01-450	400-450	X	X		X		
NH-C02-325	275-325		X		X		
NH-C03-380	340-380		X		X		
NH-C07-300	240-300	X			X		
NH-C09-310	250-310	X			X		
NH-C10-280	220-280	X			X	X	
NH-C10-360	310-360	X	X			X	
NH-C12-280	210-280	X			X	X	
NH-C12-360	310-360	X	X			X	
NH-C13-385	335-385	X	X		X		
NH-C14-250	200-250	X			X		
NH-C17-255	185-255	X			X		
NH-C19-290	230-290	X			X		
NH-C22-460	390-460		X		X		
NH-C23-310	250-310	X			X		
NH-C24-410	340-400		X		X		
NHE-3	190-286	X					X
NHE-5	180-266	X					X
NHE-7	180-270	X					X
PZ-NHE-3 (Shallow)	250-270	X				X	
PZ-NHE-3 (Deep)	305-325	X				X	
PZ-NHE-5 (Shallow)	230-250	X				X	
PZ-NHE-5 (Deep)	275-295	X				X	
PZ-NHE-7 (Shallow)	230-250	X				X	
PZ-NHE-7 (Deep)	285-305	X				X	

Note:
1. Slug tests will be performed via pneumatic methods where practicable, otherwise physical slug tests will be performed

FIGURES



Source USGS Topographic Sheets

amec

Site Vicinity Map
Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

APPENDIX
C-1

DRAWN	JOB NUMBER	CHECKED	CHECKED DATE	APPROVED	APPROVED DATE
TJH	4088115718		4/2012		

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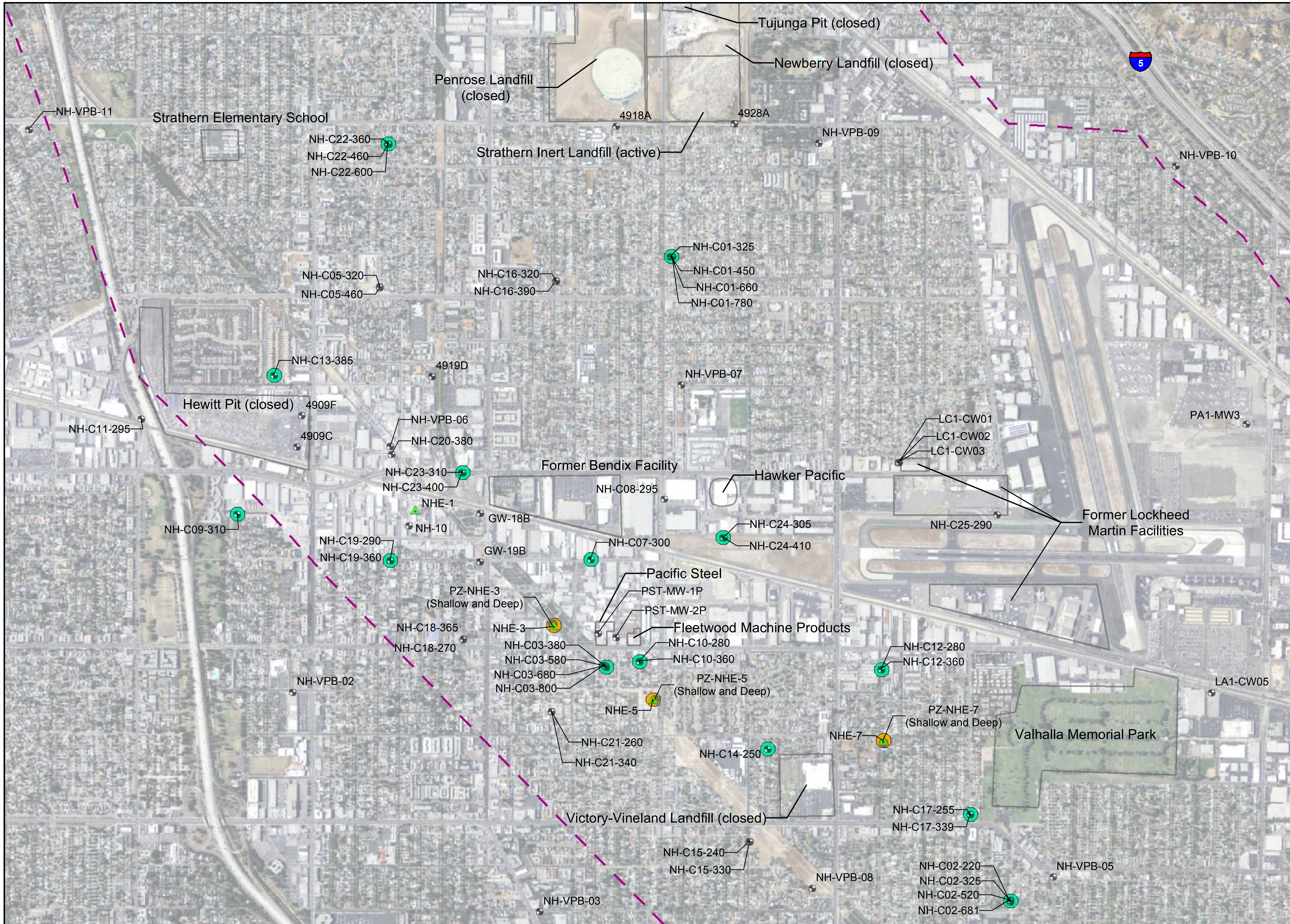

EXPLANATION

- Proposed Piezometer Couplet (Phase 1)
- NHOU Extraction Well
- Monitoring Wells
- Slug Test Location
- Aquifer Test Location
- Approximate Boundary San Fernando Valley Investigation Area 1

N

0 1,500 3,000
Feet

DRAWN: TJH	PROJECT NO: 4088115718		
REV:	SCALE: AS SHOWN		
CHECKED:	APPROVED:		
DATE: 4/2012	DATE: 4/2012		

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Phase I Pre-Design Investigation Sampling and Analysis Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Aquifer Test Locations

APPENDIX
C-2

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APPENDIX C-1

Aquifer Test Field Document

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AQUIFER TEST DATA

Well No: ___________ Project Name/No.: ______________________/_________

Page ___ of ___

Owner ________________________ Address _______________________________________ County _________________ State ____

Date ____________ Company Performing Test ______________________________________ Measured By ______________________

Well No. ______________ Distance from Pumping Well _________ Type of Test ________________________ Test No. ____________

Pumping Well _____ Observation Well _____ Measurement Equipment ____

TIME DATA

Pump on: Date ________ Time ________(t_o)

Pump off: Date ________ Time ________(t'_o)

Duration of aquifer test:

Pumping _________ Recovery _________

WATER LEVEL DATA

Static Water Level ________________

Measuring Point __________________

Elevation of Measuring Point ________

DISCHARGE DATA

How Q Measured _________________

Depth of Pump/Air Line _____________

Previous Pumping? Yes ____ No ____

Duration _________ End _________

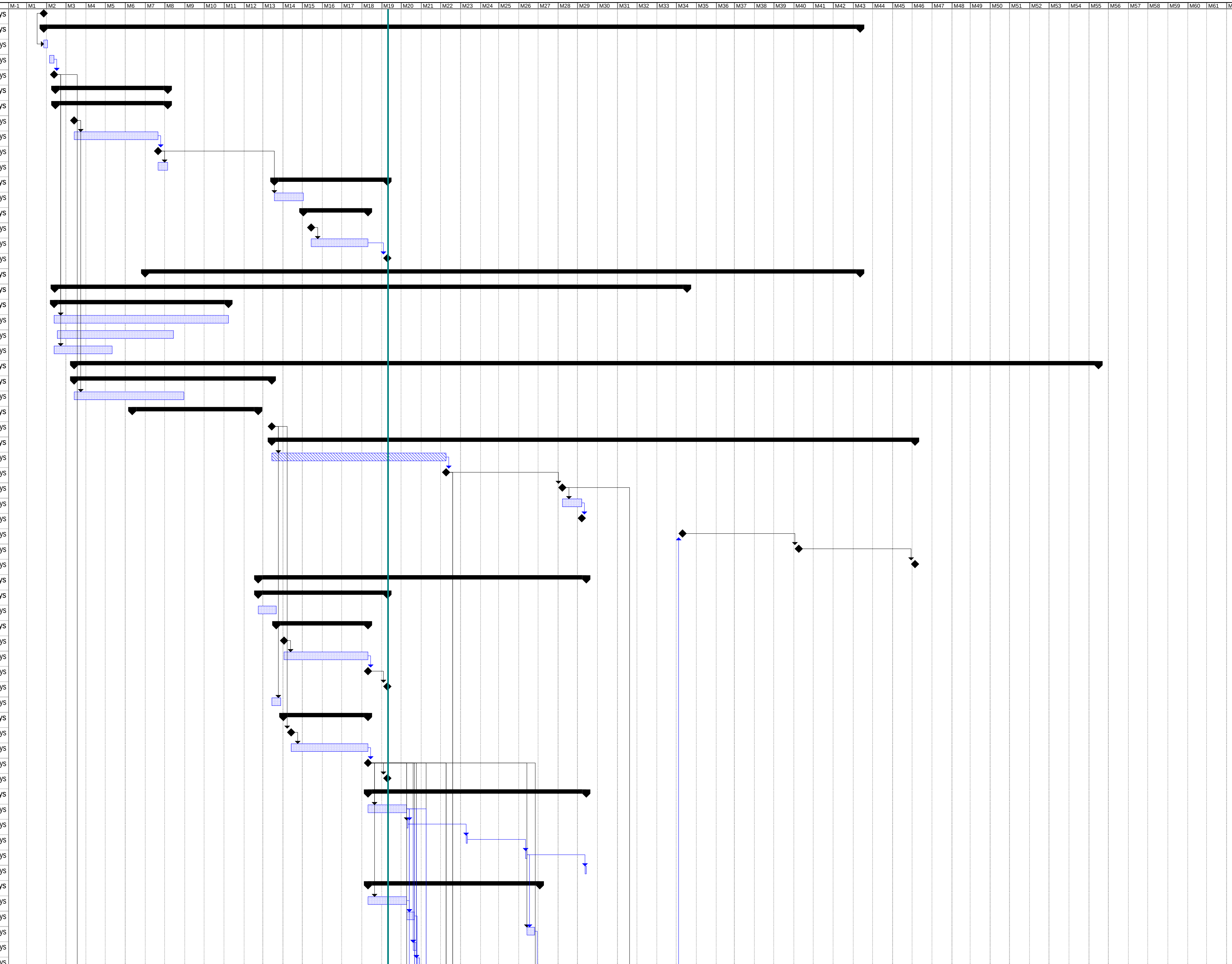
TIME DATA					WATER LEVEL DATA				DISCHARGE DATA			
Date	Clock Time	Time since Pump Started *t*	Time since Pump Stopped *t'*	*t/t'*	Water Level Measurement	Correction or Conversion	Water Level	Water Level Change *s or s'*	Discharge Measurement	Discharge Rate	Recorded By	**Comments on Factors Affecting Test Data**

APPENDIX D

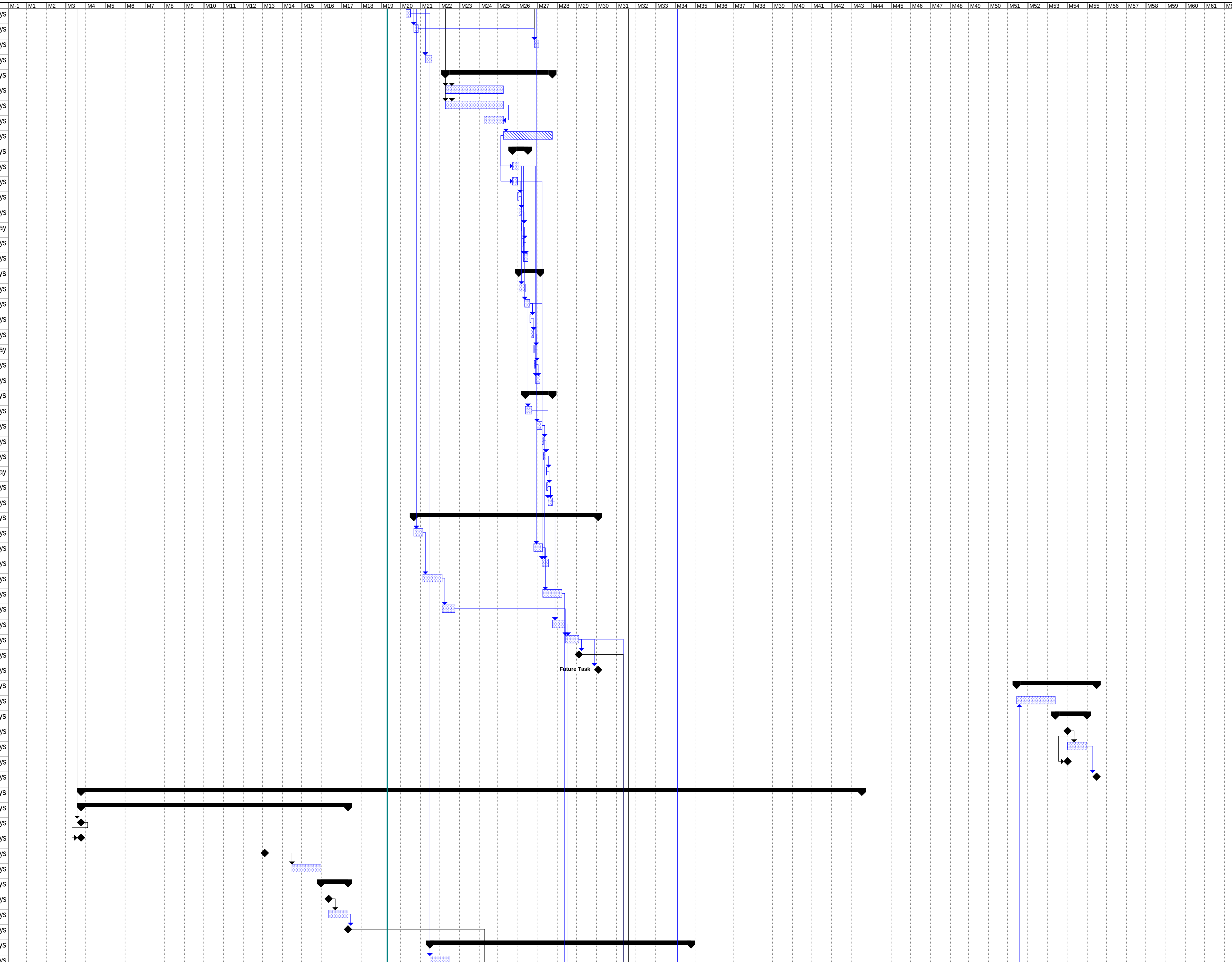
Phase 1 Pre-Design Investigation Schedule

LOCKHEED MARTIN COPORATION AND HONEYWELL INTERNATIONAL INC.
NORTH HOLLYWOOD OPERABLE UNIT (NHOU) 2nd INTERIM REMEDY GROUNDWATER REMEDIATION SYSTEM DESIGN
Project Design Schedule

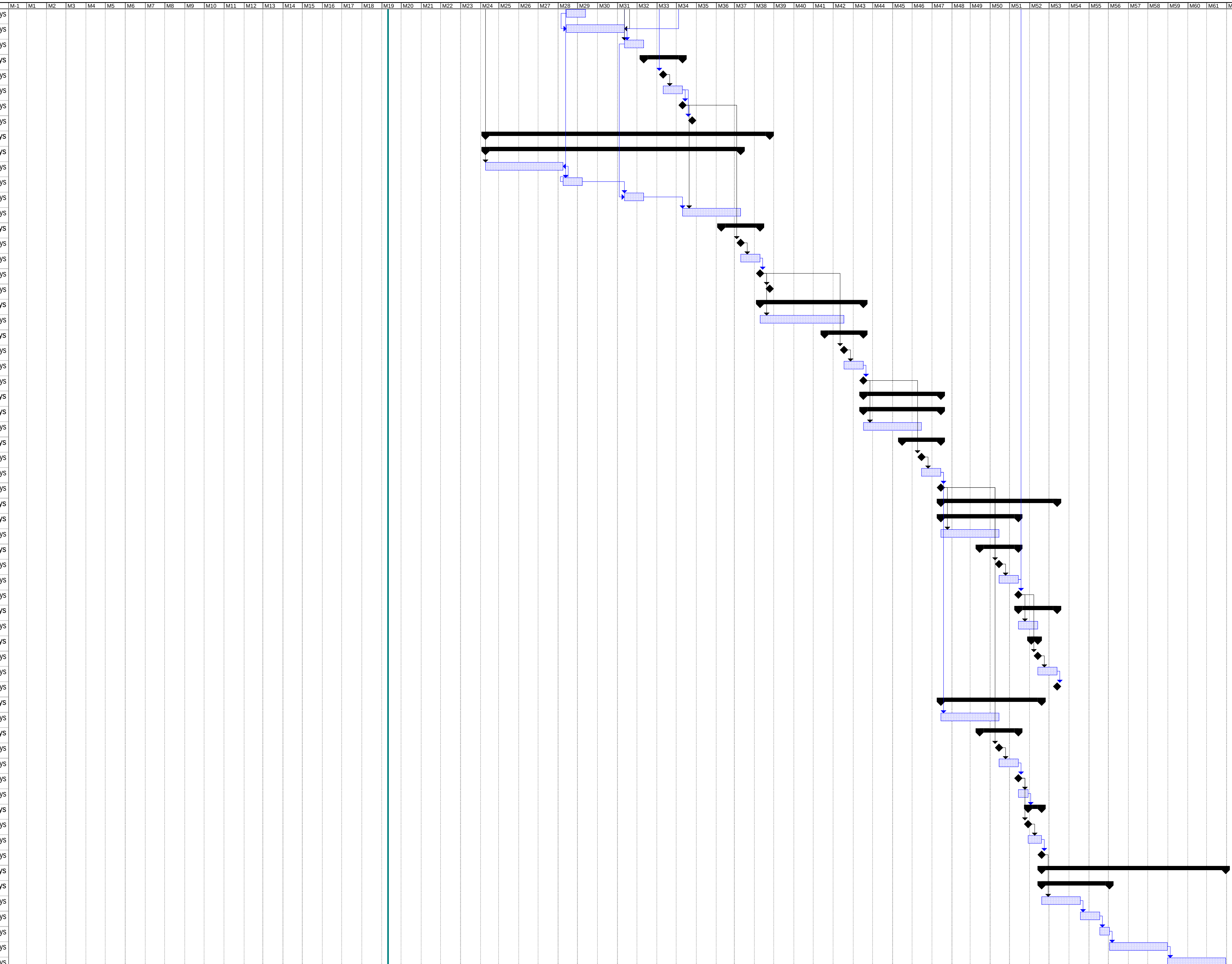
ID	Predecessors	Task Name	Duration
1		EPA APPROVAL OF SUPERVISING CONTRACTOR (NOTICE-TO-PROCEED)	0 days
2		TASK 1 - PROJECT MANAGEMENT	1264 days
3	1SS	Prepare Quality Management Plan	6 days
5	4	EPA Review	7 days
6	5	EPA Approves QMP	0 days
7		Prepare Remedial Design Work Plan, HASP, and RD QAPP	174 days
8		Review Process	174 days
14	13	Submit Draft RD Work Plan to EPA	0 days
15	14	EPA Review (30 days)	130 days
16	15	Submit Final RD Work Plan to EPA	0 days
17	16	EPA Review of Final RD Work Plan	15 days
18		Prepare RD QAPP per RD Work Plan	175 days
19	16FS+180 days	Draft RD QAPP	45 days
20		Review Process	100 days
24	23	Submit Draft RD QAPP to EPA	0 days
25	24	EPA Review (30 days)	88 days
26	25FS+30 days	Submit Final RD QAPP	0 days
27		Prepare Monthly Progress Reports and Annual Performance Evaluations	1107 days
70		Conduct Weekly and Monthly Teleconference Calls with LMC/HW Team and USEPA	979 days
213		TASK 2 - DATA AND DOCUMENT MANAGEMENT	270 days
214	6	Data Management	270 days
215		Geospatial Data Dissemination and Aggregation	180 days
216	6	e-Document Solution (SharePoint)	90 days
217		TASK 3 - GROUNDWATER CHARACTERIZATION	1586 days
218		Data Gap Analysis Report	306 days
219	14	Draft Data Gap Analysis Memorandum	170 days
220		Review Process	195 days
230	229FS+21 days	Submit Final Data Gap Analysis and revised project schedule to EPA	0 days
231		Groundwater Management Plan	996 days
232	230	EPA, LADWP, and Watermaster deliberations	270 days
233	232	Agreement to proceed among USEPA, LADWP, and ULARA Watermaster	0 days
234	233FS+180 days	USEPA, LADWP produce draft GMP	0 days
235	234	AMEC review of draft GMP	30 days
236	235	Submit comments on draft GMMP to EPA and LADWP	0 days
237	342FS+90 days	Collaboration Meeting #2 with USEPA, LADWP, ULARA W/M, CDPH, and RWQCB	0 days
238	237FS+180 days	Collaboration Meeting #3 with USEPA, LADWP, ULARA W/M, CDPH, and RWQCB	0 days
239	238FS+180 days	Collaboration Meeting #4 with USEPA, LADWP, CDPH, ULARA W/M, and RWQCB	0 days
240		Pre-Design Investigation - Phase 1	508 days
241		Sampling and Analysis Plan (SAP) and Work Plan	200 days
242	229	Develop Draft SAP (including QAPP) and HASP	28 days
243		Review Process	142 days
247	246	Submit Draft SAP + HASP to EPA	0 days
248	247	EPA Review (45 days)	130 days
249	248	EPA Approves SAP + HASP	0 days
250	249FS+30 days	Submit Final SAP + HASP	0 days
251	230	Develop Phase 1 Work Plan (including FSP)	14 days
252		Review Process	131 days
256	55,230FS+30 days	Submit Phase 1 Work Plan to EPA	0 days
257	256	EPA Review (45 days)	119 days
258	257	EPA Approves Phase 1 Work Plan	0 days
259	258FS+30 days	Submit Final Phase 1 Work Plan	0 days
260		Groundwater Elevation Measurements	338 days
261	258	Access agreements with well owners	60 days
262	261,258	First Quarterly Event	2 days
263	262FS+90 days	Second Quarterly Event	2 days
264	263FS+90 days	Third Quarterly Event	2 days
265	264FS+90 days	Fourth Quarterly Event	2 days
266		Depth-Discrete Groundwater Sampling	266 days
267	258	Access agreement with well owners	60 days
268	261,267	First Semi-annual event (A-Zone and B-Zone monitoring wells)	12 days
269	258,264	Second Semi-annual event (A-Zone and B-Zone monitoring wells)	12 days
270	61FS+10 days,258	Depth-discrete Sampling at and near NHE-1	5 days
271	61FS+15 days,258	Vertical Groundwater Quality Profiles	5 days



ID	Predecessors	Task Name	Duration
272	261,258	Surveying	7 days
273	58,262FS+10 days	First semiannual spinner logging event	7 days
274	8,273FS+180 days	Second semiannual spinner logging event	7 days
275	61FS+30 days,258	Slug Testing	10 days
276		NHE Piezometers/Aquifer Tests	166 days
277	258,233	LADPH well instllation permits (develop applications and obtain permits)	90 days
278	258,233	Access Agreements and LADWP Coordination (drilling, rehabilitation, and aquifer testing)	90 days
279	278FF	Communication planning with EPA	30 days
280	279	Execute Communication Plan	76 days
281		NHE-3 Location	24 days
282	280SS+14 days	Inspect/Rehabilitate NHE-3	10 days
283	280SS+14 days	Drill deep borehole/collect soil samples	8 days
284	283	Construct deep piezometer	2 days
285	284	Drill shallow borehole	4 days
286	285	Construct shallow piezometer	1 day
287	286	Develop shallow and deep piezometers	2 days
288	287,282	Perform NHE-3 Aquifer Test	7 days
289		NHE-5 Location	33 days
290	282	Inspect/Rehabilitate NHE-5	10 days
291	286FS+4 days	Drill deep borehole/collect soil samples	8 days
292	291	Construct deep piezometer	2 days
293	292	Drill shallow borehole	4 days
294	293	Construct shallow piezometer	1 day
295	294	Develop shallow and deep piezometers	2 days
296	295,282	Perform NHE-5 Aquifer Test (temporary pump)	7 days
297		NHE-7 Location	42 days
298	290	Inspect/Rehabilitate NHE-7	10 days
299	294FS+4 days	Drill deep borehole/collect soil samples	8 days
300	299	Construct deep piezometer	2 days
301	300	Drill shallow borehole	4 days
302	301	Construct shallow piezometer	1 day
303	302	Develop shallow and deep piezometers	2 days
304	303,298	Perform NHE-7 Aquifer Test	7 days
305		Pre-Design Investigation (Phase 1) Findings Memorandum	286 days
306	268	Laboratory Analysis (1st Semiannual Groundwater Samples)	14 days
307	269	Laboratory Analysis (2nd Semiannual Groundwater Samples	14 days
308	299,283,291	Laboratory Analysis (Soil Samples)	10 days
309	306	Third Party Analytical Data Validation (1st Semiannual Groundwater Samples)	30 days
310	307	Third Party Analytical Data Validation (2nd Semiannual Groundwater Samples)	30 days
311	309	Analytical Data Evaluation (1st Semiannual Groundwater Samples)	20 days
312	304	Geologic/Hydraulic Data Evaluation	20 days
313	312,311	Summarize Phase 1 Findings (Groundwater Modeling Memorandum Appendix)	21 days
314	313	Assess need for Phase 2	0 days
315	313FS+30 days	Meet with EPA to discuss Phase 1 Pre-Design Investigation and assessment findings	0 days
316		Groundwater Monitoring Plan and SAP	124 days
317	393	Final Design Update of Groundwater Monitoring Plan	60 days
318		Review Process	49 days
322	321	Submit Draft Groundwater Monitoring Plan and SAP to EPA	0 days
323	322	EPA Review	30 days
324	322	EPA Approves Groundwater Monitoring Plan and SAP	0 days
325	323FS+15 days	Submit Final Groundwater Monitoring Plan and SAP	0 days
326		TASK 4 - PRELIMINARY DESIGN	1211 days
327		Building Conditions Assessment	414 days
328	6FS+32 days	NHOU CTF Site Visit	0 days
329	328	Develop Draft Building Conditions Assessment Report	180 days
330		Submit LADWP Data Request	0 days
331	330FS+42 days	Finalize Draft Building Conditions Assessment Report	45 days
332		Review Process	42 days
336	335	Submit Draft Building Conditions Assessment to EPA	0 days
337	336	EPA Review	30 days
338	337	EPA Approves Building Conditions Assessment	0 days
339		Predesign Groundwater Modeling Memorandum (no Phase 2)	405 days
340	272FS+30 days	Refine SFB-FFS Model Structure	30 days



ID	Predecessors	Task Name	Duration
341	312	Refine Hydraulic Properties with AQT Findings	30 days
342	341SS,234FF	Site Model Simulations	90 days
343	13FS+30 days,314	Develop Administrative Draft Groundwater Modeling Memorandum	30 days
344		Review Process	60 days
348	47,312FS+60 days	Submit Draft Groundwater Modeling Memorandum to EPA	0 days
349	348	EPA Review	30 days
350	349	EPA Approves Pre-Design Groundwater Modeling Memorandum	0 days
351	349FS+15 days	Submit Final Groundwater Modeling Memorandum	0 days
352		Treatment Options Memorandum	440 days
353		Internal development	395 days
354	338,355SF	Evaluate potential treatment technologies	120 days
355	310	Analytical Data Evaluation (2nd Semiannual Groundwater Samples)	30 days
356	343SS,355	Evaluate potential NHOU extraction well scenarios (rates and concentration ranges)	30 days
357	356,350	Develop draft Treatment Options Memorandum	90 days
358		Review Process	60 days
362	350FS+90 days	Submit Draft Treatment Options Memorandum to EPA	0 days
363	362	EPA Review	30 days
364	363	EPA Approves Treatment Option Memorandum	0 days
365	364FS+15 days	Submit Final Treatment Options Memorandum	0 days
366		Preliminary Design Report (30%)	160 days
367	364	Internal Development	130 days
368		Review Process	60 days
372	364FS+130 days	Submit Draft Preliminary Design Report to EPA	0 days
373	372	EPA Review	30 days
374	373	EPA Approves Preliminary Design Report	0 days
375		TASK 5 - INTERMEDIATE DESIGN (60%)	120 days
376		Intermediate Design Package	120 days
377	374	Internal Development	90 days
378		Review Process	60 days
382	374FS+90 days	Submit Intermediate Design Report to EPA	0 days
383	382	EPA Review	30 days
384	383	EPA Approves Intermediate Design Report	0 days
385		TASK 6 - PRE-FINAL AND FINAL DESIGN	180 days
386		Pre-Final Design Package (90%)	120 days
387	384	Internal Development	90 days
388		Review Process	60 days
392	384FS+90 days	Submit Pre-Final Design Report to EPA	0 days
393	392	EPA Review	30 days
394	393	EPA Approves Pre-Final Design Report	0 days
395		Final Design Package (100%)	60 days
396	394	Internal Development	30 days
397		Review Process	10 days
401	394FS+30 days	Submit Final Design Report to EPA	0 days
402	401	EPA Review	30 days
403	402	EPA Approves Final Design Report	0 days
404		Pre-Achievement O&M Plans	156 days
405	383	Draft Pre-Achievement O&M Plan	90 days
406		Review Process	60 days
410	384FS+90 days	Submit Draft Pre-Achievement O&M Plan to EPA	0 days
411	410	EPA Review	30 days
412	411	EPA Approves Draft Pre-Achievement O&M Plan	0 days
413	412	Develop Final Pre-Achievement O&M Plan	15 days
414	413	Review Process	21 days
418	412FS+15 days	Submit Final Pre-Achievement O&M Plan to EPA	0 days
419	418	EPA Review	21 days
420	419	EPA Approves Final Pre-Achievement O&M Plan	0 days
421		TASK 7 - ENGINEERING SERVICES DURING BIDDING AND CONSTRUCTION	285 days
422		Construction Management Plan	105 days
423	420	Draft	60 days
424	423	Review	30 days
425	424	Final	15 days
426	425	Office-based Services During Construction	90 days
427	426	Assist LMC/HI and Contractor with Start-up and Testing	90 days



APPENDIX E

AMEC Responses to USEPA Comments to the Draft Sampling and Analysis Plan
Phase I Pre-Design Investigation (dated August 10, 2012)

10 September 2012

Mr. Matt Salazar
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

Re: AMEC Responses to EPA Comments (dated August 10, 2012)
"Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit, Second Interim Remedy" and the *"Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit, Second Interim Remedy Groundwater Remediation System Design"*

Dear Mr. Salazar:

This letter has been prepared to respond to final comments that USEPA provided to the following documents on August 10, 2012:

- *Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, April 13, 2012)
- *Draft Sampling and Analysis Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, April 13, 2012)
- *Health and Safety Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, April 13, 2012)
- *Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, May 14, 2012).

A response follows each comment provided by the USEPA and each document has been revised accordingly.

It is imperative to recognize that development of the Groundwater Management Plan, as a required Institutional Control in the ROD, remains a critical element of the Second Interim Remedy. All Phase I Pre-Design Investigation activities have been based on the expectation that the USEPA and LADWP will develop a Groundwater Management Plan that will not only be a notification of planned pumping, but also will provide a "decision-making process to address any potential conflicts between the LADWP's pumping plans and the performance of the remedy". The Groundwater Management Plan was included in the ROD as an Institutional Control to ensure that production well pumping does not negatively impact the performance of the Second Interim Remedy. The current schedule reflects the need for an agreement to proceed on the Groundwater Management Plan prior to the installation of the proposed piezometers under the Phase 1 Pre-Design Investigation and the preparation of the Groundwater Modeling Memo.

AMEC Environment & Infrastructure, Inc.
1330 Broadway, Suite 1702
Oakland, California 94612
Tel (510) 451-1001
Fax (510) 451-3465
amec.com

Should you have questions regarding our responses to EPA comments, please feel free to call me at (510) 663-3996 to discuss.

Sincerely,
AMEC Engineering & Infrastructure, Inc.

Michael Taraszki, PG, CHG, PMP
Project Manager

Robert Hartwell, PE w/permission
Engineering Manager

Attachments:

Attachment A — USEPA Comments on the *Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* and the *Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design (August 10, 2012)*

WORK PLAN

1. **General comment:** The Work Plan is well written and indicates a comprehensive understanding of both the available site data and the data gaps in the NHOU. Conduct of the work proposed in the Work Plan (and SAP) will improve the conceptual site model for the NHOU and provide important hydrogeologic data required for RD of the Second Interim Remedy.

As stated in Section 2.4 of the Work Plan, “The overall objective of the Phase I Pre-Design Investigation is to fill critical data gaps identified as necessary for the Second Interim Remedy design to meet RAOs…” And Section 4 of the Work Plan states that a second phase of investigation would only be performed “if it is determined that insufficient data exist (at that time) to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements.” However, actions that might fill some of the “critical data gaps” identified in the Final Data Gap Analysis report (pages 5-14 and 5-15) prepared by AMEC (dated March 14, 2012) are not proposed in this Work Plan. Specifically, critical data gaps 4, 5, 6, 8, and 9 listed on pages 5-14 and 5-15 of the Final Data Gap Analysis report seem to be unaddressed, or only partly addressed, by the activities listed in the Work Plan. It seems that either some of the data gaps identified in the Final Data Gap Analysis report are no longer deemed critical, or will simply not be addressed by the proposed Phase I investigation and will be addressed in some other manner. Please revise the Work Plan to provide more clarity regarding which of the critical data gaps are addressed by each proposed field activity, and which critical data gaps are not addressed in the proposed Phase I investigation (together with an explanation of why not, and how they will be addressed in the future). Our comments and/or recommendations for filling these data gaps are summarized below, but could be modified depending on additional information provided by the respondents:

- **Critical Data Gap 4** (“existing monitoring well network insufficient to characterize vadose zone and groundwater conditions beneath known and potential source areas”): The Work Plan should show critical areas for further investigation on a map, or at least describe how the need for further characterization in the vicinity of the “known and potential source areas” would be evaluated and conducted during a Phase II data gaps investigation. The area southwest of NHOU extraction wells NHE-2 and NHE-3, where high concentrations of VOCs and hexavalent chromium have been detected, but are poorly delineated, seems to be of primary concern. It is not clear how the data collection activities described in the Work Plan would fill this data gap or aid in further delineating contaminant concentrations in this particular area. We recommend that at least two new monitoring wells be installed in this area as part of the Phase I investigation.

  AMEC Response: As shown on Figure 6-1 in the Final Data Gap Analysis (AMEC, March, 14, 2012), two groundwater monitoring wells have been considered for installation in this area. However, as described in that document and in the Phase I Pre-Design Investigation Work Plan, additional monitoring wells (whether at the locations illustrated on Figure 6-1 or elsewhere) will be considered following the evaluation of data collected as part of Phase I sampling and testing. Depth-discrete analytical data and accurate groundwater elevations from existing monitoring wells are anticipated to be particularly useful in supporting that assessment. Should it be determined that additional are needed, the number (if any) and location(s) of additional monitoring wells will be determined and installed and sampled as part of the Phase II Pre-Design Investigation.

- **Critical Data Gap 5** ("objective projections of pumping and recharge volumes, including beyond year 2015, are not yet available"): The Work Plan should state that addressing this data gap does not require field activity; rather, discussions are ongoing (presumably) with LADWP and the ULARA Watermaster to develop improved and updated projections of future pumping and recharge volumes.

  AMEC Response: Comment acknowledged. The ULARA Watermaster has affirmed that the projections included in his annual Pumping and Spreading reports have been provided by associated municipalities and are presumed to be accurate. AMEC anticipates that forthcoming discussions between the EPA and various stakeholders will clarify how these projections correspond with the 2007 Stipulated Agreement. Table 2-1 has been incorporated into the Final Work Plan to provide further clarification.

- **Critical Data Gap 6** ("performance monitoring wells have not been installed and monitored"): It is unclear whether the proposed piezometers in the Work Plan constitute some or all of the needed performance monitoring wells that comprise this critical data gap. The Work Plan should clarify whether the planned piezometers are expected to address this data gap by themselves, or if installation of additional performance monitoring wells is anticipated to be required in the future, to complete the RD. If so, then the Work Plan should describe how and when decisions about the need for additional performance monitoring wells will be made.

  AMEC Response: Proposed piezometers adjacent to NHE-3, NHE-5, and NHE-7 will provide empirical data that will be used to verify, calibrate, and refine the numerical groundwater flow model as needed to support the design of the Second Interim Remedy. It is not anticipated that additional piezometers will be needed to achieve this objective.

- **Critical Data Gap 8** ("available analytical data are insufficient to evaluate A-Zone and, potentially, B-Zone groundwater quality within the future NHOU capture zone to meet CDPH 97-005 requirements"): The Work Plan should define whether this is still considered to be a critical data gap, and describe how and when it will be addressed.

  AMEC Response: This remains a critical data gap; the Work Plan has been revised to specify that additional data beyond those included in the Phase I Pre-Design Investigation will be required to address CDPH 97-005 requirements. AMEC anticipates that specific groundwater samples (within the anticipated NHOU capture zone) will be collected after the groundwater flow model has been refined and calibrated such that the Second Interim Remedy capture area can be more accurately estimated and monitoring wells within that area (from the A-Zone and B-Zone) can be identified. This sampling activity would be integrated into the current NHOU sampling program, to the extent possible, and would not comprise a Phase II Pre-Design Investigation. Table 2-1 has been incorporated into the Final Work Plan to provide further clarification.

- **Critical Data Gap 9** ("vertical conduits throughout the NHOU study area have not been sufficiently evaluated"): The Work Plan includes investigative activities to evaluate existing monitoring wells as potential vertical conduits for contaminant migration; however, it does not include plans to evaluate existing inactive production wells. Inactive production wells appear to pose a greater threat of vertical contaminant migration, due to their number, long screens, and large diameter. The Work Plan should describe how and when this part of Critical Data Gap 9 will be addressed (e.g., will it be addressed as part of a future Phase II investigation, and are there any conditions on which such an investigation would depend).

  AMEC Response: Figure 4-3 of the Final Data Gap Analysis report shows the locations of probable and suspected vertical conduits at inactive and active municipal production wells. Inspection and/or elimination of vertical conduits at inactive production wells (in particular) is the responsibility of the well owner. This responsibility has been clarified in the additional table and text of the Work Plan (see our response to Comment #5); however, we cannot speculate as to exactly when this critical data gap may be addressed. Honeywell and Lockheed Martin expect that the USEPA will participate in activities required to get well owners, including LADWP, to address the issue of closing vertical conduits at inactive and active supply wells to facilitate the success of the Second Interim Remedy. Table 2-1 has been incorporated into the Final Work Plan to provide further clarification.

2. **Table of Contents page iii, Table, Figures, and Appendix sections:** The title provided in the table of contents for Table 3-1 is different from the title actually on Table 3-1. The titles for Figure 3-1 and Appendix A are similarly inconsistent with the titles given in the table of contents. Please make the titles listed in the table of contents consistent with the actual titles of the corresponding tables, figures, and appendices.

AMEC Response: Comment acknowledged. The table of contents has been revised to correctly match table and figure titles.

3. **Section 2.2, Project Background, page 2-3, first full paragraph:** This paragraph paraphrases the key remedial action objectives (RAOs) and relates them to the specific work scope items in the Agreement and Order on Consent (AOC). However, the second sentence in this paragraph focuses exclusively on the second RAO for the NHOU Second Interim Remedy. We recommend that this sentence be modified to also accommodate the fourth remedial action objective (RAO), which is to achieve improved hydraulic containment to inhibit horizontal and vertical contaminant migration in groundwater from the more highly contaminated areas and depths of the aquifer to the less contaminated areas and depths of the aquifer, including the southeast portion of the NHOU near the Erwin and Whitnall production well fields. We assume that this RAO influences the AOC work scope items, as well as the scope of work for the activities described in the Work Plan.

AMEC Response: The second sentence has been modified to acknowledge other production well fields as suggested. Otherwise, please note that the RAOs are represented in full on the previous page and that this paragraph, including the focus on the Rinaldi-Toluca well field, stems from the Record of Decision, Section 2.8, page 2-19.

4. **Section 2.3, Previous Investigations, page 2-4, fourth paragraph:** The second-to-last sentence in this paragraph states "However, it was concluded that existing data are

insufficient to proceed with a Second Interim Remedy…" We recommend that the sentence be modified to state which entity came to that conclusion, and provide a reference to a document where that conclusion is stated (perhaps the Draft or Final Data Gap Analysis report prepared by AMEC).

AMEC Response: This was the conclusion of AMEC as part of the Final Data Gap Analysis report and has been additionally referenced in the Work Plan for clarity.

5. **Section 2.4, Phase I Pre-Design Investigation Objectives, page 2-5, bullets 1 through 6:** It is difficult to directly compare these bulleted "specific objectives" of the Phase I Pre-Design Investigation to the "critical data gaps" listed in the Final Data Gaps Analysis report (prepared by AMEC, dated March 14, 2012, see pages 5-14 and 5-15). We recommend adding a table to the Work Plan that lists the critical data gaps provided in the Final Data Gaps Analysis report and then lists the corresponding specific objectives of the Phase I Pre-Design Investigation in an adjacent column. Such a table would allow easier comparison of critical data gaps to objectives of the upcoming investigation, and possibly aid in identification of redundancies or additional needs.

AMEC Response: AMEC has included Table 2-1 in the Work Plan to explicitly reference each task item to a data gap identified in the Final Data Gap Analysis report. This table describes how each data gap will be addressed by the tasks outlined in the Phase I Pre-Design Investigation, or if and when each may be addressed in a subsequent investigation.

6. **Section 2.4, Phase I Pre-Design Investigation Objectives, page 2-5, bullet 7:** This bullet states that a specific objective of the Phase I Pre-Design Investigation is to "Assess whether sufficient data exist to proceed with designing the Second Interim Remedy…" We recommend adding a discussion in this document or the SAP (and referencing such a location within bullet 7) that describes the process and people who will make such an assessment.

AMEC Response: Text comprising this bullet has been modified to include a reference to a section within the Work Plan that will outline the AMEC's decision processes regarding determining data sufficiency for the Second Interim Remedy design.

7. **Section 3.3.2, Aquifer Testing, page 3-5, first paragraph of section:** The second sentence of this paragraph states that "…the vertical extent of capture cannot be determined because pressure responses at depths below the existing NHOU extraction wells does not exist" (sic). We recommend revising this sentence to clarify that *measurements* of pressure responses at depths below the extraction wells do not exist.

AMEC Response: Comment acknowledged. Text has been revised as suggested.

8. **Section 3.3.2, Aquifer Testing, page 3-5:** During the planned aquifer testing, wells NHE-3, -5, and -7 will alternately be turned off and on, and pumped at different rates during the step-discharge tests. CDPH is concerned that these changes in the relative pumping rates at each extraction well will change the concentrations of contaminants entering the existing NHOU treatment system, particularly 1,4-dioxane and chromium, which are not removed by air stripping. Furthermore, well NHE-5 has not been pumped (or sampled) in several years, so there is substantial uncertainty regarding water quality at this well at present. An evaluation of estimated combined influent concentrations entering the NHOU treatment system during each distinct phase of the planned pumping tests should be provided, indicating the anticipated concentrations of chromium and 1,4-dioxane. This could be accomplished for wells NHE-3 and NHE-7 using a spreadsheet-

based mixing cell calculation, based on anticipated flow rates and recent concentration data. Well NHE-5 should be sampled in advance of the pumping tests to obtain more recent contaminant concentration data and overdue Title 22 monitoring data, in order to complete such an evaluation Results may indicate that treatment or an alternative disposal method is required to ensure that the water sent to the distribution system meets MCLs and NLs, since the NHOU treatment plant does not remove chromium and 1,4-dioxane. This evaluation should be included in the work plan or provided under separate cover at least six weeks before the aquifer testing commences, to provide adequate time for EPA and CDPH review.

AMEC Response: Anticipated influent water quality will be included in an Appendix B to the Work Plan to evaluate potential changes in hexavalent chromium and 1,4-dioxane concentrations as a result of pumping NHE-5, based on historical and recent NHE extraction well pumping performance and the anticipated pumping rate of NHE-5 during the 72-hour pumping test. Based on our preliminary calculations, increasing the influent hexavalent chromium concentration to above 5 µg/L would require concentrations at NHE-5 to exceed 20 µg/L, which is far higher than historical data at this well or nearby NHE wells. Similarly, increasing the influent 1,4-dioxane concentration to above 1 µg/L would require concentrations at NHE-5 to also exceed concentrations higher than historical data at this well or nearby NHE wells. This is consistent with the relatively low pumping rate expected from NHE-5 compared to the overall treatment system (approximately 10 percent).

As such, there appears to be little cause for concern regarding impacts to water quality as a result of pumping NHE-5. However, AMEC supports the concept of utilizing additional hexavalent chromium and 1,4-dioxane data from the NHOU extraction wells, as obtained by LADWP, to support the Phase I Pre-Design Investigation and the Second Interim Remedy design.

9. **Section 3.3.2.1, Monitoring Well Testing, page 3-6:** The second sentence of this paragraph states that "…the resulting hydraulic conductivity values (from slug testing) will be incorporated into the groundwater flow model…" We recommend revising this sentence to state that the resulting hydraulic conductivity values from slug testing will be used to guide development of the hydraulic conductivity matrix in the model. Forcing results of slug tests, which focus on local aquifer properties near the well or boring being tested, into the model may degrade numerical model representativeness of the physical system at the site, rather than improve it.

AMEC Response: Comment acknowledged. Text has been revised as suggested.

10. **Section 4, Data Management, Data Evaluation, and Reporting, page 4-2:** The last sentence of the first full paragraph on this page states that "This report (following the Phase I investigation) will evaluate Phase I data and will recommend that a Phase II Pre-Design Investigation be performed if it is determined that insufficient data exist to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." As noted in Comment 1, above, some of the critical data gaps described in the Final Data Gap Analysis report are not addressed by the activities proposed in the Work Plan. Therefore, it seems certain that insufficient data will exist to fill those critical data gaps. Please revise so the Work Plan provides a better explanation of why some previously "critical" data gaps may no longer need to be filled.

AMEC Response: See responses to previous comments and, in particular, our response to Comment #5.

SAMPLING AND ANALYSIS PLAN

1. **General comment:** The SAP directly incorporates components of a Quality Assurance Project Plan (QAPP); a stand-alone QAPP is not included. We have no objections to this approach. However, at several locations the SAP text, figures, and Field Sampling Plans (FSPs) refer to “the QAPP.” We recommend that these document components refer to the SAP, rather than the non-existent (at the time of submittal) QAPP.

AMEC Response: Comment acknowledged. References to “the QAPP” have been revised to “the SAP” for consistency and clarity**.**

2. **Figures:** Figures within the SAP and FSPs do not have consistent title blocks. Some title blocks reference the QAPP, Work Plan, etc. We recommend updating the figure title blocks for consistency.

AMEC Response: Figures with inconsistent title blocks have been revised accordingly.

3. **Table 2-1:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Tables A-3 and B-2 located in the appropriate appendices:

a) The table lists EPA Method 8260 as the analytical method to be used for analysis of volatile organic compounds. A more suitable method for analysis of potential drinking water is EPA Method 524.2. The SAP should provide an explanation (perhaps as part of development of data quality objectives) regarding why EPA Method 8260 analysis is appropriate for some or all samples to be obtained under this SAP.

AMEC Response: Previous sampling of monitoring wells in the NHOU have been analyzed using EPA Test Method 8260 and this information will be incorporated into the SAP to justify the continued use of this method over EPA Test Method 524.2, unless lower method detection limits warrant the use of EPA Test Method 524.2 (e.g., 1,1,1-TCA).

b) For perchlorate by EPA Method 331, the sample container is listed as “100 mL Sanitized,” but no container type (e.g. polyethylene) is listed.

AMEC Response: Comment acknowledged. The container type has been added.

c) The column heading marked “MDL” lists a number of values related to each method. This heading implies that the values listed are the achievable method detection limits for each method. However, the values directly correlate with the performance standards listed in Section 2.3.2, page 2-7. Heading either needs to be changed to “Performance Standard,” or the actual, achievable MDLs for each method need to be added instead.

AMEC Response: Actual, achievable MDLs are lab-specific in most cases. AMEC has updated the SAP with the MDL values provided by the analytical laboratory selected to perform these analyses.

4. **Table 2-2:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Table A-2 located in the appropriate appendix:

a) The Acceptance Criteria listed for the Temperature blank (under Accuracy, Field) is less than 4 degrees centigrade. However, Table 2-1 lists the appropriate temperature preservation for each method as 4 ± 2 degrees centigrade.

AMEC Response: To be consistent with Table 2-1 and the National Guideline, the Acceptance Criteria listed for the Temperature blank (under Accuracy, Field) has been revised to "4 ± 2 degrees centigrade".

b) The Acceptance Criteria for Method blanks (under Accuracy, Laboratory) is listed as "No compounds should be detected in the laboratory method blanks." Does this statement imply that all compounds should be detected below the laboratory's MDL, or below the laboratory's reporting limit?

AMEC Response: This statement means that no compound should be detected above its respective Reporting limit in the Method blanks.

c) The Acceptance Criterion for Preparation blanks (under Accuracy, Laboratory) is listed as "%R less than compound specific limit". This criterion is better suited for Laboratory Control Samples (LCS) than the blanks. The similar criteria listed for Method blanks should be used for Preparation blanks.

AMEC Response: Comment acknowledged. Text has been revised as suggested.

5. **Acronyms**: Many acronyms were: 1) not captured in the abbreviations and acronyms list, 2) not defined with the first time use, 3) defined multiple times throughout the SAP, or 4) not used after being defined. Please ensure that the SAP (and appendices) undergoes a comprehensive review to appropriately capture and correct all acronyms and callouts. In addition, the definition of the acronym COC should be determined and used consistently throughout the SAP (e.g. chemical of concern, contaminant of concern, constituent of concern). Finally, the definition of the acronym CSM should be determined and used consistently throughout the SAP (e.g. conceptual site model vs. site conceptual model).

AMEC Response: Comment acknowledged. Acronyms and abbreviations have been properly defined and introduced throughout the revised documents.

6. **Emerging Chemicals:** The SAP is inconsistent when referencing and listing what is considered an emerging chemical (e.g. hexavalent chromium, 1,4-dioxane, 1, 2, 3-trichloropropane, perchlorate, and n-nitrosodimethylamine). In addition, the term "emerging chemical" should replace the term "new chemical" when used within the SAP.

AMEC Response: Text has been revised to be consistent with Attachment 4 in Appendix A (Scope of Work) of the Administrative Settlement Agreement and Order on Consent for Remedial Design (AOC; EPA, 2011).

7. **Section 1.0 Introduction, page 1-1:** In the first paragraph, please add the reference USEPA, 2011, after the AOC callout.

AMEC Response: The citation has been included as suggested.

8. **Section 2.0 Project Management, page 2-1:** A "Project Method Performance Objectives" bullet should be added after the "Project Data Quality Objectives (DQOs) and criteria for measurement of data" bullet for consistency of summarizing the subsections within Section 2.0.

AMEC Response: A new fifth bullet titled "Method Performance Objectives has been included as suggested

9. **Section 2.1.3.5 Role/Responsibility of Data Reviewer, page 2-2:** One of the roles listed for the Data Reviewer is performing data validation according to the National Functional Guidelines. However, later in this same section, and in Section 5.1, paragraph 3, the SAP indicates that data validation will be performed by a qualified third party data validator, independent from AMEC. Will the Data Reviewer perform some portion of the data validation, or will all of the validation be performed by third party? Some additional clarification is needed to better describe the role of the Data Reviewer in regards to data validation.

AMEC Response: As specified in the AOC, a qualified third party will perform primary data validation. AMEC's Data Manger (as clarified in our response to Comment #15) will verify that data validation procedures were followed and completed. SAP text has been revised accordingly.

10. **Section 2.2, page 2-3:** What is the back-up plan if NHE 1 and 5 cannot be made operational?

AMEC Response: The context of this comment cannot be determined because there is no reference to NHE-1 and NHE-5 in this section or page of the SAP.

11. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-4 and 2-5:** We recommend listing the eight NHOU extraction wells earlier in this section so that when reference is made to the shutdown of NHE-2 later in the section, the reader understands the well is affiliated with the NHOU Extraction and Treatment System.

AMEC Response: Comment acknowledged. Text has been modified accordingly.

12. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-5:** Last paragraph, line 6; we recommend deleting the term "NHOU treatment system" and replacing with the term "NHOU Extraction and Treatment System". Consider making this a global change.

AMEC Response: Comment acknowledged. Text has been revised through the document as appropriate.

13. **Section 2.3.1 Potential Measurements, page 2-6:** In the second paragraph, line 2, 1,2,3-TCP should be added to the list of chemicals identified for analysis. In addition, this paragraph refers to total alkalinity while Table 2-1 makes reference to alkalinity. Finally, this paragraph refers to pH and specific conductance; however, Table 2-1 does not list these parameters for analysis. We recommend modifying the text to improve the consistency within this section and with Table 2-1.

AMEC Response: Comment acknowledged. Text has been revised accordingly.

14. **Section 2.3.2 Applicable Technical Quality Standards and Criteria, page 2-7:** We recommend replacing "TCP" with "1,2,3-TCP" for consistency and clarity, in this section and elsewhere in the document as appropriate to consistently abbreviate 1,2,3-trichloropropane.

AMEC Response: Comment acknowledged. Text has been revised accordingly.

15. **Section 2.7.2 Laboratory Records, page 2-14, third paragraph:** This paragraph indicates that the AMEC Data Manager will have the responsibility for obtaining and tracking GeoTracker deliverables. However, the AMEC Data Manager's roles and responsibilities are not outlined in Section 2.1.3.

AMEC Response: The "Data Reviewer" title in Section 2.1.3 has been revised to "Data Manager" and throughout this document.

16. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** In the first paragraph, line 8, we believe that 1,2,3-TCP should be added to the list of chemicals identified for analysis, consistent with Table 2-1.

AMEC Response: Comment acknowledged. Text has been revised accordingly.

17. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** The second and third paragraphs state that vertical flow logs and groundwater level measurements will be obtained from "select existing piezometers." The activities may be performed at monitoring wells, not piezometers, and if so, the text should be modified accordingly.

AMEC Response: Table C-1 lists the monitoring wells planned for vertical profiling. Text has been revised accordingly.

18. **Section 6.0 References, page 6-1:** The USEPA Guidance on Systematic Planning Using the Data Quality Objectives Process is listed twice, once as 2006 and the other as 2006a. We recommend that one of these duplicate references be deleted, and that corresponding references to this document within the body of the report be modified accordingly.

AMEC Response: Comment acknowledged. The "USEPA, 2006" reference listed in Section 6 has been deleted; citations within the text correctly refer to USEPA, 2006a.

19. **Appendix A, Table A-3:** If results of groundwater quality sampling are planned for use to support a CDPH policy 97-005 evaluation, the following analytical methods are recommended by CDPH as being more suitable for drinking water analysis than those listed in Table A-3:

a) 1,2,3-trichloropropane (TCP): CDPH SRL "low" method (http://www.cdph.ca.gov/certlic/drinkingwater/Pages/123TCPanalysis.aspx)

b) 1,4-dioxane: EPA Method 522

c) Nitrosodimethylamine: EPA method 521; in addition, CDPH recommends analyzing for all nitrosamines

d) Perchlorate: EPA method 314 (false positives can occur using this method—a backup analytical method using a mass-spectrometer-based analysis is recommended if positive results are detected in excess of the State MCL)

AMEC Response: As mentioned in our response to the Work Plan General Comment #1, additional samples separate from the Phase I Pre-Design Investigation are anticipated to be needed to address CDPH 97-005 requirements and proposed analytical methods are considered appropriate to address RAOs. However, AMEC has reviewed the methods recommended by CDPH and has incorporated them into the SAP tables as appropriate.

20. **Appendix A, Section A1.0 Introduction, page A1-1:** In the second paragraph, line 4, we recommend adding the term “Phase I” in front of the term “Pre-Design Investigation.” This change can be carried into the introduction for Appendix B and C as well.

AMEC Response: Text has been revised accordingly.

21. **Appendix A, Section A1.3 Responsible Agency, page A1-1:** For consistency with Appendix B and C, we recommend adding “Region IX” to the end of the sentence.

AMEC Response: Text has been revised accordingly.

22. **Appendix A, Section A1.4 Project Organization, page A1-2:** Based on our understanding of the Work Plan, Eileen Bailiff is the Field Team Leader for Groundwater Sampling and Monitoring, rather than Sean Culkin. Please clarify.

AMEC Response: Comment acknowledged. Eileen Bailiff will be identified as the Field Team Leader in Appendix A as stated in the Work Plan.

23. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend revising the first bullet to read as follows (bold text indicates new text for consideration): “Analytical data are insufficient to delineate the lateral and vertical distribution and temporal variability of COCs **in the NHOU study area with respect to the A-Zone and B-Zone** and to define the necessary target capture area.” This change can also be made to Section A3.2, page A3-2 under “State the Problem”.

AMEC Response: Text has been revised accordingly in Sections A1.5 and A3.2.

24. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend updating the second bullet to read as follows (bold text indicates new text for consideration): “Groundwater elevation data are not surveyed to a common elevation datum to verify and clarify groundwater flow directions **and gradients in some locations**.” This change can also be made to Section A3.2, page A3-2 under “State the Problem”.

AMEC Response: Text has been revised accordingly.

25. **Appendix A, Section A2.1 Site or Sampling Area Description, page A2-1:** We recommend revising the first sentence within the second paragraph, as the description of the system is already provided in the operational history section, as follows: “The NHOU Extraction and Treatment System and associated well field network is located in the San Fernando groundwater basin.” We don’t believe the author intended to claim that the NHOU groundwater production well system consists of eight extraction wells, etc. This change can be carried into the same description within Appendix B and C as well.

AMEC Response: Text in Appendices A, B, and C has been revised accordingly.

26. **Appendix A, Section A2.2 Operational History, page A2-1:** We recommend revising the first sentence of this paragraph as follows: “The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8), a collector line, and a central treatment system consisting of an air-stripping treatment system to remove VOCs from extracted groundwater, two activated carbon units to remove VOCs from the air stream, a chlorination system, and ancillary equipment.” This change can be carried into the same description within Appendix B and C as well.

In addition, in the last sentence, we recommend deleting "(sans NHE-1)" and adding the following sentences to the end of the paragraph for consistency with Appendix B: "As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHOU system and NHE-5 has not operated since 2008." This change can be carried into the same description within Appendix C as well.

AMEC Response: Text in Appendices A, B, and C has been revised accordingly.

27. **Appendix A, Section A2.3 Previous Investigations/Regulatory Involvement, page A2-2:** The reference to USEPA, 2009a is not found in the reference list. Please add the correct reference.

AMEC Response: The Second Interim Remedy Record of Decision has been included in Section 6.0 and the citation here has been revised to "USEPA, 2009".

28. **Appendix A, Section A2.4 Geological and Hydrogeological Information, page A2-2:** We recommend including a reference for the Data Gap Analysis report (e.g. AMEC, 2012a). This change can be carried into the same section within Appendix B and C as well.

AMEC Response: Comment acknowledged. A citation has been inserted and Section 6.0 has been revised accordingly.

29. **Appendix A, Section A2.5 Environmental and/or Human Impact, page A2-2:** In line 8, we recommend adding "1,2,3-" in front of "TCP". This change can be carried into the same section within Appendix B and C as well.

AMEC Response: Text has been revised accordingly.

30. **Appendix A, Section A3.1 Project Task and Problem Definition, page A3-1:** We recommend adding the following text to the end of the fifth task: "and to further evaluate the potential utilization of the well (which has never operated as part of the NHOU Extraction and Treatment System) as part of the Second Interim Remedy."

In addition, is a seventh task justified for addition to the SAP related to NH-10, per the Work Plan (i.e. "At least two depth-discrete samples will be collected from the upper perforation zones of production well NH-10 during a single monitoring event to evaluate groundwater quality in the A-Zone and B-Zones at that location.")?

AMEC Response: Groundwater samples proposed to be collected from NHE-1 are intended to assess groundwater quality at this location and will not pertain to the evaluation of whether this well could be utilized as an extraction well as part of the Second Interim Remedy. The need for an extraction well at this location will be based, in part, on analytical results from the proposed samples and from numerical model simulation results that will be presented and discussed in the Groundwater Modeling Memorandum.

Similarly, there is no need for a seventh task because the fifth task was specifically written to account for sampling at NH-10 (i.e., "…obtain…groundwater quality samples and groundwater elevation measurement near the NHE-1 extraction well…"). NH-10 is near NHE-1 and, although not specifically mentioned, proposed sampling activities at that location are accounted for in Table A-1, as the comment acknowledges.

31. **Appendix A, Section A3.2 Data Quality Objectives (DQOs), page A3-3:** Step 6, Item "a", we recommend including a reference for the Data Gap Analysis report (i.e. AMEC, 2012a).

AMEC Response: Comment acknowledged. A citation has been inserted and Section 6.0 has been revised accordingly.

32. **Appendix A, Section A5.1 Analyses** Narrative**, page A5-1:** Table A-1 lists 29 monitoring wells that will be sampled semiannually. Reference to 30 monitoring wells in this paragraph should be updated.

AMEC Response: Section A5.1 intentionally refers to "approximately 30 wells" to acknowledge potential problems associated with accessing proposed monitoring wells. Text has not been revised.

33. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-1:** We recommend that AMEC verify whether the reference to Appendix A-2 in the third paragraph should actually be to Appendix A-1, and that this be corrected if necessary.

AMEC Response: Text has been revised accordingly.

34. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-2:** The bullets under the statement "The following steps will be followed for document retention:" do not correspond with the same bullets in Appendix B, Section B8.3 Waste Profiling and Documentation with respect to who sends, signs, and receives the profiles and manifests. We recommend revising Appendix A or B, as appropriate.

AMEC Response: Comment acknowledged. Section B8.3 has been updated to include Lockheed Martin in the profiling and manifesting process.

35. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the first paragraph add reference to Appendix A-1 at the end of the second sentence.

AMEC Response: Text has been revised accordingly.

36. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the sixth bullet be updated to read as follows: "Sample media (e.g., groundwater) **and depth of collection.**"

AMEC Response: This information will be recorded on either the Daily Field Record or activity-specific data form as listed near the bottom of page 9-1. Text has not been revised.

37. **Appendix A, Section A9.1.2 Activity-Specific Forms, page A9-2 and Section A9.3 Sample Chain-of-Custody Forms, page A9-3:** Please provide a sample chain of custody form in Appendix A-1.

AMEC Response: A sample chain-of-custody form was inadvertently omitted from the draft SAP and has been included in the revised SAP**.**

38. **Appendix A, Section A11.0 Field Variances, page A11-1:** Please add the following text after the second sentence for consistency with Appendix B: "The AMEC Project Manager will notify the USEPA of major modifications or variances to the field program." Please modify the text in Appendix B to the previous statement. The same change can be made to this section in Appendix C.

AMEC Response: Text has been revised accordingly.

39. **Appendix A, Section A13.0 References, page A13-1:** We recommend updating the reference list and/or deleting those references that are not used within Appendix A.

AMEC Response: Comment acknowledged. Unused citations have been deleted as appropriate.

40. **Appendix B, Section B1.5, page B1-2:** We recommend updating the first bullet to read as follows (bold text indicates new text for your consideration): "Performance monitoring well **and piezometers** have not been installed and monitored to demonstrate the size and shape of the existing NHOU extraction well capture area, **specifically with regard to the A-Zone and B-Zone.**"

AMEC Response: Text has been revised accordingly.

41. **Appendix B, Section B1.6 Schedule, page B1-2:** In the second line, we recommend deleting the word "sampling" and replacing with the phrase "drilling and piezometer installation". It is hard to tell whether this Field Sampling Plan is supposed to cover drilling, sampling, or both.

AMEC Response: Text has been revised accordingly.

42. **Appendix B, Section B2.1 Site Description, page B2-1:** Second paragraph, in addition to listing Figure B-2, it would also be appropriate to list Figures B-4 and B-6.

AMEC Response: Text has been revised accordingly.

43. **Appendix B, Section B3.1 Project Task and Problem Definition, page B3-1:** Line 6, reference to Figures B-3, B-5, and B-7 should be corrected to reference Figures B-2, B-4, and B-6 instead. Line 8, reference to Figures B-4, B-6, and B-8 should be corrected to reference Figures B-3, B-5, and B-7 instead.

AMEC Response: Text has been revised accordingly.

44. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-2:** We recommend adding an item to the second step: "h) Do the NHOU extraction wells need to be deepened to meet RAOs?"

AMEC Response: We respectfully disagree with the recommendation, which refers to an objective within the Second Interim Remedy Record of Decision. That objective does not pertain to the design and location of performance monitoring wells (or piezometers), which is the subject of Appendix B of the SAP. Whether or not NHOU extraction wells may need to be deepened will be one of several actions considered as part of the Groundwater Modeling Memorandum.

45. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** The following figure references should be corrected in the fourth step: Items a), c), and e) – Figure B-3 should be updated to call out Figure B-2 instead, and Figure B-8 should be updated to call out Figure B-7 instead.

AMEC Response: Text has been revised accordingly.

46. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** Sixth step, item "a", should include reference to the Data Gap Analysis report (e.g. AMEC, 2012a).

AMEC Response: Text has been revised accordingly.

47. **Appendix B, Section B3.5 Data Management and Assessment Oversight, page B3-6:** Last paragraph, this section makes reference to a Data Usability Evaluation and Field QA/QC submittal. This submittal may need to be referenced in Appendix A as well.

AMEC Response: Text has been revised accordingly.

48. **Appendix B, Section B4 Sampling Rationale, page B4-1:** Second paragraph, line 7 – Reference to Table B-1 should be updated to reference Table B-2 instead.

AMEC Response: Text has been revised accordingly.

49. **Appendix B, Section B6.7 Piezometer Installation, page B6-4:** First paragraph, figure references in the first line on this page should be updated from B-4, B-6, and B-8 and corrected to reference Figures B-3, B-5, and B-7.

AMEC Response: Text has been revised accordingly.

50. **Appendix B, Section B6.8.2 Post-Development Groundwater Sampling, page B6-5:** Reference to Table B-3 should be updated to reference Table B-2 instead.

AMEC Response: Text has been revised accordingly.

51. **Appendix B, Section B9.3 Sample Chain-Of-Custody Forms, page B9-3:** First paragraph, consider changing reference from Appendix B-2 to Appendix B-1.

AMEC Response: Text has been revised accordingly.

52. **Appendix B, Section B13.0 References, page B13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix B.

AMEC Response: Comment acknowledged. Unused references have been deleted as appropriate.

53. **Appendix C, Section C1.6 Schedule, page C1-2:** In the first sentence, suggest deleting the phrase "in multiple sampling events" and replace with the word "testing". In the second sentence, suggest deleting the word "sampling" and replacing with the word "testing".

AMEC Response: Text has been revised accordingly.

54. **Appendix C, Section C2.1 Site or Sampling Area Description, page C2-1:** All references to Figures A-1 or A-2 should be updated to reference Figures C-1 or C-2, respectively.

AMEC Response: Text has been revised accordingly.

55. **Appendix C, Section C2.4 Geological and Hydrogeological Information, page C2-2:** Line 3, suggest adding the phrase "and testing" after the word "sampling".

AMEC Response: Text has been revised accordingly.

56. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the first item to read as follows: "Slug tests will be performed at 12 monitoring wells screened primarily in either the A-Zone or B-Zone to estimate hydraulic parameters. These data will be used to estimate hydraulic conductivity values as simulated in the current groundwater flow model to define the NHOU extraction well capture zone."

AMEC Response: The text and Table C-1 have been corrected to cite the 14 monitoring wells as are discussed in the Phase I Pre-Design Investigation Work Plan.

57. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the second item to read as follows (bold text indicates new text for

consideration): "Perform aquifer pumping tests at three NHE extraction wells (NHE-3, NHE-5, and NHE-7) **while monitoring the response to the pumping test in 10 observation wells** to estimate well efficiency and A-Zone hydraulic parameters.

AMEC Response: Text has been revised accordingly.

58. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** In the third paragraph, suggest updating the first sentence to read as follows (bold text indicates new text for consideration): "Aquifer tests at NHE wells will consist of a step drawdown test **to evaluate extraction well performance** followed by a constant discharge test **with corresponding recovery tests**."

AMEC Response: Text has been revised accordingly.

59. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-2:** In Step 2, suggest updating the lettering of the items. In Step 3, part "b", line 1, clarify which "NHE" well is referred to, and suggest adding "as well as other existing monitoring wells" to the end of the line (before "as listed in Table C-1").

AMEC Response: Text has been revised as appropriate in Steps 2 and 3.

60. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-3:** In step 7, delete reference to analytical methodologies as sampling and analysis will not occur as part of this FSP.

AMEC Response: "Analytical methodologies" refers to the analytical methods that will used to evaluate the aquifer test drawdown data. The first sentence of step 7a) has been revised to state "Aquifer test locations, number of observation wells, and aquifer test evaluation methodologies are proposed herein."

61. **Appendix C, Section C6.4 Decontamination Procedures, page C6-12:** At the end of the first paragraph, suggest correcting the acronym FSA to the acronym FSP. At the end of this paragraph, suggest referencing Appendix A of the SAP.

AMEC Response: Text has been revised accordingly.

62. **Appendix C, Section C13.0 References, page C13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix C.

AMEC Response: Comment acknowledged. Unused references have been deleted as appropriate.

HEALTH AND SAFETY PLAN

1. **Section 1.5, Table in "Chemical Hazards," page C1-3:** The current Threshold Limit Value for TCE is 10 ppm; the table should be clarified or corrected accordingly.

AMEC Response: Text has been revised accordingly.

2. **Appendix E, Job Safety Analyses, Pre-ground Disturbance and Clearance Activities:** If saw cutting of concrete or asphalt, the Job Safety Analysis may not adequately address use of respiratory protection for dust, or physical controls for use of a chop saw. We recommend that the authors of the HASP consider expanding this discussion if saw cutting is anticipated.

AMEC Response: Text has been revised accordingly.

Remedial Design QUALITY ASSURANCE PROJECT PLAN

1. **Distribution List:** The name of Ms. Acharya (DTSC) appears to be misspelled, and the street address for Mr. Lindquist (CH2M HILL) should be 2525 Airpark Drive (not 2625). Other errors may be present that delay delivery of this or future documents in a timely manner. We recommend that AMEC review and, if necessary, update their distribution list.

AMEC Response: AMEC has reviewed the distribution list and made corrections to Ms. Acharya's name and Mr. Lindquist's street address. Ms. Acharya and Mr. Lindquist were correctly included on the e-mail notification regarding the report's availability for their review. All required document deliveries for this project have consistently been made in a timely manner to the distribution list specified in the AOC.

2. **Section 2.2, Project Delivery, page 2-4, first and second paragraphs:** It appears that the terms "design/bid/build" and "design/build" may have been inadvertently transposed in the first and second paragraphs. This is not a critical issue from a regulatory perspective, but may lead to confusion if the RD QAPP is forwarded to potential construction bidders in the future. We recommend that this potential transposition be checked and corrected, if appropriate.

AMEC Response: AMEC has reviewed the terms noted above and has determined that they were used correctly in the text describing project delivery methods. Text has been added to further clarify the difference in the two delivery methods to prevent future confusion.

3. **Section 4.3.8, Procedures for Records Retention, page 4-7, first paragraph:** This paragraph states that various records will be filed and retained, but does not state the period of retention nor that it is consistent with the Records Retention section of the AOC. We recommend that the RD QAPP include the duration for records retention and maintenance of files on a SharePoint site.

AMEC Response: AMEC has revised Section 4.3.8 to make it consistent with the records retention section of the AOC.

ATTACHMENT A

USEPA Comments on the *Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* and the *Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design (August 10, 2012)*

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9
75 Hawthorne Street
San Francisco, California

August 10, 2012

Michael Taraszki
AMEC for Honeywell and Lockheed
1330 Broadway Street, Ste 1702
Oakland, CA 94612

RE: Comments on *"Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit, Second Interim Remedy Groundwater Remediation System Design"* and the *" Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit, Second Interim Remedy Groundwater Remediation System Design"*

Dear Mr. Taraszki:

EPA has reviewed the above-referenced document, and provides the following comments in the attached file. These comments should be addressed and resubmitted with the final drafts of the above referenced documents, which are due **thirty days** from the date of this letter.

The attached comments are comprehensive, and the following agencies/firms commented or had an opportunity to comment, in addition to EPA:

- the Los Angeles Department of Water and Power (LADWP)
- the Upper Los Angeles River Area (ULARA) Watermaster
- the Los Angeles Regional Water Quality Control Board (Regional Board)
- CH2M HILL, consultant to EPA

Please include a separate letter which addresses each of the general and major comments specifically, and indicates how the responses to the comments have been incorporated into the final.

Please let me know if you have any questions.

Sincerely,

Matt Salazar
EPA Project Manager

The review focused on significant technical issues; we have not commented on typographical or grammatical errors except where such errors may lead to confusion on technical issues. Following are our comments on these submittals.

Work Plan

1. **General comment:** The Work Plan is well written and indicates a comprehensive understanding of both the available site data and the data gaps in the NHOU. Conduct of the work proposed in the Work Plan (and SAP) will improve the conceptual site model for the NHOU and provide important hydrogeologic data required for RD of the Second Interim Remedy.

   As stated in Section 2.4 of the Work Plan, "The overall objective of the Phase 1 Pre-Design Investigation is to fill critical data gaps identified as necessary for the Second Interim Remedy design to meet RAOs…" And Section 4 of the Work Plan states that a second phase of investigation would only be performed "if it is determined that insufficient data exist (at that time) to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." However, actions that might fill some of the "critical data gaps" identified in the Final Data Gap Analysis report (pages 5-14 and 5-15) prepared by AMEC (dated March 14, 2012) are not proposed in this Work Plan. Specifically, critical data gaps 4, 5, 6, 8, and 9 listed on pages 5-14 and 5-15 of the Final Data Gap Analysis report seem to be unaddressed, or only partly addressed, by the activities listed in the Work Plan. It seems that either some of the data gaps identified in the Final Data Gap Analysis report are no longer deemed critical, or will simply not be addressed by the proposed Phase 1 investigation and will be addressed in some other manner. Please revise the Work Plan to provide more clarity regarding which of the critical data gaps are addressed by each proposed field activity, and which critical data gaps are not addressed in the proposed Phase 1 investigation (together with an explanation of why not, and how they will be addressed in the future). Our comments and/or recommendations for filling these data gaps are summarized below, but could be modified depending on additional information provided by the respondents:

   - **Critical Data Gap 4** ("existing monitoring well network insufficient to characterize vadose zone and groundwater conditions beneath known and potential source areas"): The Work Plan should show critical areas for further investigation on a map, or at least describe how the need for further characterization in the vicinity of the "known and potential source areas" would be evaluated and conducted during a Phase II data gaps investigation. The area southwest of NHOU extraction wells NHE-2 and NHE-3, where high concentrations of VOCs and hexavalent chromium have been detected, but are poorly delineated, seems to be of primary concern. It is not clear how the data collection activities described in the Work Plan would fill this data gap or aid in further delineating contaminant concentrations in this particular area. We recommend that at least two new monitoring wells be installed in this area as part of the Phase 1 investigation.
   - **Critical Data Gap 5** ("objective projections of pumping and recharge volumes, including beyond year 2015, are not yet available"): The Work Plan should state that addressing this data gap does not require field activity; rather, discussions are ongoing (presumably) with LADWP and the ULARA Watermaster to develop improved and updated projections of future pumping and recharge volumes.

- **Critical Data Gap 6** ("performance monitoring wells have not been installed and monitored"): It is unclear whether the proposed piezometers in the Work Plan constitute some or all of the needed performance monitoring wells that comprise this critical data gap. The Work Plan should clarify whether the planned piezometers are expected to address this data gap by themselves, or if installation of additional performance monitoring wells is anticipated to be required in the future, to complete the RD. If so, then the Work Plan should describe how and when decisions about the need for additional performance monitoring wells will be made.
- **Critical Data Gap 8** ("available analytical data are insufficient to evaluate A-Zone and, potentially, B-Zone groundwater quality within the future NHOU capture zone to meet CDPH 97-005 requirements"): The Work Plan should define whether this is still considered to be a critical data gap, and describe how and when it will be addressed.
- **Critical Data Gap 9** ("vertical conduits throughout the NHOU study area have not been sufficiently evaluated"): The Work Plan includes investigative activities to evaluate existing monitoring wells as potential vertical conduits for contaminant migration; however, it does not include plans to evaluate existing inactive production wells. Inactive production wells appear to pose a greater threat of vertical contaminant migration, due to their number, long screens, and large diameter. The Work Plan should describe how and when this part of Critical Data Gap 9 will be addressed (e.g., will it be addressed as part of a future Phase II investigation, and are there any conditions on which such an investigation would depend).

2. **Table of Contents page iii, Table, Figures, and Appendix sections:** The title provided in the table of contents for Table 3-1 is different from the title actually on Table 3-1. The titles for Figure 3-1 and Appendix A are similarly inconsistent with the titles given in the table of contents. Please make the titles listed in the table of contents consistent with the actual titles of the corresponding tables, figures, and appendices.
3. **Section 2.2, Project Background, page 2-3, first full paragraph:** This paragraph paraphrases the key remedial action objectives (RAOs) and relates them to the specific work scope items in the Agreement and Order on Consent (AOC). However, the second sentence in this paragraph focuses exclusively on the second RAO for the NHOU Second Interim Remedy. We recommend that this sentence be modified to also accommodate the fourth remedial action objective (RAO), which is to achieve improved hydraulic containment to inhibit horizontal and vertical contaminant migration in groundwater from the more highly contaminated areas and depths of the aquifer to the less contaminated areas and depths of the aquifer, including the southeast portion of the NHOU near the Erwin and Whitnall production well fields. We assume that this RAO influences the AOC work scope items, as well as the scope of work for the activities described in the Work Plan.
4. **Section 2.3, Previous Investigations, page 2-4, fourth paragraph:** The second-to-last sentence in this paragraph states "However, it was concluded that existing data are insufficient to proceed with a Second Interim Remedy…" We recommend that the sentence be modified to state which entity came to that conclusion, and provide a reference to a document where that conclusion is stated (perhaps the Draft or Final Data Gap Analysis report prepared by AMEC).
5. **Section 2.4, Phase 1 Pre-Design Investigation Objectives, page 2-5, bullets 1 through 6:** It is difficult to directly compare these bulleted "specific objectives" of the Phase 1 Pre-Design Investigation to the "critical data gaps" listed in the Final Data Gaps Analysis report (prepared by AMEC, dated March 14, 2012, see pages 5-14 and 5-15). We recommend adding a table to the Work Plan that lists the critical data gaps provided in the Final Data Gaps Analysis report and then

lists the corresponding specific objectives of the Phase 1 Pre-Design Investigation in an adjacent column. Such a table would allow easier comparison of critical data gaps to objectives of the upcoming investigation, and possibly aid in identification of redundancies or additional needs.

6. **Section 2.4, Phase 1 Pre-Design Investigation Objectives, page 2-5, bullet 7:** This bullet states that a specific objective of the Phase 1 Pre-Design Investigation is to "Assess whether sufficient data exist to proceed with designing the Second Interim Remedy…" We recommend adding a discussion in this document or the SAP (and referencing such a location within bullet 7) that describes the process and people who will make such an assessment.

7. **Section 3.3.2, Aquifer Testing, page 3-5, first paragraph of section:** The second sentence of this paragraph states that "…the vertical extent of capture cannot be determined because pressure responses at depths below the existing NHOU extraction wells does not exist" (sic). We recommend revising this sentence to clarify that *measurements* of pressure responses at depths below the extraction wells do not exist.

8. **Section 3.3.2, Aquifer Testing, page 3-5:** During the planned aquifer testing, wells NHE-3, -5, and -7 will alternately be turned off and on, and pumped at different rates during the step-discharge tests. CDPH is concerned that these changes in the relative pumping rates at each extraction well will change the concentrations of contaminants entering the existing NHOU treatment system, particularly 1,4-dioxane and chromium, which are not removed by air stripping. Furthermore, well NHE-5 has not been pumped (or sampled) in several years, so there is substantial uncertainty regarding water quality at this well at present. An evaluation of estimated combined influent concentrations entering the NHOU treatment system during each distinct phase of the planned pumping tests should be provided, indicating the anticipated concentrations of chromium and 1,4-dioxane. This could be accomplished for wells NHE-3 and NHE-7 using a spreadsheet-based mixing cell calculation, based on anticipated flow rates and recent concentration data. Well NHE-5 should be sampled in advance of the pumping tests to obtain more recent contaminant concentration data and overdue Title 22 monitoring data, in order to complete such an evaluation Results may indicate that treatment or an alternative disposal method is required to ensure that the water sent to the distribution system meets MCLs and NLs, since the NHOU treatment plant does not remove chromium and 1,4-dioxane. This evaluation should be included in the work plan or provided under separate cover at least six weeks before the aquifer testing commences, to provide adequate time for EPA and CDPH review.

9. **Section 3.3.2.1, Monitoring Well Testing, page 3-6:** The second sentence of this paragraph states that "…the resulting hydraulic conductivity values (from slug testing) will be incorporated into the groundwater flow model…" We recommend revising this sentence to state that the resulting hydraulic conductivity values from slug testing will be used to guide development of the hydraulic conductivity matrix in the model. Forcing results of slug tests, which focus on local aquifer properties near the well or boring being tested, into the model may degrade numerical model representativeness of the physical system at the site, rather than improve it.

10. **Section 4, Data Management, Data Evaluation, and Reporting, page 4-2:** The last sentence of the first full paragraph on this page states that "This report (following the Phase 1 investigation) will evaluate Phase 1 data and will recommend that a Phase 2 Pre-Design Investigation be performed if it is determined that insufficient data exist to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." As noted in Comment 1, above, some of the critical data gaps described in the Final Data Gap Analysis report are not addressed by the activities proposed in the Work Plan. Therefore, it seems certain that insufficient data will exist to fill those critical data gaps. Please revise so the Work Plan

provides a better explanation of why some previously “critical” data gaps may no longer need to be filled.

SAP

1. **General comment:** The SAP directly incorporates components of a Quality Assurance Project Plan (QAPP); a stand-alone QAPP is not included. We have no objections to this approach. However, at several locations the SAP text, figures, and Field Sampling Plans (FSPs) refer to “the QAPP.” We recommend that these document components refer to the SAP, rather than the non-existent (at the time of submittal) QAPP.

2. **Figures:** Figures within the SAP and FSPs do not have consistent title blocks. Some title blocks reference the QAPP, Work Plan, etc. We recommend updating the figure title blocks for consistency.

3. **Table 2-1:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Tables A-3 and B-2 located in the appropriate appendices:

    a) The table lists EPA Method 8260 as the analytical method to be used for analysis of volatile organic compounds. A more suitable method for analysis of potential drinking water is EPA Method 524.2. The SAP should provide an explanation (perhaps as part of development of data quality objectives) regarding why EPA Method 8260 analysis is appropriate for some or all samples to be obtained under this SAP.

    b) For perchlorate by EPA Method 331, the sample container is listed as “100 mL Sanitized,” but no container type (e.g. polyethylene) is listed.

    c) The column heading marked “MDL” lists a number of values related to each method. This heading implies that the values listed are the achievable method detection limits for each method. However, the values directly correlate with the performance standards listed in Section 2.3.2, page 2-7. Heading either needs to be changed to “Performance Standard,” or the actual, achievable MDLs for each method need to be added instead.

4. **Table 2-2:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Table A-2 located in the appropriate appendix:

    a) The Acceptance Criteria listed for the Temperature blank (under Accuracy, Field) is less than 4 degrees centigrade. However, Table 2-1 lists the appropriate temperature preservation for each method as 4 ± 2 degrees centigrade.

    b) The Acceptance Criteria for Method blanks (under Accuracy, Laboratory) is listed as “No compounds should be detected in the laboratory method blanks.” Does this statement imply that all compounds should be detected below the laboratory’s MDL, or below the laboratory’s reporting limit?

    c) The Acceptance Criterion for Preparation blanks (under Accuracy, Laboratory) is listed as “%R less than compound specific limit”. This criterion is better suited for Laboratory Control

Samples (LCS) than the blanks. The similar criteria listed for Method blanks should be used for Preparation blanks.

5. **Acronyms**: Many acronyms were: 1) not captured in the abbreviations and acronyms list, 2) not defined with the first time use, 3) defined multiple times throughout the SAP, or 4) not used after being defined. Please ensure that the SAP (and appendices) undergoes a comprehensive review to appropriately capture and correct all acronyms and callouts. In addition, the definition of the acronym COC should be determined and used consistently throughout the SAP (e.g. chemical of concern, contaminant of concern, constituent of concern). Finally, the definition of the acronym CSM should be determined and used consistently throughout the SAP (e.g. conceptual site model vs. site conceptual model).

6. **Emerging Chemicals:** The SAP is inconsistent when referencing and listing what is considered an emerging chemical (e.g. hexavalent chromium, 1,4-dioxane, 1, 2, 3-trichloropropane, perchlorate, and n-nitrosodimethylamine). In addition, the term "emerging chemical" should replace the term "new chemical" when used within the SAP.

7. **Section 1.0 Introduction, page 1-1:** In the first paragraph, please add the reference USEPA, 2011, after the AOC callout.

8. **Section 2.0 Project Management, page 2-1:** A "Project Method Performance Objectives" bullet should be added after the "Project Data Quality Objectives (DQOs) and criteria for measurement of data" bullet for consistency of summarizing the subsections within Section 2.0.

9. **Section 2.1.3.5 Role/Responsibility of Data Reviewer, page 2-2:** One of the roles listed for the Data Reviewer is performing data validation according to the National Functional Guidelines. However, later in this same section, and in Section 5.1, paragraph 3, the SAP indicates that data validation will be performed by a qualified third party data validator, independent from AMEC. Will the Data Reviewer perform some portion of the data validation, or will all of the validation be performed by third party? Some additional clarification is needed to better describe the role of the Data Reviewer in regards to data validation.

10. **Section 2.2, page 2-3:** What is the back-up plan if NHE 1 and 5 cannot be made operational?

11. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-4 and 2-5:** We recommend listing the eight NHOU extraction wells earlier in this section so that when reference is made to the shutdown of NHE-2 later in the section, the reader understands the well is affiliated with the NHOU Extraction and Treatment System.

12. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-5:** Last paragraph, line 6; we recommend deleting the term "NHOU treatment system" and replacing with the term "NHOU Extraction and Treatment System". Consider making this a global change.

13. **Section 2.3.1 Potential Measurements, page 2-6:** In the second paragraph, line 2, 1,2,3-TCP should be added to the list of chemicals identified for analysis. In addition, this paragraph refers to total alkalinity while Table 2-1 makes reference to alkalinity. Finally, this paragraph refers to pH and specific conductance; however, Table 2-1 does not list these parameters for analysis. We recommend modifying the text to improve the consistency within this section and with Table 2-1.

14. **Section 2.3.2 Applicable Technical Quality Standards and Criteria, page 2-7:** We recommend replacing "TCP" with "1,2,3-TCP" for consistency and clarity, in this section and elsewhere in the document as appropriate to consistently abbreviate 1,2,3-trichloropropane.

15. **Section 2.7.2 Laboratory Records, page 2-14, third paragraph:** This paragraph indicates that the AMEC Data Manager will have the responsibility for obtaining and tracking GeoTracker deliverables. However, the AMEC Data Manager's roles and responsibilities are not outlined in Section 2.1.3.

16. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** In the first paragraph, line 8, we believe that 1,2,3-TCP should be added to the list of chemicals identified for analysis, consistent with Table 2-1.

17. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** The second and third paragraphs state that vertical flow logs and groundwater level measurements will be obtained from "select existing piezometers." The activities may be performed at monitoring wells, not piezometers, and if so, the text should be modified accordingly.

18. **Section 6.0 References, page 6-1:** The USEPA Guidance on Systematic Planning Using the Data Quality Objectives Process is listed twice, once as 2006 and the other as 2006a. We recommend that one of these duplicate references be deleted, and that corresponding references to this document within the body of the report be modified accordingly.

19. **Appendix A, Table A-3:** If results of groundwater quality sampling are planned for use to support a CDPH policy 97-005 evaluation, the following analytical methods are recommended by CDPH as being more suitable for drinking water analysis than those listed in Table A-3:

    a) 1 ,2,3-trichloropropane (TCP): CDPH SRL "low" method (http://www.cdph.ca.gov/certlic/drinkingwater/Pages/123TCPanalysis.aspx)

    b) 1,4-dioxane: EPA Method 522

    c) Nitrosodimethylamine: EPA method 521; in addition, CDPH recommends analyzing for all nitrosamines

    d) Perchlorate: EPA method 314 (false positives can occur using this method—a backup analytical method using a mass-spectrometer-based analysis is recommended if positive results are detected in excess of the State MCL)

20. **Appendix A, Section A1.0 Introduction, page A1-1:** In the second paragraph, line 4, we recommend adding the term "Phase 1" in front of the term "Pre-Design Investigation." This change can be carried into the introduction for Appendix B and C as well.

21. **Appendix A, Section A1.3 Responsible Agency, page A1-1:** For consistency with Appendix B and C, we recommend adding "Region IX" to the end of the sentence.

22. **Appendix A, Section A1.4 Project Organization, page A1-2:** Based on our understanding of the Work Plan, Eileen Bailiff is the Field Team Leader for Groundwater Sampling and Monitoring, rather than Sean Culkin. Please clarify.

23. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend revising the first bullet to read as follows (bold text indicates new text for consideration): "Analytical data are insufficient to delineate the lateral and vertical distribution and temporal variability of COCs **in the NHOU study area with respect to the A-Zone and B-Zone** and to define the necessary target capture area." This change can also be made to Section A3.2, page A3-2 under "State the Problem".

24. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend updating the second bullet to read as follows (bold text indicates new text for consideration):

"Groundwater elevation data are not surveyed to a common elevation datum to verify and clarify groundwater flow directions **and gradients in some locations**." This change can also be made to Section A3.2, page A3-2 under "State the Problem".

25. **Appendix A, Section A2.1 Site or Sampling Area Description, page A2-1:** We recommend revising the first sentence within the second paragraph, as the description of the system is already provided in the operational history section, as follows: "The NHOU Extraction and Treatment System and associated well field network is located in the San Fernando groundwater basin." We don't believe the author intended to claim that the NHOU groundwater production well system consists of eight extraction wells, etc. This change can be carried into the same description within Appendix B and C as well.

26. **Appendix A, Section A2.2 Operational History, page A2-1:** We recommend revising the first sentence of this paragraph as follows: "The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8), a collector line, and a central treatment system consisting of an air-stripping treatment system to remove VOCs from extracted groundwater, two activated carbon units to remove VOCs from the air stream, a chlorination system, and ancillary equipment." This change can be carried into the same description within Appendix B and C as well.

    In addition, in the last sentence, we recommend deleting "(sans NHE-1)" and adding the following sentences to the end of the paragraph for consistency with Appendix B: "As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHOU system and NHE-5 has not operated since 2008." This change can be carried into the same description within Appendix C as well.

27. **Appendix A, Section A2.3 Previous Investigations/Regulatory Involvement, page A2-2:** The reference to USEPA, 2009a is not found in the reference list. Please add the correct reference.

28. **Appendix A, Section A2.4 Geological and Hydrogeological Information, page A2-2:** We recommend including a reference for the Data Gap Analysis report (e.g. AMEC, 2012a). This change can be carried into the same section within Appendix B and C as well.

29. **Appendix A, Section A2.5 Environmental and/or Human Impact, page A2-2:** In line 8, we recommend adding "1,2,3-" in front of "TCP". This change can be carried into the same section within Appendix B and C as well.

30. **Appendix A, Section A3.1 Project Task and Problem Definition, page A3-1:** We recommend adding the following text to the end of the fifth task: "and to further evaluate the potential utilization of the well (which has never operated as part of the NHOU Extraction and Treatment System) as part of the Second Interim Remedy."

    In addition, is a seventh task justified for addition to the SAP related to NH-10, per the Work Plan (i.e. "At least two depth-discrete samples will be collected from the upper perforation zones of production well NH-10 during a single monitoring event to evaluate groundwater quality in the A-Zone and B-Zones at that location.")?

31. **Appendix A, Section A3.2 Data Quality Objectives (DQOs), page A3-3:** Step 6, Item "a", we recommend including a reference for the Data Gap Analysis report (i.e. AMEC, 2012a).

32. **Appendix A, Section A5.1 Analyses** Narrative**, page A5-1:** Table A-1 lists 29 monitoring wells that will be sampled semiannually. Reference to 30 monitoring wells in this paragraph should be updated.

33. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-1:** We recommend that AMEC verify whether the reference to Appendix A-2 in the third paragraph should actually be to Appendix A-1, and that this be corrected if necessary.

34. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-2:** The bullets under the statement "The following steps will be followed for document retention:" do not correspond with the same bullets in Appendix B, Section B8.3 Waste Profiling and Documentation with respect to who sends, signs, and receives the profiles and manifests. We recommend revising Appendix A or B, as appropriate.

35. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the first paragraph add reference to Appendix A-1 at the end of the second sentence.

36. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the sixth bullet be updated to read as follows: "Sample media (e.g., groundwater) **and depth of collection.**"

37. **Appendix A, Section A9.1.2 Activity-Specific Forms, page A9-2 and Section A9.3 Sample Chain-of-Custody Forms, page A9-3:** Please provide a sample chain of custody form in Appendix A-1.

38. **Appendix A, Section A11.0 Field Variances, page A11-1:** Please add the following text after the second sentence for consistency with Appendix B: "The AMEC Project Manager will notify the USEPA of major modifications or variances to the field program." Please modify the text in Appendix B to the previous statement. The same change can be made to this section in Appendix C.

39. **Appendix A, Section A13.0 References, page A13-1:** We recommend updating the reference list and/or deleting those references that are not used within Appendix A.

40. **Appendix B, Section B1.5, page B1-2:** We recommend updating the first bullet to read as follows (bold text indicates new text for your consideration): "Performance monitoring well **and piezometers** have not been installed and monitored to demonstrate the size and shape of the existing NHOU extraction well capture area, **specifically with regard to the A-Zone and B-Zone.**"

41. **Appendix B, Section B1.6 Schedule, page B1-2:** In the second line, we recommend deleting the word "sampling" and replacing with the phrase "drilling and piezometer installation". It is hard to tell whether this Field Sampling Plan is supposed to cover drilling, sampling, or both.

42. **Appendix B, Section B2.1 Site Description, page B2-1:** Second paragraph, in addition to listing Figure B-2, it would also be appropriate to list Figures B-4 and B-6.

43. **Appendix B, Section B3.1 Project Task and Problem Definition, page B3-1:** Line 6, reference to Figures B-3, B-5, and B-7 should be corrected to reference Figures B-2, B-4, and B-6 instead. Line 8, reference to Figures B-4, B-6, and B-8 should be corrected to reference Figures B-3, B-5, and B-7 instead.

44. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-2:** We recommend adding an item to the second step: "h) Do the NHOU extraction wells need to be deepened to meet RAOs?"

45. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** The following figure references should be corrected in the fourth step: Items a), c), and e) – Figure B-3 should be updated to call out Figure B-2 instead, and Figure B-8 should be updated to call out Figure B-7 instead.

46. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** Sixth step, item "a", should include reference to the Data Gap Analysis report (e.g. AMEC, 2012a).
47. **Appendix B, Section B3.5 Data Management and Assessment Oversight, page B3-6:** Last paragraph, this section makes reference to a Data Usability Evaluation and Field QA/QC submittal. This submittal may need to be referenced in Appendix A as well.
48. **Appendix B, Section B4 Sampling Rationale, page B4-1:** Second paragraph, line 7 – Reference to Table B-1 should be updated to reference Table B-2 instead.
49. **Appendix B, Section B6.7 Piezometer Installation, page B6-4:** First paragraph, figure references in the first line on this page should be updated from B-4, B-6, and B-8 and corrected to reference Figures B-3, B-5, and B-7.
50. **Appendix B, Section B6.8.2 Post-Development Groundwater Sampling, page B6-5:** Reference to Table B-3 should be updated to reference Table B-2 instead.
51. **Appendix B, Section B9.3 Sample Chain-Of-Custody Forms, page B9-3:** First paragraph, consider changing reference from Appendix B-2 to Appendix B-1.
52. **Appendix B, Section B13.0 References, page B13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix B.
53. **Appendix C, Section C1.6 Schedule, page C1-2:** In the first sentence, suggest deleting the phrase "in multiple sampling events" and replace with the word "testing". In the second sentence, suggest deleting the word "sampling" and replacing with the word "testing".
54. **Appendix C, Section C2.1 Site or Sampling Area Description, page C2-1:** All references to Figures A-1 or A-2 should be updated to reference Figures C-1 or C-2, respectively.
55. **Appendix C, Section C2.4 Geological and Hydrogeological Information, page C2-2:** Line 3, suggest adding the phrase "and testing" after the word "sampling".
56. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the first item to read as follows: "Slug tests will be performed at 12 monitoring wells screened primarily in either the A-Zone or B-Zone to estimate hydraulic parameters. These data will be used to estimate hydraulic conductivity values as simulated in the current groundwater flow model to define the NHOU extraction well capture zone."
57. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the second item to read as follows (bold text indicates new text for consideration): "Perform aquifer pumping tests at three NHE extraction wells (NHE-3, NHE-5, and NHE-7) **while monitoring the response to the pumping test in 10 observation wells** to estimate well efficiency and A-Zone hydraulic parameters.
58. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** In the third paragraph, suggest updating the first sentence to read as follows (bold text indicates new text for consideration): "Aquifer tests at NHE wells will consist of a step drawdown test **to evaluate extraction well performance** followed by a constant discharge test **with corresponding recovery tests**."
59. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-2:** In Step 2, suggest updating the lettering of the items. In Step 3, part "b", line 1, clarify which "NHE" well is referred to, and suggest adding "as well as other existing monitoring wells" to the end of the line (before "as listed in Table C-1").

60. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-3:** In step 7, delete reference to analytical methodologies as sampling and analysis will not occur as part of this FSP.

61. **Appendix C, Section C6.4 Decontamination Procedures, page C6-12:** At the end of the first paragraph, suggest correcting the acronym FSA to the acronym FSP. At the end of this paragraph, suggest referencing Appendix A of the SAP.

62. **Appendix C, Section C13.0 References, page C13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix C.

HASP

1. **Section 1.5, Table in "Chemical Hazards," page C1-3:** The current Threshold Limit Value for TCE is 10 ppm; the table should be clarified or corrected accordingly.

2. **Appendix E, Job Safety Analyses, Pre-ground Disturbance and Clearance Activities:** If saw cutting of concrete or asphalt, the Job Safety Analysis may not adequately address use of respiratory protection for dust, or physical controls for use of a chop saw. We recommend that the authors of the HASP consider expanding this discussion if saw cutting is anticipated.

Remedial Design QAPP

1. **Distribution List:** The name of Ms. Acharya (DTSC) appears to be misspelled, and the street address for Mr. Lindquist (CH2M HILL) should be 2525 Airpark Drive (not 2625). Other errors may be present that delay delivery of this or future documents in a timely manner. We recommend that AMEC review and, if necessary, update their distribution list.

2. **Section 2.2, Project Delivery, page 2-4, first and second paragraphs:** It appears that the terms "design/bid/build" and "design/build" may have been inadvertently transposed in the first and second paragraphs. This is not a critical issue from a regulatory perspective, but may lead to confusion if the RD QAPP is forwarded to potential construction bidders in the future. We recommend that this potential transposition be checked and corrected, if appropriate.

3. **Section 4.3.8, Procedures for Records Retention, page 4-7, first paragraph:** This paragraph states that various records will be filed and retained, but does not state the period of retention nor that it is consistent with the Records Retention section of the AOC. We recommend that the RD QAPP include the duration for records retention and maintenance of files on a SharePoint site