FINAL
PORT-WIDE
SOIL MANAGEMENT PROTOCOL
PART OF
PORT OF OAKLAND
MATERIALS MANAGEMENT PROGRAM

FEBRUARY 2010

Prepared for:

PORT OF OAKLAND

530 Water Street
Oakland, California 94607

Prepared by:

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In consultation with:

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Acronyms and Abbreviations

ASTM	American Society of Testing and Materials
BASELINE	Baseline Environmental Consulting, Inc.
bgs	Below Ground Surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
COPCs	Chemicals of Potential Concern
CRE	Commercial Real Estate
DTSC	Department of Toxic Substances and Control
EPA	Environmental Protection Agency
EP&P	Environmental Programs and Planning
ESA	Environmental Site Assessment
ESL	Environmental Screening Levels
FISCO	Fleet and Industrial Supply Center of Oakland
HASP	Health and Safety Plan
IDW	Investigation-Derived Waste
IS/ND	Initial Study/Negative Declaration
IS/MND	Initial Study/Mitigated Negative Declaration
LBNL	Lawrence Berkeley National Laboratory
LUC	Land Use Covenant
MTBE	Methyl tert butyl ether
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MMP	Material Management Program
MMS	Materials Management Site
NEPA	National Environmental Protection Act
OAB	Oakland Army Base
OBM	Old Bay Mud
OIA	Oakland International Airport
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
Port	Port of Oakland
RAO	Regulatory Agency Order
RAP	Remedial Action Plan
RMP	Risk Management Plan
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
TPH	Total petroleum hydrocarbons
SAIC	Science Applications International Corporation
SMP	Soil Management Protocol
SPLP	Synthetic Precipitation Leaching Procedure
STLC	Soluble Threshold Limit Concentration
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resource Control Board
SVOCs	Semi-volatile Organic Compounds
TDS	Total Dissolved Solids

Acronyms and Abbreviations (continued)

TPH	Total Petroleum Hydrocarbons
TCLP	Toxicity Characteristic Leaching Procedure
TTLC	Total Threshold Limit Concentration
UCL	Upper Confidence Limit
WET	Waste Extraction Test
VOC	Volatile Organic Compounds
YBM	Young Bay Mud

1.0 INTRODUCTION

Science Applications International Corporation (SAIC), in consultation with BASELINE Environmental Consulting, Inc. (BASELINE), has prepared this Port-wide Soil Management Protocol (SMP) on behalf of the Port of Oakland (Port) to provide protocols for 1) characterization of soil excavated from Port-owned properties, including Oakland International Airport (OIA), Maritime, and Commercial Real Estate (CRE), 2) soil storage, and 3) soil reuse within Port-owned properties (**Figure 1**).

1.1 Background - Materials Management Program

The OIA and Maritime Materials Management Programs (MMP) provides for concrete and asphalt generated from construction projects on Port property to be transported to centralized designated locations on other Port-owned property, and then processed in order to produce various types of construction aggregates. The aggregates are then recycled back into Port construction projects. The MMP at the OIA and Maritime areas were evaluated separately for potential environmental impacts in accordance with the California Environmental Quality Act (CEQA).

In September of 2004, the Board of Port Commissioners (Port Board) adopted the *OIA MMP Initial Study/Mitigated Negative Declaration* (IS/MND) (Port, 2004) which evaluated the potential environmental impacts associated with the Phase I operations of the OIA MMP. Phase I operations included on-site processing and stockpiling of clean concrete rubble, asphalt rubble and grindings, vegetation, and excavated soil from OIA construction projects at designated OIA Materials Management Sites (MMS). Stockpiled materials were then reused on construction projects on OIA property.

In March 2005, the Port Board adopted the *Subsequent OIA MMP IS/MND* (Port, 2005b) which expanded the OIA MMP to include stockpiling, handling, and processing of clean concrete rubble, asphalt rubble and grindings, vegetation, and excavated soil from the Port Maritime area and the CRE area. The Subsequent IS/MND also further defined the OIA soil reuse requirements to be soil that is considered nonhazardous waste (i.e., below Federal and State hazardous waste thresholds) and is shown to have contamination concentrations below the current San Francisco Bay Regional Water Quality Control Board (RWQCB) Commercial/Industrial Environmental Screening Levels (ESLs) and Lawrence Livermore National Laboratory background levels for arsenic and cobalt (LBNL, 2002).

An *Addendum to the Subsequent OIA MMP IS/MND* was completed in December 2006 (Port, 2006), further expanding the OIA MMP to allow the Port to obtain clean concrete, asphalt rubble and grindings from construction projects outside Port-owned properties, and to process and stockpile these materials at the OIA MMS for reuse within the OIA area or sell the material to outside contractors.

In November 2007, the Port Board adopted the *Maritime MMP IS/ND* (Port, 2007), further expanding the Port MMP operations to the Maritime area. The Maritime IS/ND evaluated the potential environmental impacts associated with the implementation of the Maritime MMP at three Maritime MMS located in the Port's Maritime area. Maritime MMP operations include stockpiling and processing of concrete rubble, asphalt rubble, asphalt grindings, and soil generated from Port and Port-tenant projects in the Maritime area, including the Oakland Army Base (OAB) and other construction projects on Port-owned properties. The Maritime MMP also provides for the issuance of Non-Exclusive Supply Agreements (Supply Agreements) to contractors working outside the Port-owned properties. Under these Supply Agreements, the Port may obtain, process, and stockpile clean concrete, asphalt rubble and asphalt grindings at designated MMS areas from construction projects outside Port-owned properties. Processed materials stockpiled at the Port MMS areas can then be reused on Port property.

The MMPs provide for soil generated from Port and Port-tenant projects to be stockpiled and processed at the MMS areas for reuse as clean fill on Port property. The OIA Subsequent IS/MND defined soil reuse requirements which subsequently lead to the development of the OIA MMP Soil Management Protocol (OIA SMP), finalized in October 2005 (Port, 2005b). The OIA SMP specifies the protocols used by the Port and its contractors to ensure excess soil excavated from OIA construction projects and stockpiled at the OIA MMS do not pose a potential threat to human health and the environment during storage or after reuse within the OIA area.

With the expansion of the MMP to the Maritime area, the Port determined that developing a Port-wide SMP to replace the OIA SMP, best addresses soil management and reuse practices within Port-owned property. As a result of the expansion of the SMP, in August 2008, the Port prepared *Addendum No. 2 to the Subsequent IS/MND for the OIA MMP* (Port, 2008b) and an *Addendum to the IS/ND to the Maritime MMP* (Port, 2008a).

The following sections provide specific protocols for characterization and evaluation of soil excavated from Port-owned properties, including the OIA, Maritime, and CRE areas, and protocols for subsequent storage and reuse of suitable soil at the Port.

1.2 Port Land Use, Geology and Hydrogeology

As shown on **Figure 1,** the Port encompasses an area of land comprised of three distinct divisions. The OIA consists of approximately 2,500 acres in the southwestern portion of the City of Oakland. The OIA consists of the north field and south field **(Figure 2)**. The Maritime area consists of 19 miles of waterfront and more than 900 acres of marine terminal facilities located in the northwest portion of the City of Oakland **(Figure 3)**. The Maritime area currently contains ten major container terminals and two intermodal rail facilities. The City of Oakland General Plan Land Use and Transportation Element (City of Oakland, 2008) designates both the OIA and Maritime areas as General Industrial/Transportation and the areas are zoned as industrial and commercial. The CRE area is over 1,000 acres of land along the Oakland Estuary and includes Jack London Square, the Hegenberger Corridor, and the Oak Street to Ninth Street project **(Figure 4)**. Other CRE-managed property borders the waterfront from Jack London Square to the Airport, supporting land uses such as marinas, industrial, retail, office and public access at Embarcadero Cove, the Business Park, and the Distribution Center.

The hydrogeologic regime of Port lands is dominated by proximity to the Bay margin. The following provides a generalized discussion of the typical geology and hydrogeology underlying Port lands.

The subsurface soils throughout the Port typically consists of artificial fill overlying soft to medium stiff bay clays (Young Bay Mud [YBM]), dense sands (Merritt Sand), and stiff clays and silt (Old Bay Mud [OBM]). The fill consists of either terrestrially derived fill or marine-derived fill. The fill is underlain in places by YBM and/or the Merritt Sands. The Merritt Sands extend beyond 50 feet below ground surface (bgs). Beneath the Merritt Sands is the OBM which consists of very stiff fat clay with a limited number of interbedded medium stiff and hard clay layers. Beneath the OBM deposits are the sediments of the Alameda Formation, which consists of interlayered and discontinuous sandy soils within a clay matrix.

State Water Resource Control Board (SWRCB) *Resolution 88-63: Sources of Drinking Water* (SWRCB, 2006) states that groundwaters of the state are considered to be suitable, or potentially suitable, for municipal or domestic water supply with the exception of certain waters, including those for which total dissolved solids (TDS) exceed 3,000 milligrams per liter (mg/L) and it is not reasonably expected by Regional Boards to supply a public water system. In June 1999, the RWQCB Groundwater Committee completed its *East Bay Plain Groundwater Basin Beneficial Use Evaluation Report* (Report) (RWQCB, 1999). The Report stated that in the Oakland Shoreline/Alameda Point Brackish Shallow Groundwater Zone ("Oakland Shoreline Zone"), shallow bay-front groundwater in the artificial fill, YBM and San Antonio/Merritt Formations generally exceeds the 3,000 mg/l TDS criteria and, therefore, dedesignation of the municipal beneficial use in this area is warranted. The Report recommended that the Oakland Shoreline Zone existing municipal (MUN) beneficial use designation be dedesignated. This is an area that includes the Fleet and Industrial Supply Center of Oakland (FISCO) Navy Base, Port of Oakland, and Alameda Point. For this area, the Report states that "most groundwater to a depth of 100 feet below ground surface is not a [RWQCB] Resolution No. 89-39 source of drinking water."

2.0 PORT-WIDE SOIL MANAGEMENT PROTOCOL

2.1 Soil Management Protocol Overview

This Port-wide SMP defines the Port's soil sampling, analysis, and evaluation requirements to demonstrate whether excavated soil from Port-owned property would or would not be suitable for reuse on Port properties. Soil would be considered to be suitable for reuse if it is not a hazardous waste according to Federal (Resource Conservation and Recovery Act [RCRA]) and State hazardous waste thresholds, and chemical concentrations are below applicable ESLs or background levels. Only soil that has been determined to be suitable for reuse may be transported to a Port MMS for storage or reused on Port-owned properties. This document includes protocols for characterization of soil at the point of origin (Source Site), management procedures at the MMS stockpile areas or construction stockpile areas (Storage Site), and placement of soils at the Port-owned locations where soil will be reused for fill (Reuse Site).

Except for arsenic and chromium VI, the SMP uses the Commercial/Industrial ESLs developed by the RWQCB in *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater - Interim Final* (Table B) (RWQCB, 2008), as updated, for shallow soils, for sites where groundwater is not a potential drinking water source. Table B Commercial/Industrial ESLs are intended to be protective of aboveground, long-term commercial/industrial workers and the environment, but not necessarily protective of construction/trench workers who may come into direct contact with the soil. Arsenic and chromium VI have lower ESLs intended for the protection of Construction/Trench Workers (Table K-3) than ESLs for Commercial/Industrial Workers (Table B). For chromium VI, the ESL that is protective of Construction/Trench Workers (0.53 milligram per kilogram [mg/kg]) is used in this SMP (versus 8.0 mg/kg for commercial/industrial land uses). For arsenic, the Port conducted a study of arsenic concentrations in fill and native materials throughout the Port area (Appendix D). As a result, two arsenic values are used instead of the ESLs in this SMP: one arsenic background value for fill (16.4 mg/kg) and a second arsenic value for native materials (5.6 mg/kg).

The set of ESLs and background concentration for arsenic used in this SMP to evaluate suitability of soil for reuse are presented on **Table 1**. See the RWQCB ESL document (Table B and Table K-3) for a complete list of ESLs.

Depending on the concentrations of metals and organics in the soil proposed for reuse, the Synthetic Precipitation Leaching Procedure ("SPLP"), using EPA Method 1312, may also be employed for analysis of samples, if the 95% UCL of the mean exceed specific contaminant ESLs.

Soil from Source Sites or Storage Sites will be reused on Reuse Sites within Port-owned land. Reuse Sites must be sites that have undergone the Port's planning process including obtaining local, state, and/or federal permits and have been subject to CEQA and/or National Environmental Protection Act (NEPA) review, as applicable.

All Reuse Sites may receive excavated soil deemed suitable for reuse in accordance with the Port-wide SMP with the exception of particular areas described in Section 2.4, which may have additional reuse restrictions.

The following further defines the SMP protocols for all Source Sites, Storage Sites, and Reuse Sites at the Port.

2.2 Source Site Protocol

2.2.1 Excavated Soils

Excavation for construction activities Port-wide are expected to generate three general types of materials (depending on the depth of excavation): artificial fill, YBM, and/or native sediments underneath the YBM. These types of materials will exhibit different chemical characteristics. The chemical characteristics of the artificial fill may be related to the source of the fill and historic or current land uses. The chemical characteristics of the YBM and the native sediments may have been affected by historic or current land uses, contaminated groundwater, and/or leaching of contaminants from overlying contaminated artificial fill.

In order to reuse the soil, this SMP requires that each type of material to be excavated from a given Source Site must be segregated and characterized separately in a representative manner. This requires both identification of the chemicals of potential concern (COPCs) for each type of material excavated, and the implementation of an appropriate sampling methodology, in terms of both the number of samples and choice of sample locations.

2.2.2 Identify Chemicals of Potential Concern

COPCs shall be determined by either conducting a Phase I Environmental Site Assessment (Phase I ESA) or analyzing a pre-determined list of analytes. These two options are further described below:

a. The Port must conduct a Phase I ESA in substantial compliance with American Society of Testing and Materials Standards (ASTM) for Phase I Site Assessment (ASTM Standard E1527-05, or current version). The COPCs must reflect the potential for historic or current land uses to have used, stored, generated, or disposed of hazardous materials. The Port shall develop a list of COPCs for each type of material to be excavated (i.e., artificial fill, YBM, and/or native sediments). Representative samples of each type of excavated material shall be analyzed for all the required COPCs and any COPCs identified in the Phase I ESA. Sample analyses shall be performed by a California-certified laboratory, certified to conduct the specific analyses. See Section 2.2.3 for a detailed list of approved Environmental Protection Agency (EPA) Methods and analytical requirements.

If the Phase I ESA findings suggest the potential presence of compounds not detected by the methods listed below, those compounds will also be analyzed using applicable EPA Method(s) contained in the U.S. EPA document, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Chapter 9, dated 1986, as updated (SW-846) (U.S. EPA, 1986).

Or

b. If a Phase I ESA is not conducted, soil samples must be analyzed for the complete suite of organic and inorganic compounds listed in Section 2.2.3, below and assumed to be: volatile organic compounds (VOCs) associated with fuels, specifically benzene, toluene, ethylbenzene, xylenes (BTEX), and methyl tert-butyl ether (MTBE); semi-volatile organic compounds (SVOCs), specifically polycyclic aromatic compounds (PAHs), volatile and extractable total petroleum hydrocarbons (TPH) (as gasoline, as diesel, and as motor oil), and Title 22 metals. In addition, TPH as bunker C fuel is considered a COPC at Maritime sites and TPH as jet fuel is considered a COPC at OIA sites. Representative samples of each type of excavated material will be analyzed per the list of approved EPA Methods below for all of these compounds. Section 2.2.4 describes the guidance for collecting representative samples in accordance with this SMP.

2.2.3 Determine Analytical Requirements

For the COPCs that are identified for analysis pursuant to Section 2.2.2.a or that are required to be analyzed pursuant to Section 2.2.2.b, soil samples must be analyzed for those COPCs following the analytical method(s) listed below:

Minimum Analytical Testing Program

PAHs by EPA Method 8310 or 8270C
Title 22 metals by EPA Methods 6010B/7000 series
TPH (as gasoline, as diesel, and as motor oil [with silica gel cleanup for extractable hydrocarbons]) by EPA Method 8015M
BTEX and MTBE by EPA Method 8021B or 8260B
Toxicity Characteristic Leaching Procedures (TCLP) by EPA Method 1311 (as needed)
Waste Extraction Test (WET) Procedures by Title 22 CCR, Section 66261, Appendix II (as needed)
Synthetic Precipitation Leaching Procedure (SPLP) by EPA Method 1312[1] (as needed)

Additional Analytical Testing Program Based on Site Location and Previous Uses

VOCs by EPA Method 8260B
SVOCs EPA Method 8270C
PCBs by EPA Method 8082
TPH as bunker C fuel (required at Maritime sites) by EPA Method 8015M
TPH as jet fuel (required at all OIA sites) by EPA Method 8015M
Organochlorine pesticides by EPA Method 8081A
Chlorinated herbicides by EPA Method 8151A
Cyanide by EPA Method 335.2
Dioxin by EPA Method 8280

Note that it will be necessary to also analyze samples for chromium VI, in addition to total chromium, if the total chromium concentration, determined by EPA Method 6010B, exceeds the ESL

[1] SPLP is used to evaluate the potential for leaching metals into ground and surface waters. This method provides a realistic assessment of metal mobility under actual field conditions.

criterion for chromium VI in **Table 1**. See Section 2.2.5 for further discussion of hazardous waste testing criteria to be used to determine if soil is a non-hazardous waste for disposal purposes.

2.2.4 Determine Sampling Strategy and Collect Samples

Soil sampling frequency for excavated soils has been selected to be consistent with the Department of Toxic Substances Control (DTSC) guidance document, *Information Advisory, Clean Imported Fill Material* (DTSC, 2001), as is listed below.

Volume of Excavated Soils (for each type of excavated material)	**Number of Discrete Samples**
Up to 1,000 cubic yards	1 sample per 250 cubic yards, with a minimum of 4 samples
Between 1,000 and 5,000 cubic yards	4 samples for first 1,000 cubic yards, plus 1 sample per additional 500 cubic yards
Greater than 5,000 cubic yards	12 samples for first 5,000 cubic yards, plus 1 sample per additional 1,000 cubic yards

Soil sampling can be performed in-situ or from stockpiled material. The sampling scheme may be systematic, systematic random, or random, but must be representative of each type of material in accordance with either the SW-846 guidance or the EPA's *RCRA Waste Sampling Draft Technical Guidance, Planning, Implementation, and Assessment* (EPA, 2002).

If feasible, the excavated soil will be segregated in separate stockpiles by type of material (i.e., artificial fill, YBM, and/or native coarser-grained sediments) and stockpiles will be configured to facilitate volume estimation and sample collection. Samples will be collected that are representative of the entire depth of the stockpiles. If a Source Site contains one or more suspected contaminant source areas (e.g., sumps, oil/water separators, vehicle maintenance areas, underground tanks), the excavated soil from each of the suspected contaminant source areas will be stockpiled and sampled separately to define the extent of possible contamination.

All soil sampling activities will be conducted in accordance with a site-specific Health and Safety Plan (HASP) meeting the requirements of Title 8 California Code of Regulations (CCR) Section 5192 for the protection of construction workers. Compliance with these requirements may also be applicable for excavation or other soil handling activities if workers may be exposed to contaminants in the soil. The site-specific HASP will include monitoring requirements to ensure that contaminant levels do not exceed action levels for specific contaminants at the site boundary, as appropriate.

Sample collection, handling, and decontamination procedures will be conducted in a manner consistent with current industry practices. Investigation-derived wastes (IDW) in volumes of 5,000 cubic yards or more will be analyzed for compliance with Commercial ESLs to determine if eligible for disposal at a designated MMS or Reuse Site. IDW of lesser volumes will be characterized and disposed of at an offsite permitted facility, as appropriate.

2.2.5 Determine Suitability of Soil for Reuse

Once the soil quality data have been collected and the chemical characteristics of the excavated soil (or soils already stockpiled at the Source Sites) have been determined, two categories of criteria will be used to determine whether excavated soils are suitable for transport and storage at a Storage Sites and/or subsequent reuse on a Reuse Site. The first criterion is that soil must be determined to be a non-hazardous waste[2] for disposal purposes; the second criterion is that concentrations of COPCs must not exceed applicable ESLs or background concentration for arsenic, as explained in Section 2.1, above, and listed in Table 1.

a. Non-Hazardous Waste Criterion

The Port must determine whether each type of excavated soil is a non-hazardous waste (i.e., below Federal and State hazardous waste thresholds). The maximum concentration of any 22 CCR 66261.24(a)(1)(B), Table I compound, determined to be a COPC, identified in samples collected from any type of excavated material must be below the Table I "regulatory level" value for that compound. The maximum total concentration of any 22 CCR 66261.24(a)(2)(A) and (B), Table II and Table III compound, determined to be a COPC, identified in samples collected from a type of excavated material must be below the Table II and Table III total threshold limit concentration (TTLC) value for that compound. In addition, if the total concentrations indicate the potential for the soluble threshold limit concentrations (STLC) to exceed State hazardous waste thresholds then soluble concentrations need to be determined, and the soluble concentration of any 22 CCR 66261.24(a)(2)(A) and (B), Table II and Table III compound, determined to be a COPC, identified in samples collected from a type of excavated material must be below the Table II and Table III STLC value for that compound (**Table 2**). If a soil passes these requirements, then the excavated soil will have met the non-hazardous waste criterion.[3]

Or

If the maximum concentration of a compound in any sample of a given type of excavated soil exceeds Federal or State hazardous waste thresholds (either total or soluble concentrations), then the 90% upper confidence limit (UCL) (one-tailed)[4] of the data will be calculated, based on the methodology in EPA Guidance *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (U.S. EPA, 2002), and using appropriate formulas or software, such as the ProUCL software provided by the EPA. The 90% UCL will be compared to Federal or State hazardous waste thresholds. If

[2] For purposes of this document, *non-hazardous waste* means the soil cannot be a RCRA-listed waste or considered hazardous based on toxicity.

[3] This assumes that the soils are not reactive, corrosive, or ignitable. If generator knowledge indicates the potential for the soils to be a hazardous waste due to these characteristics, additional analyses would need to be performed to determine that the soils are non-hazardous.

[4] The 90% one-tailed UCL is numerically equivalent to the 80% two-tailed UCL.

the 90% UCLs for these compounds for a given type of excavated soil are below Federal or State hazardous waste thresholds, then the excavated soil will be considered to have met the non-hazardous waste criterion. See Section 2.2.6 for additional information on ProUCL.

b. ESL Criterion

A multi-step evaluation, as illustrated in **Figure 5**, is required to determine whether the chemical concentrations in samples of each type of excavated soil meets the applicable ESLs or background concentration for arsenic in **Table 1**, as updated. If all the results are below the ESLs as shown in **Table 1**, then the soil can be reused without further evaluation.

Or

If any one or more samples are above their respective ESLs or background concentration for arsenic, then the 95% UCL (one-tailed) of the data must be calculated. If the 95% UCL or the maximum concentration for all compounds analyzed for a given type of soil is below the values in **Table 1**, the soil will be considered to have met the ESL criterion for transport to a Storage Site, and reuse at a Reuse Site.

Or

If the 95% UCL for any compound exceeds the ESLs or background concentration for arsenic in Table 1, then the samples with the four highest concentrations of that compound will be extracted using the SPLP by EPA Method 1312 and analyzed for that compound. The maximum or 95% UCL soluble concentration for these samples will be compared to the ESLs for groundwater that is not a drinking water source in **Table 1**. If the maximum or 95% UCL soluble concentration does not exceed the groundwater ESLs in **Table 1**, the soil will be considered to have met the ESL criterion for transport to a Storage Site, and/or subsequent reuse at a Reuse Site.

Only soils that meet both the ESL criteria (and arsenic background concentration) and have been demonstrated to not be Federal or State hazardous wastes may be transported to a Storage Site and/or subsequent reuse on a Reuse Site on Port-owned properties. Soils that fail to meet one or both criteria will be profiled for off-site disposal at a permitted facility. Data for profiling will be either from in-place sampling or sampling from a stockpile and will comply with the requirements of SW-846 for collection of representative sampling and of the specific disposal facility. Compliance with the SMP evaluation does not necessarily fulfill requirements of the specific disposal facility. The Port maintains a list of designated disposal facilities. If the soils fail to meet the reuse criteria, the RWQCB will be notified in writing by the Port about the location of characterized soil that did not meet the reuse criteria and the associated results from the analytical testing.

Appendix A of this SMP provides an example of one way that the SMP process is implemented. Each site is distinct and will have unique requirements for the number of samples and analysis.

Investigations and characterization of excavated soils from Source Sites and the evaluation of whether the excavated soils meet the reuse criteria, as described above, will be documented by the Port. The Port will confirm Soil Source Site characterization and documentation prior to the transport to Storage Sites and ultimate placement of these soils at Reuse Sites, as detailed in Section 2.5 SMP Documentation and Reporting Protocol, below.

2.2.6 ProUCL Information

ProUCL 4.0 can be downloaded from EPA's Technical Support Center website at http://www.epa.gov/nerlesd1/tsc/tsc.htm. The same website can be used to download ProUCL 4.0 User Guide, Technical Guide and Fact sheet. The website contains download and usage instructions.

The TSC website at http://www.epa.gov/nerlesd1/tsc/tsc.htm provides additional information. EPA technical issue papers used in the development of ProUCL are also available at the EPA TSC website. A Fact Sheet for ProUCL 4.0 is included as **Appendix B** of this document.

2.3 Storage Site Protocol

After the characterization and evaluation protocols, described in Section 2.2, have been completed and the Port determines that the soil is suitable for reuse, soil from a Source Site may be transported to a Reuse Site directly or transported and stored at a Storage Site. A Storage Site will be one of the approved MMS's, as defined in the MMP, or a temporary construction stockpile area on Port property.

The SMP requires management of soil stockpiles to ensure that the soil does not migrate, by wind or water, to off-site areas, and does not have the potential to affect water quality, biological resources, or public health. In addition, the MMP requires the Port contractor operating a designated MMS to prepare and implement a storm water pollution prevention plan (SWPPP). The Port is responsible for inspecting the MMS areas on a regular basis to determine contractor compliance and documentation of SWPPP compliance. When a contractor is not actively present at a MMS or temporary construction stockpile area, the Port Environmental Programs and Planning (EP&P) Division will have the responsibility for compliance with a site-specific SWPPP.

Soils at Storage Sites will remain stockpiled until transported to Reuse Sites when fill is needed. The Port will document all soils transported to and stockpiled at the Storage Sites, as well as the ultimate placement of these soils at Reuse Sites as detailed in the Section 2.5 SMP Documentation and Reporting Protocol, below.

2.4 Reuse Site Protocol

The MMP allows for soil excavated from Port-owned properties to be transported to MMS stockpile areas or to Reuse Sites where the suitable soil will be reused for fill. As summarized in Section 2.2 above, the Source Site Protocol requires that only soil that has been fully characterized and demonstrated to not be a Federal or State hazardous waste and to meet applicable ESLs (and arsenic background concentration) for COPCs may be transported either to a Storage Site or directly to a Reuse Site.

Soils found to be suitable for reuse in accordance with this SMP may be reused at Reuse Sites without further evaluation with the exception of the following:

a. Port-owned properties in the CRE area; soils cannot be reused in the CRE area, since portions of this area may in the future be redeveloped for residential use.

b. Soils from Port-owned properties with Land Use Covenants (LUCs), Risk Management Plans, Regulatory Agency Orders (RAOs), or under active regulatory oversight - placement of reuse soils at these sites would need to be determined on a site-specific basis, which may involve coordination with the applicable regulatory agency. **Appendix C** contains a list of Port-owned sites with regulatory constraints or recorded LUCs.

c. The OAB, which has LUCs. Soil reuse at the OAB must comply with requirements specific to the OAB, including, without limitation, the Remedial Action Plan (RAP)/ Risk Management Plan (RMP), and any requirements imposed by DTSC, which may differ from the SMP.

Soils from Port-owned properties identified above (i.e., from the CRE area, Port-owned properties with LUC, RMPs, RAOs, sites under active regulatory oversight, or in the OAB) may be acceptable for reuse on other Port-owned properties following the assessments described in this SMP. However, acceptability of soils from those Port-owned properties, listed above, for reuse, will require determination on a site-by-site basis.

Soils will only be placed at Reuse Sites in areas where soils cannot be eroded by wind or wave action into adjacent surface waters. In addition, reuse Sites must be sites that have undergone the Port's planning process including obtaining local, state, and/or federal permits and have been subject to CEQA and/or National Environmental Protection Act (NEPA) review, as applicable.

The Port will document the placement of soils from Storage Sites to Reuse Sites as detailed in Section 2.5 SMP Documentation and Reporting Protocol below.

2.5 Soil Management Protocol Documentation and Reporting Protocol

The MMP is overseen by the Port-designated MMP Coordinator. Responsibilities include management of MMS operations, scheduling and tracking contractor disposal and reuse activities, and ensuring documentation and reporting of the MMP operations. Other core team members include a Construction Administrator and MMP Assistant to support MMS field operations, documentation, and compliance. Through the implementation of field operations and procedures, the Port on-call crushing contractors are responsible for the day-to-day material disposal, aggregate production and reuse activities at the MMS areas. The operating procedures for the MMP include soil inspection, stockpiling, tracking, and contractor documentation for soil transported to the MMS for storage. Key requirements include ensuring that Port and contractors delivering soil to the MMS receive authorization prior to all trucking activities, and adhere to Source Site, Storage Site, and Reuse Site documentation requirements in accordance with this SMP. See Sections 2.2, 2.3, 2.4, and 2.5 of this SMP which sections provide documentation requirements for Source Sites, Storage Sites, and Reuse Sites.

2.5.1 Soil Source Site, Storage Site, and Reuse Site Documentation

Investigations and characterization of excavated soils from Source Sites and the evaluation of whether the excavated soils meet the storage and reuse criteria, as described above, will be documented in technical reports prepared by licensed professionals by or on behalf of the Port or Port tenants. Reports will include, at a minimum, figures showing site location and sampling locations, tables summarizing the analytical results compared to the two reuse criteria described in Section 2.2.5, UCL data inputs and outputs, and laboratory analytical reports with chain-of-custody documentation. The reports will be provided to the Port MMP Coordinator for review and confirmation of compliance with the SMP.

In order to provide complete documentation of the Source Site material, volume, type, and characterization, the Port will maintain a tracking system to document the volume of soil received at and removed from the Storage Sites and the volume of soil transported directly from a Source Site to a Reuse Site. Information entered into the tracking system will be obtained from truck tags which at a minimum include the following:

<u>Transport of Soil from Source Site to Storage Site</u>

1. Name or identification of Source Site
2. Name or identification of Storage Site
3. Date of receipt at the Storage Site
4. Type and volume of each type of material transported to the Storage Site (i.e., artificial fill, Bay Mud, and/or coarse-grained native sediments).

<u>Transport of Soil from Storage Site to Reuse Site</u>

1. Name or identification of Storage Site
2. Name or identification of Reuse Site
3. Date of transport to Reuse Site
4. Type and volume of each type of material transported to the Reuse Site

Transport of Soil from Source Site to Reuse Site

1. Name or identification of Source Site
2. Name or identification of Reuse Site
3. Date of transport to Reuse Site
4. Type and volume of each type of material transported to the Reuse Site

2.5.2 Annual Reporting to the RWQCB

By January 31st of each year, the Port MMP Coordinator will prepare and submit an SMP Annual Report to the RWQCB documenting the excavated soils from Source Sites transported to either a Storage Site or Reuse Site.

2.5.3 Additional Information or Assistance

For information on this SMP or assistance in implementing the required protocols please contact:

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Environmental Programs and Planning Division
530 Water Street
Oakland, California 94607
510-627-1184
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3.0 REFERENCES

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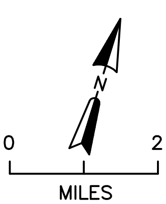
Figures

Legend:

- Maritime Area
- CRE Area
- OIA Area

Note: Boundaries are approximate. Confirm property type and any restrictions.



SAIC From Science to Solutions

TITLE:	DWN:	DES.:	PROJECT NO.:
Figure 1 Port of Oakland Vicinity Map	CNF	CNF	06-5026-00-9052
	CHKD: SP	APPD: KP	FIGURE NO.: 1
	DATE: 04/08/2008	REV.: 02	

Legend:

Oakland International Airport (OIA) Boundary

Materials Management Sites (MMS)

- A 65-Acre Site (Site A-1 and A-2)
- B Site B
- C Eden Road Site
- D Site D5

0 0.5
MILES

SAIC From Science to Solutions

TITLE:
Figure 2
Port of Oakland
Oakland International Airport and Materials Management Sites

DWN: CNF	DES.: CNF	PROJECT NO.: 06-5026-00-9052
CHKD: SP	APPD: KP	FIGURE NO.: 2
DATE: 04/08/2008	REV.: 02	

Legend:

Port Maritime Area

Port Oakland Army Base (OAB) Area

Maritime Materials Management Sites (MMS)

1. MMS OAB Package A Site
2. MMS Berth 10 Site
3. MMS Maritime Service Center Site

Restricted Areas *Note: Import or export of soil from the Restricted Areas may need to follow a different and/or more stringent protocol.*

N

0 0.5
MILES

SAIC
From Science to Solutions

TITLE:	DWN:	DES.:	PROJECT NO.:
Figure 3 Port of Oakland Maritime Materials Management Sites	CNF	CNF	06-5026-00-9052
	CHKD: SP	APPD: KP	FIGURE NO.: 3
	DATE: 04/08/2008	REV.: 01	

Legend:

Commercial Real Estate Area

Note: Boundaries are approximate. Confirm property type and any restrictions.

0 0.5
MILES

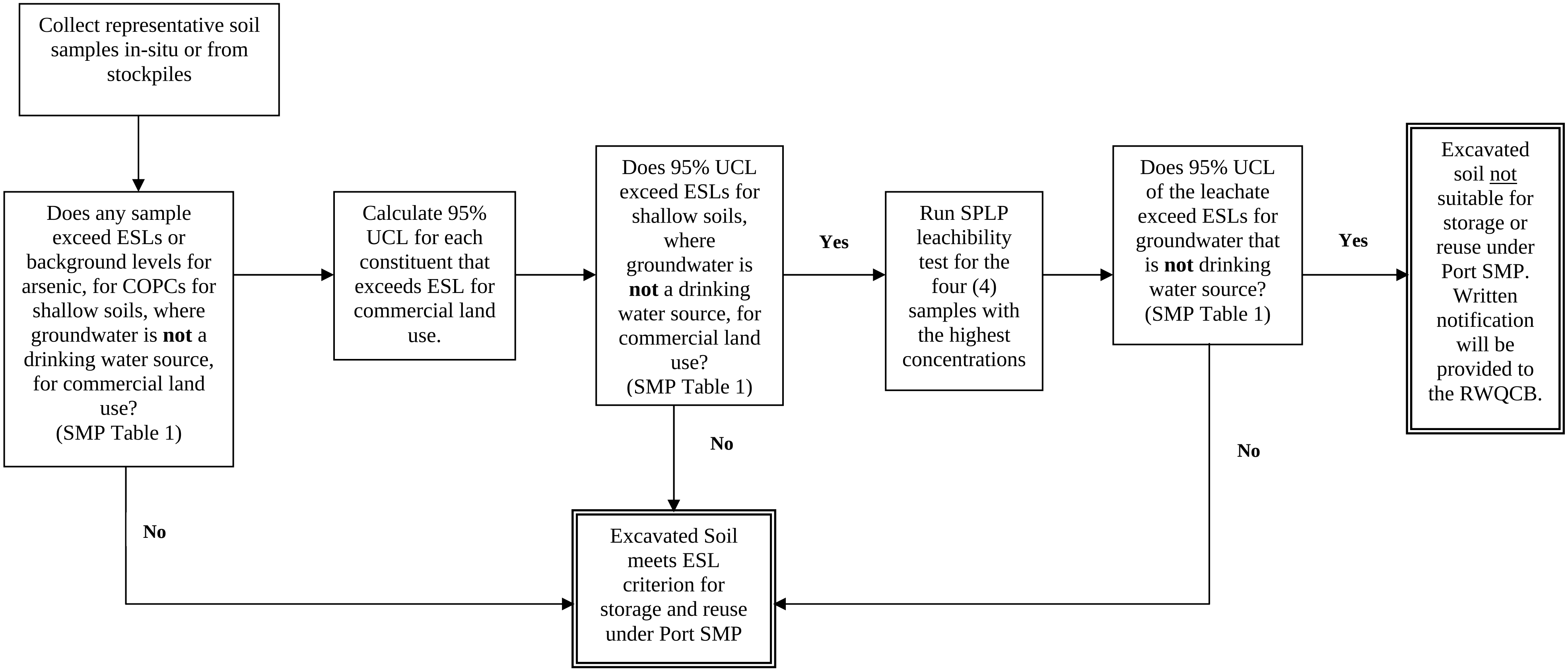
Source: Port of Oakland Geomatics Group, 2008

SAIC
From Science to Solutions

TITLE:
Figure 4
Port of Oakland
Commercial Real Estate Vicinity

DWN: CNF	DES.: CNF	PROJECT NO.: 06-5026-00-9052
CHKD: SP	APPD: KP	FIGURE NO.: 4
DATE: 04/08/2008	REV.: 02	

Port of Oakland, Soil Management Protocol
Figure 5
Decision Flowchart for Soil Storage and Reuse to Demonstrate Compliance with RWQCB Commercial ESLs



Notes:

RWQCB = Regional Water Quality Control Board

ESL – Environmental Screening Levels (RWQCB, 2008)

ESLs are from RWQCB, 2008 Tables B and K-3, and arsenic from BASELINE (2008)reproduced in Port SMP Table 1.

UCL - Upper Confidence Level

Tables

CHEMICAL PARAMETER	**RWQCB ESLs for Shallow Soils**[1] Groundwater is NOT Drinking Water Source - Commercial Land Use (mg/kg)	**RWQCB ESLs for Groundwater**[1] Groundwater is NOT Drinking Water Source (μg/L)
Acenaphthene	19	23
Acenaphthylene	13	30
Acetone	0.50	1500
Aldrin	0.13	0.13
Anthracene	2.8	0.73
Antimony	40	30
Arsenic	16.4/5.6 [2]	36
Barium	1,500	1,000
Benzene	0.27	46
Benzo(a)anthracene	1.3	0.027
Benzo(b)fluoranthene	1.3	0.029
Benzo(k)fluoranthene	1.3	0.40
Benzo(g,h,i)perylene	27	0.10
Benzo(a)pyrene	0.13	0.014
Beryllium	8.0	0.53
1,1-Biphenyl	6.5	5.0
Bis(2-chloroethyl) ether	0.16	12
Bis(2-chloroisopropyl) ether	0.077	12
Bis(2-ethylhexyl) phthalate	120	32
Boron	2.0	1.6
Bromodichloromethane	1.3	170
Bromoform (Tribromomethane)	24	1,100
Bromomethane	2.3	160
Cadmium	7.4	0.25
Carbon tetrachloride	0.044	9.3
Chlordane	1.7	0.0040
p -Chloroaniline	0.053	5.0
Chlorobenzene	1.5	25
Chloroethane	0.85	12
Chloroform	1.5	330
Chloromethane	6.4	41
2-Chlorophenol	0.12	1.8
Chromium (total)	--	180
Chromium III	750	180
Chromium VI	0.53 [3]	11
Chrysene	23	0.35
Cobalt	80	3.0
Copper	230	3.1
Cyanide	0.0036	1.0
Dibenz(a,h)anthracene	0.21	0.25
Dibromochloromethane	14	170
1,2-dibromo-3-chloropropane	0.0045	0.20
1,2-Dibromoethane	0.044	150
1,2-Dichlorobenzene	1.60	14
1,3-Dichlorobenzene	7.4	65

RWQCB 2008 ESLs may be periodically updated by RWQCB.
Future updated values must be reviewed and confirmed with the Port.

CHEMICAL PARAMETER	**RWQCB ESLs for Shallow Soils**[1] Groundwater is NOT Drinking Water Source - Commercial Land Use (mg/kg)	**RWQCB ESLs for Groundwater**[1] Groundwater is NOT Drinking Water Source (μg/L)
1,4-Dichlorobenzene	1.8	15
3,3-Dichlorobenzidine	2.4	250
Dichlorodiphenyldichloroethane (DDD)	10	0.0010
Dichlorodiphenyldichloroethene (DDE)	4.0	0.0010
Dichlorodiphenyltrichloroethane (DDT)	4.0	0.0010
1,1-Dichloroethane	1.9	47
1,2-Dichloroethane	0.48	200
1,1-Dichloroethene	4.3	25
cis -1,2-Dichloroethene	18	590
trans -1,2-Dichloroethene	34	590
2,4-Dichlorophenol	3.0	3.0
1,2-Dichloropropane	1.0	100
1,3-Dichloropropene	0.36	24
Dieldrin	0.0023	0.0019
Diethyl phthalate	0.035	1.5
Dimethyl phthalate	0.035	1.5
2,4-Dimethylphenol	0.74	110
2,4-Dinitrophenol	0.042	15
2,4-Dinitrotoluene	0.86	115
1,4-Dioxane	30	50,000
Dioxin (2,3,7,8-TCDD)	0.000018	0.0000010
Endosulfan	0.0046	0.0087
Endrin	0.00065	0.0023
Ethylbenzene	4.69	43.00
Fluoranthene	40	8.0
Fluorene	8.9	3.9
Heptachlor	0.013	0.0036
Heptachlor epoxide	0.014	0.0036
Hexachlorobenzene	1.3	3.7
Hexachlorobutadiene	4.6	0.93
g-Hexachlorocyclohexane (Lindane)	0.010	0.02
Hexachloroethane	41	12
Indeno(1,2,3-c,d)pyrene	2.1	0.048
Lead	750	2.5
Mercury (elemental)	10	0.025
Methoxychlor	19	0.0030
Methylene chloride	17	2,200
Methyl ethyl ketone	13	14,000
Methyl isobutyl ketone	3.9	170
Methyl mercury	12	0.0030
2-Methylnaphthalene	0.25	2.1
tert -Butyl methyl ether	8.4	1,800
Molybdenum	40	240
Naphthalene	2.8	24
Nickel	150	8.2

RWQCB 2008 ESLs may be periodically updated by RWQCB.
Future updated values must be reviewed and confirmed with the Port.

CHEMICAL PARAMETER	**RWQCB ESLs for Shallow Soils**[1] Groundwater is NOT Drinking Water Source - Commercial Land Use (mg/kg)	**RWQCB ESLs for Groundwater**[1] Groundwater is NOT Drinking Water Source (μg/L)
Pentachlorophenol	5.0	7.9
Perchlorate	140	600
Phenanthrene	11	4.6
Phenol	3.9	260
Polychlorinated biphenyls (PCBs)	0.74	0.014
Pyrene	85	2.0
Selenium	10	5.0
Silver	40	0.19
Styrene	15	100
tert -Butyl alcohol	110	18,000
1,1,1,2-Tetrachloroethane	4.5	930
1,1,2,2-Tetrachloroethane	0.60	190
Tetrachloroethene	0.95	120
Thallium	16	4.0
Toluene	9.3	130
Toxaphene	0.00042	0.00020
TPH (gasolines)	180	210
TPH (middle distillates)	180	210
TPH (residual fuels)	2,500	210
1,2,4-Trichlorobenzene	7.6	25
1,1,1-Trichloroethane	7.8	62
1,1,2-Trichloroethane	1.1	340
Trichloroethene	4.1	360
2,4,5-Trichlorophenol	0.18	11
2,4,6-Trichlorophenol	10	97
Vanadium	200	19
Vinyl chloride	0.047	3.8
Xylenes	11	100
Zinc	600	81

Notes:

RWQCB = Regional Water Quality Control Board

ESLs = Environmental Screening Levels (RWQCB, 2008)

mg/kg = milligram per kilogram

mg/L = microgram per liter

[1] Source: Table B -Shallow Soils, Groundwater is not a Current or Potential Source of Drinking Water (RWQCB, 2008).

[2] Background concentrations of Port fill (16.4 mg/kg) and native materials (including YBM) (5.6 mg/kg) established by BASELINE (2008); refer to Appendix D.

[3] Source: Table K-3 - Direct Exposure Soil Screening Levels (RWQCB, 2008).

RWQCB 2008 ESLs may be periodically updated by RWQCB.
Future updated values must be reviewed and confirmed with the Port.

TABLE 2: Port of Oakland, Soil Management Protocol
California Hazardous Waste Threshold Levels

CHEMICAL PARAMETER	TTLC (mg/kg)	STLC (mg/L)
Aldrin	1.4	0.14
Antimony and/or antimony compounds	500	15
Arsenic and/or arsenic compounds	500	5
Asbestos	1.0 (as percent)	
Barium and/or barium compounds	10,000	100
Beryllium and/or beryllium compounds	75	0.75
Cadmium and/or cadmium compounds	100	1
Chlordane	2.5	0.25
Chromium (VI) compounds	500	5
Chromium and/or chromium (III) compounds	2,500	5
Cobalt and/or cobalt compounds	8,000	80
Copper and/or cooper compounds	2,500	25
DDT, DDE, DDD	1.0	0.1
2,4-Dichlorophenoxyacetic acid	100	10
Dieldrin	8.0	0.8
Dioxin (2,3,7,8-TCDD)	0.01	0.001
Endrin	0.2	0.02
Fluoride salts	18,000	180
Heptachlor	4.7	0.47
Kepone	21	2.1
Lead and/or lead compounds	1,000	5.0
Lead compounds, organic	13	--
Lindane	4.0	0.4
Mercury and/or mercury compounds	20	0.2
Methoxychlor	100	10
Mirex	21	2.1
Molybdenum and/or molybdenum compounds	3,500	350
Nickel and/or nickel compounds	2,000	20
Pentachlorophenol	17	1.7
Polychlorinated biphenyls (PCBs)	50	5.0
Selenium and/or selenium compounds	100	1
Silver and/or silver compounds	500	5.0
Thallium	700	7
Toxaphene	5	0.5
Trichloroethylene	2,040	204
2,4,5-Trichlorophenoxypropionic acid	10	1.0
Vanadium and/or vanadium compounds	2,400	24
Zinc and/or zinc compounds	5,000	250

Source: 22 CCR 66261.24(a)(2)(A) and (B)
Notes: TTLC = Total Threshold Limit Concentration.
STLC = Soluble Threshold Limit Concentration.
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

Appendix A - Example of Soil Management Protocol Evaluation Process

Appendix A

Example of Soil Management Protocol Evaluation Process

The following is a general example of how the SMP may be implemented to evaluate the acceptability of soil reuse at a Reuse Site. There are many ways to determine soil sampling locations and methods and each site will have a different number of soil samples and analyses required. Refer to guidance listed in Section 2.0 of the SMP.

Background:

Site X, located at the OIA will require the excavation of an area 300 feet long, 50 feet wide, and 10 feet deep near a runway. Previous investigations have shown that the soils within this excavation are all artificial fill; no known releases have been identified at the site and no land uses other than aircraft runway are known to have been located at the site.

Evaluation Process:

1. Determine analytical requirements (**Section 2.2.3**) - Since previous investigations have not shown elevated levels of COPCs or land uses other than runways, the samples will all be analyzed for the required analysis only.
2. Determine soil volume (**Section 2.2.4**) - As the excavation is expected to remove 150,000 cubic feet or approximately 5,555 cubic yards, 12 discrete samples are required to evaluate the soils for reuse pursuant to the SMP.
3. Determine sampling strategy (**Section 2.2.4**) - The Contractor has decided to collect samples systematically at approximately 5 feet bgs with the aid of a backhoe.
4. Confirm soil is not a Federal or State hazardous waste (**Section 2.2.5a**) - Upon review of the analytical results it was determined that all soil samples were neither a Federal nor State hazardous waste.
5. Determine if all soil is below the commercial ESLs (cESLs) (**Section 2.2.5b**) - The following samples exceeded their respective cESLs:
    - Two samples for TPH as gasoline;
    - One sample for lead; and
    - Three samples for zinc.

    The 95% UCL of TPH as gasoline, lead, and zinc were calculated for all samples. The 95% UCL for TPH as gasoline was below the cESLs, but the 95% UCL for lead and zinc exceeded its respective cESLs. As a result, the contractor would request that the lab conduct SPLP analysis for four samples with the highest concentrations of lead and zinc. Note the four samples with the highest concentrations may be different for each COPC.

All results for SPLP lead and zinc were below their respective cESLs for groundwater and therefore all the soil is considered to meet the criterion for storage and reuse under the SMP.

Appendix B – Fact Sheet for ProUCL 4.0

From Science to Solutions

Facts Sheet for ProUCL 4.0
A Statistical Software Package for Environmental Applications for Data Sets With and Without Nondetect Observations

Exposure assessment, risk assessment and management, and cleanup decisions at potentially polluted sites are often made based upon the mean concentrations of the contaminants of potential concern (COPCs). Typically, the mean concentration of a COPC at a contaminated site is unknown, and is frequently estimated by the sample mean based upon the data collected from the site areas under investigation. In order to address the uncertainties associated with the estimates of the unknown mean concentrations of the COPCs, appropriate 95% upper confidence limits (UCLs) of the respective unknown means are used in many environmental applications including the estimation of exposure point concentration (EPC) terms. The Technical Support Center (TSC), EPA Las Vegas, NV developed ProUCL Version 3.0 software package (EPA, 2004) to support risk assessment and cleanup decisions at contaminated sites based upon full data sets without nondetect observations (NDs). For data sets without NDs, ProUCL 3.0 has several parametric and nonparametric UCL computation methods as described in the revised EPA UCL Guidance Document for Hazardous Waste Sites (EPA, 2002a).

The Need for an Upgrade of ProUCL 3.0

Nondetect observations are inevitable in most data sets collected from the various environmental applications. The ProUCL 4.0 software package is an upgrade of ProUCL 3.0 software package, and provides several statistical methods that can be used on left censored data sets with nondetect observations potentially having multiple detection limits (DLs). ProUCL 4.0 is especially developed to address the various statistical issues arising in exposure and risk assessment studies, and also in background and site evaluation and comparison applications. All capabilities of ProUCL 3.0 have been retained in ProUCL 4.0. The TSC, EPA Las Vegas has revised the Background Guidance Document for CERCLA sites (EPA, 2002b). The revised background document includes some exploratory graphical methods to pre-process a data set, and a couple of new chapters describing the computations of parametric and nonparametric upper limits that are used to estimate the background level contaminant concentrations or background threshold values (BTVs), and other not-to-exceed values based upon data sets with and without ND observations.

It is noted that the methods to compute upper limits to estimate BTVs and not-to-exceed values are not easily available in any of the available software packages, especially for data sets with nondetect observations. ProUCL 4.0 can be used to compute various parametric and nonparametric upper limits often used to estimate environmental parameters of interest including the EPC terms, BTVs, and other not-to-exceed values. The BTVs and not-to-exceed values are also used for screening of contaminants of potential concern (COPCs). Typically, upper confidence limits (UCLs) are used to estimate the EPC terms; upper prediction limits (UPLs), upper tolerance limits (UTLs), or upper percentiles are used to estimate the BTVs and not-to-exceed values. ProUCL 4.0 can be used to compute those upper limits based upon full uncensored data sets without NDs and left-censored data sets with NDs having multiple DLs.

Additionally, ProUCL 4.0 offers several parametric and nonparametric single sample and two sample hypotheses testing approaches used in background versus site comparison studies. Those hypotheses testing approaches can be used on data sets with NDs and without NDs. ProUCL 4.0

also offers some useful graphical displays including histograms, multiple quantile-quantile (Q-Q) plots, and side-by-side box plots for data sets with and without ND observations. The graphical displays provide additional insight and information contained in data sets that cannot be revealed by the use of estimates (e.g., 95% UCLs) and test statistics such as goodness-of-fit (GOF) test statistics, t-test statistic, Rosner test, and various other statistics. In addition to providing information about the data distributions (e.g., normal, lognormal, gamma), the graphical Q-Q plots are very useful to identify potential outliers and the presence of mixture samples (if any) in a data set. Side-by-side box plots and multiple Q-Q plots are quite useful to visually compare two or more data sets such as site versus background contaminant concentrations, monitoring well (MW) concentrations, and so on. Therefore, it is desirable and suggested that the conclusions derived using estimates (e.g., 95% UCL) and test statistics (e.g., t-test) should always be supplemented with graphical displays.

ProUCL 4.0 serves as a companion software package for the *UCL* Computation Guidance Document for Hazardous Waste Sites (EPA, 2002a) and the Background Guidance Document (currently under revision) for CERCLA Sites (EPA, 2002b). Most of the statistical and graphical methods described and recommended in these two EPA guidance documents have been incorporated in ProUCL 4.0. It should be noted that ProUCL 4.0 also has some parametric and nonparametric single sample hypotheses approaches that may be used to compare site mean concentrations (or some site threshold value such as an upper percentile) with some average cleanup standards, C_s (with a not-to-exceed limit, A_0) to verify the attainment of cleanup levels (EPA, 1989, and EPA, 2006) after some remediation activities have been performed at potentially impacted site areas. Several of the statistical methods as incorporated in ProUCL 4.0 can be used in groundwater (GW) monitoring applications (EPA, 1992).

Two reference guides: 1) ProUCL 4.0 User Guide and 2) ProUCL 4.0 Technical Guide have also been developed for ProUCL 4.0 software package. The User Guide describes and illustrates the uses of the various menu items and options as incorporated in ProUCL 4.0. The ProUCL 4.0 Technical Guide describes the theory (with references) behind the statistical methods as incorporated in ProUCL 4.0. These two documents can be downloaded from the EPA website for ProUCL 4.0. ProUCL 4.0 also provides Online Help for the various methods available in ProUCL 4.0.

Data Requirements

Statistical methods (e.g., upper limits) as incorporated in ProUCL 4.0 (and also in other software packages such as SAS and Minitab) assume that the user has collected an adequate amount of data of good quality, perhaps using appropriate data quality objectives (DQOs) as described in EPA, 2006. However, many times (e.g., using the available historical data, or due to budgetary and time constraints), it may not be possible to collect data sets based upon specified performance measures (e.g., decision errors) and other DQOs. It is noted that many times, administrators and decision makers do not want to collect many samples, especially background samples. Therefore, when it may not be possible to collect adequate amount of data using DQOs (EPA, 2006), Chapter 1 of the two ProUCL 4.0 reference guides can be used to determine the minimum sample size requirements associated with the various estimation and hypotheses testing approaches available in ProUCL 4.0. The suggested minimum sample size requirements as described in Chapter 1 are made based upon the practical applicability of the procedures incorporated in ProUCL 4.0. Those suggestions are particularly useful when the data are sparse and it may not be feasible to collect additional data based upon DQOs. However, it should be pointed out that for more accurate (reduced bias) estimates and reliable (increased precision) results, whenever possible, it is desirable to collect adequate amount of data, perhaps using DQOs with specified performance measures.

A partial listing of the statistical and graphical methods as incorporated in ProUCL 4.0 is given as follows. The details of the various statistical and graphical procedures with illustrating examples can be found in the User Guide and the Technical Guide associated with ProUCL 4.0.

ProUCL Version 4.0 Capabilities

All of the capabilities of ProUCL 3.0 have been retained in ProUCL 4.0. It is anticipated that ProUCL 4.0 will serve as a companion software package for: 1) *UCL* Computation Guidance Document for Hazardous Waste Sites (EPA, 2002a), and 2) Background Guidance Document (currently under revision) for CERCLA Sites (EPA, 2002b). Several statistical and graphical methods for data sets with and without ND observations have been incorporated in the upgraded ProUCL 4.0 software package. Some of those capabilities are listed in the following paragraphs.

Group Option

ProUCL 4.0 provides a "Group" option. An appropriate Group-ID variable representing the various groups such as different site areas of concern (AOC) or monitoring wells (MWs) should be available in the data sheet. Using this option, graphical displays and statistical analyses can be performed separately for each of the group represented by the Group-ID variable. This group graph option is very useful to perform visual multiple comparison (multiple Q-Q plots, side-by-side box plots) of the various groups (e.g., AOCs, MWs) identified by the Group-ID variable. The details of this option are given in ProUCL 4.0 User Guide.

Graphical Methods

ProUCL 4.0 has several graphical methods including multiple quantile-quantile (Q-Q) plots, side-by-side box plots, and histograms. These graphical methods can be used on data sets with and without nondetect observations. A typical Q-Q plot (normal, gamma, lognormal) is often used to visually assess the data distribution of the COPCs. A Q-Q plot also provides important information about presence of potential outliers and multiple populations that may be contained in a data set. For data sets with NDs, ProUCL 4.0 can be used to generate Q-Q plots based upon regression on order statistics (ROS) methods including the robust ROS method. The graphical displays of multiple Q-Q plots and side-by-side box plots are useful to visually compare the concentrations of two or more populations, some of which are listed as follows:

- Site versus background populations (areas)
- Surface versus subsurface concentrations
- Concentrations of two or more AOCs or MWs

Goodness-of-Fit (GOF) Test Methods

ProUCL 4.0 has GOF tests for normal, lognormal, and gamma distributions for data sets with and without nondetect observations. The following GOF tests to assess normality or lognormality of a data set are available in ProUCL 4.0.

GOF Tests to Assess Normality or Lognormality for Full Data Sets without ND Observations

- Informal graphical Q-Q plot (normal probability plot) and histogram.
- Shapiro-Wilk (SW) test for sample sizes less than or equal to 50.
- Lilliefors test for larger sample sizes such as greater than 50.

GOF Tests to Assess Normality or Lognormality for Left-Censored Data Sets with NDs and Multiple Detection Limits

- ProUCL 4.0 can be used to perform normal GOF tests as mentioned above (for full data) on data sets consisting of ND values. Specifically, normal or lognormal GOF tests can be performed using detected data values only.
- The normal or lognormal GOF tests can also be performed on data sets (detected values and extrapolated NDs) obtained using one of the regression on order statistics (ROS) methods. The details of constructing Q-Q plots (normal and lognormal) and performing ROS on data sets with multiple DLs are given in ProUCL 4.0 Technical Guide.
- The three ROS methods available in ProUCL 4.0 are the normal ROS, lognormal ROS (also known as robust ROS), and Gamma ROS methods.
- ProUCL 4.0 can be used to generate additional columns (with suitable headings assigned by ProUCL 4.0) of data consisting of the detected data and extrapolated nondetect data.

<u>Goodness-of-Fit Test for Gamma Distribution</u>

Gamma GOF Tests for Full Data Sets without ND Observations

- Informal graphical quantile-quantile (Q-Q) plot (gamma probability plot) and histogram.
- Kolmogorov-Smirnov test for sample sizes in the range 4-2500 (critical values computed using Monte Carlo simulations) and values of the estimated shape parameter, k, in the interval [0.01, 100.0].
- Anderson-Darling test for sample sizes in the range 4-2500 (critical values computed using Monte Carlo simulations) and values of the estimated shape parameter, k, in the interval [0.01, 100.0].

Gamma GOF Tests for Left-Censored Data Sets with NDs and Multiple Detection Limit

- ProUCL 4.0 can be used to perform gamma GOF tests on data sets consisting of ND values. Specifically, gamma GOF tests can be performed on data set consisting of only detected data.
- The gamma GOF tests listed above can also be used on data sets (detected values and extrapolated NDs) obtained using one of the regression on order statistics (ROS) methods as incorporated in ProUCL 4.0. The details of constructing gamma Q-Q plots and performing ROS on data sets with multiple detection limits are given in ProUCL 4.0 Technical Guide.

Summary Statistics

- For full data sets without NDs, ProUCL computes and lists all relevant descriptive summary statistics for raw and log-transformed data.
- For data sets with NDs, ProUCL computes simple summary statistics using only detected data values for raw or log-transformed data.

Note: Summary statistics option does not compute and lists the estimates of the population parameters. Those estimates are computed and listed by the 'UCL' and 'Background' options of ProUCL 4.0.

Estimates of Population Parameters

- Computes the maximum likelihood estimates (MLEs) and minimum variance unbiased estimates (MVUEs) of the various population parameters such as the mean, standard deviation, quantiles, coefficient of variation (CV), skewness, and also the MLEs of the shape parameter k and scale parameter θ of a gamma distribution. These estimates (e.g., MLE, MVUE) are shown when the menu items Background and UCL are used to compute the upper limits.

- For data sets with NDs, ProUCL 4.0 also computes parametric (e.g., normal MLE) and nonparametric (Kaplan Meier (KM), Bootstrap) estimates of population mean, variance, and standard error of the mean. These statistics do not represent simple summary statistics. Therefore, these estimates (e.g., MLE, KM) are shown when the menu items Background and UCL are used to compute the upper limits.

Upper Confidence Limits (UCLs) to Estimate Exposure Point Concentration Terms

A 95% UCL of the unknown population arithmetic mean, μ_1, of a COPC is used to estimate the EPC term and also to determine the attainment of cleanup standards. It should be noted that gamma distribution is often better suited to model positively skewed environmental data sets than the lognormal distribution. For positively skewed data sets, the default use of a lognormal distribution often results in impractically large UCLs, especially when the data sets are small (Singh, Singh, and Iaci, 2002). In order to obtain accurate and stable UCLs of practical merit, other distributions such as a gamma distribution should be used to model positively skewed data sets. ProUCL, Version 4.0 has procedures to perform the gamma goodness-of-fit tests and to compute UCLs of the population mean, and various other limits based upon gamma distributed data sets with and without nondetect observations. ProUCL 4.0 also has several bootstrap methods (e.g., percentile bootstrap, bias corrected bootstrap, bootstrap-t) to compute UCLs of the mean for data sets with and without ND observations.

For full data sets without NDs and for left-censored data sets with ND observations, ProUCL 4.0 can compute several parametric and nonparametric UCLs with a confidence coefficient (*CC*) specified in the interval [0.5, 1.0) including the commonly used *CC* level 0.95. ProUCL 4.0 can compute parametric UCLs for normal, lognormal, and gamma distributions. It is noted that in environmental applications (e.g., estimation of EPC), a 95% UCL of mean is used, therefore, ProUCL makes recommendations only for an appropriate 95% UCL (s) which may be used to estimate the EPC term. The basis and theoretical justification for those recommendations are summarized in Singh and Singh (2003) for full data sets without ND observations.

<u>UCLs for Full Uncensored Data Sets without ND Observations</u>

1. Student's-t UCL: to be used for normally (or at least approximately normally) distributed data sets. Student's-t UCL is available for all confidence coefficients, (1-α) in the interval [0.5, 1.0).
2. Approximate Gamma UCL: to be used for gamma distributed data and is typically used when k hat (ML estimate of the shape parameter, k) is greater than or equal to 0.5. Approximate gamma UCL is available for all confidence coefficients (1-α) in the interval [0.5, 1.0).
3. Adjusted Gamma UCL: to be used for gamma distributed data sets and should be used when k hat is greater than 0.1 and less than 0.5. Adjusted gamma UCL is available only for three confidence coefficients: 0.90, 0.95, and 0.99.
4. H-UCL based upon Land's H-statistic: to be used for lognormally distributed data sets. In ProUCL, H-UCL is available only for two confidence coefficients: 0.90 and 0.95. ProUCL can compute H-UCL for samples of size up to 1001.
   Caution: For highly skewed data sets, the use of H-UCL should be avoided as the H-statistic often results in unrealistically large, impractical and unusable H-UCL values. ProUCL provides warning messages and recommends the use of alternative UCLs for such highly skewed lognormally distributed data sets.
5. Chebyshev (MVUE) UCL: to be used for lognormally distributed data sets. This UCL computation method uses the MVU estimates of the standard deviation of the mean and of other parameters of a lognormal distribution. Chebyshev (MVUE) UCL is available for all confidence coefficients, (1-α) in the interval [0.5, 1.0).
6. Central Limit Theorem (CLT) based UCL: to be used when the sample size is large.
7. Adjusted-CLT (adjusted for skewness) UCL: may be used for mildly skewed data sets of large sizes.
8. Modified-t statistic (Adjusted for skewness) based UCL: may be used for mildly skewed data.
   Caution: UCLs listed in 6, 7, and 8 do not provide adequate (e.g., 95%) coverage when the data are moderately to heavily skewed, even when the sample size is large such as greater than 50.
9. Chebyshev (Mean, Sd) UCL: based upon the sample mean and standard deviation, Sd.
10. Jackknife UCL for mean (same as Student's-t UCL).
11. Standard Bootstrap UCL.
12. Bootstrap-t UCL.
13. Hall's Bootstrap UCL.
14. Percentile Bootstrap UCL.
15. Bias-corrected accelerated (BCA) Bootstrap UCL.

<u>UCLs Based Upon Left Censored Data Sets with ND Observations</u>

In order to compute UCLs, one has to first obtain estimates of population mean, standard deviation, and standard error of the mean based upon data sets with single or multiple detection limits. ProUCL 4.0 has a couple of estimation methods such as the ROS methods and Kaplan-Meier (KM) method that can handle multiple detection limits. The following methods for estimation of population mean and the standard deviation have been incorporated in ProUCL 4.0.

- Maximum likelihood method (MLE) (Cohen (1991)) – Single DL
- ROS Methods for normal, gamma, and lognormal distributions –Multiple DLs
  Note: ProUCL 4.0 can be used to generate columns consisting of detected data and extrapolated NDs obtained using a ROS method (normal, lognormal, and gamma).
- Kaplan-Meier (KM) method (Kaplan-Meier (1958)) – Multiple DLs
- Winsorization method
- DL/2 substitution (DL/2) method – not a recommended method. *The DL/2 method is included for historical reasons only.*

Note on the Use of DL/2 and Other Substitution Methods

- The use of DL/2 (and DL) method is not recommended in statistical procedures that may be used in decision-making processes. Therefore, it is suggested to avoid the use of the DL/2 method (and other substitution methods such replacement of NDs by '0', 'DL') to estimate the EPC terms and BTVs.
- Also, the use of the substitution methods is not recommended in hypothesis testing approaches.
- However, the substitution methods such as the DL/2 method may be used in graphical and exploratory methods to gain visual information about the data distributions and outliers. Several graphical methods (e.g., boxplots, Q-Q plots) based upon DL/2 method are available in ProUCL 4.0.

ProUCL 4.0 can compute several parametric and nonparametric UCLs with a confidence coefficient (*CC*) specified in the interval [0.5, 1.0) including the commonly used *CC* level 0.95. However, since in most environmental applications (e.g., estimation of EPC), a 95% UCL of mean is used, therefore, ProUCL 4.0 makes recommendations for the most appropriate 95% UCL (s) that may be used to estimate the EPC terms based upon data sets with ND observations. The theory behind those recommendations can be found in Singh, Maichle, and Lee (EPA, 2006). Using the estimates of mean and standard deviation, or extrapolated NDs obtained using one of the ROS methods listed above, ProUCL 4.0 computes UCLs of the means using the following methods.

- Tiku's UCL method (Tiku (1967 and 1971)) – Single DL
- Ad hoc UCL methods using Student's t-statistic on ML estimates and KM estimates
- Ad hoc UCL methods based upon Land's H-statistic – Single DL
- Gamma UCL – Bootstrap UCL on gamma ROS
- Nonparametric Chebyshev UCL based upon KM estimates
- Bootstrap (percentile, standard bootstrap, bootstrap t, and bias-corrected accelerated (BCA)) methods on ROS methods and KM estimates.

Upper Limits to Estimate Background Level Threshold Values (BTVs) or Not-to-Exceed Values

ProUCL 4.0 can be used to compute several parametric and nonparametric upper limits that are used to estimate the BTVs or not-to-exceed values for data sets with NDs and without NDs. These upper limits include: upper prediction limits (UPLs), upper tolerance limits (UTLs), and upper percentiles. Some of the nonparametric methods such as the Kaplan-Meier (Meier, 1958) method and ROS methods are applicable on left-censored data sets having multiple detection limits. The background statistics as incorporated in ProUCL 4.0 are particularly useful when individual site observations from some impacted site areas (perhaps after some remediation activities) are to be compared with BTVs to determine if adequate amount of remediation and cleanup has been performed yielding remediated site concentrations comparable to background level concentrations; that is if the site concentrations can be considered as coming from (or approaching to) the population of background concentrations.

The process of comparing individual site observations with BTVs or some other not-to-exceed values is also used for screening purposes (e.g., before performing any cleanup and assessment) to identify the COPCs, and to determine if site areas under study need further sampling and remediation actions. Specifically, the process of comparing onsite data with the BTVs may help the working crew, project team, or the decision makers to take immediate decisions if more remediation and more onsite sample collection need to be performed at the site areas under investigation.

The first step in establishing site specific background level contaminant concentrations for site related hazardous pollutants is to perform background sampling to collect appropriate number of samples from the designated site specific background areas or some agreed upon site reference areas. An appropriate DQO process (EPA, 2006) may be followed to collect an adequate number of background samples. It is desirable to collect at least 10-15 background samples to compute reliable estimates of BTVs. Furthermore, it is suggested not to use estimated BTVs and not-to-exceed values based upon background data sets of sizes smaller than 8-10. Once, an adequate amount of background data have been collected, the next step is to determine the data distribution. This can be achieved by using exploratory graphical tools (quantile-quantile (Q-Q) plots and histograms) as well as formal GOF tests as incorporated in ProUCL 4.0.

Once the data distribution of a background data set has been determined, one can use parametric or nonparametric statistical methods to compute background statistics. A review of the environmental literature reveals that one or more of the following statistical limits are used to compute the background statistics; that is to determine and estimate background level contaminant concentrations. Collectively, these statistics represent estimates of the background threshold values (BTVs). The BTVs are estimated by statistics representing values in the upper tail (e.g., 95% upper percentile, 95% UPL) of the background data distribution. Typically, a site observation (preferably based upon a composite sample) in exceedance of a BTV (e.g., UPL, upper percentile) can be considered as coming from a site area (location), which might have been impacted by the site-related activities. In other words, such a site observation may be considered as exhibiting some evidence of contamination at that site area (location) due to site related activities. For data sets with NDs, the BTVs can be estimated using upper limits based upon KM estimates. Some of the statistical limits used to estimate the BTVs for data sets with and without NDs as incorporated in ProUCL 4.0 are listed as follows.

1. Upper Percentiles (e.g., 95%, 99%) for data sets without and with NDs (e.g., based upon KM estimates)
2. Upper Prediction Limit (UPL) for a future (site observation) observation (using KM or other estimates for data sets with NDs)
3. UPL for future k (e.g., next k or k site observations) observations
4. Upper Tolerance limits (UTLs) - Upper Confidence Limits for Upper Percentiles
5. Upper percentiles, UPLs, UTLs based upon data obtained using ROS methods – data with NDs
6. IQR Upper Limit (upper end of the upper whisker in a Box Plot)
7. UPL and UTL based upon resampling bootstrap
8. UPL based upon Chebyshev inequality
9. UTL based upon bootstrap methods for data sets with NDs
10. BTVs using nonparametric methods based upon higher order statistics (Conover, 1999)

Note: *The behavior of the exploratory IQR based upper limit as an estimate of a BTV is not well studied. This limit should be used with caution to estimate the BTVs or not-to-exceed values.*

It should be noted that background versus site comparisons based upon the BTVs are performed when not enough site data (e.g., < 4-6 observations) are available to perform traditional two sample comparisons using hypotheses testing approaches such as t-test, Wilcoxon Rank Sum test, and Gehan test. When enough site data are available (e.g., at least 8-10, more are preferable), it is preferable to use hypotheses testing approaches to compare site data with BTVs or not-to-exceed values. Thus, in the absence of adequate amount of site data, individual point-by-point site observations are compared with some BTVs to determine the presence or absence of contamination due to site related activities. This method of comparing site versus background level contamination is particularly helpful to use after some sort of remediation activities have taken place at the site; and the objective is to determine if the remediated site areas have been remediated enough to the background level contaminant concentrations.

Typically, a site observation (possibly based upon composite samples) in exceedance of a background threshold value can be considered as coming from a contaminated site area that may have been impacted by the site-related activities. In other words, such a site observation may be considered as exhibiting some evidence of contamination at the site due to site related activities. In case of an exceedance of the BTV by a site location, some practitioners like to verify the possibility of contaminated site location by re-sampling (collecting 2-3 additional samples) that location, and comparing the sampled value(s) with the BTV.

<u>Hypothesis Testing Approaches</u>

Both single sample and two sample parametric and nonparametric hypotheses testing approaches are available in ProUCL 4.0. The hypotheses testing approaches as incorporated in ProUCL 4.0 can be used on full data sets without any ND observations, and on left-censored with nondetect data values. Form 1, Form 2, Form 2 with substantial difference, and two-sided alternative hypotheses approaches (EPA, 2002b) are available in ProUCL 4.0. It is desirable to collect adequate amount of data of good quality from the populations under investigation using appropriate DQOs (EPA, 2006). In case, data sets cannot be collected using DQOs, it is suggested to follow the minimum sample size requirements as described in Chapter 1 of the ProUCL Technical Guide and User Guide. Some single sample and two sample hypotheses testing approaches as available in ProUCL 4.0 are listed as follows.

Single Sample Hypotheses Testing Approaches

One Sample t-Test: Based upon the sampled site data, this test is used to compare the site mean, μ, with some specified cleanup standard, C_s, where the cleanup standard, C_s, represents an average threshold value, say μ_0. The Student's t- test (or a UCL of mean) is often used (assuming normality of site data or when site sample size is large such as larger than 30, 50) to determine the attainment of cleanup levels at a polluted site, perhaps after some remediation activities. This test should be used on data sets without any ND observations.

One Sample Sign Test or Wilcoxon Signed Rank (WSR) Test: These two tests are nonparametric tests and can also handle nondetect observations provided all nondetects (e.g., associated detection limits) fall below the specified threshold value, C_s. These tests are used to compare the site location (e.g., median, mean) with some specified cleanup standard, C_s, representing the similar location parameter.

One Sample Proportion Test or Percentile Test: When a specified cleanup standard, A_0, such as a PRG or a BTV represents an upper threshold value (e.g., not-to-exceed value, compliance limit) of a contaminant concentration distribution rather than the mean or median concentration value, μ_0, of the contaminant concentration distribution, then a test for a proportion or a percentile (equivalently a UTL 95%-95% or UTL 95%-90%) may be used to compare the site proportion, P, of exceeding (by site observations) the threshold value, A_0 with some pre-specified proportion, P_0, of exceedances of A_0 by site observations. This test is especially useful when the data set consists of many ND observations. However, this test also assumes that all ND observations lie below the Compliance Limit, A_0.

Two Sample Hypotheses testing Approaches

Typically, two sample hypotheses testing approaches are used for site versus background comparisons, for comparisons of two or more site areas of concern (AOCs), or for comparison of contaminant concentrations of two or more monitoring wells (MWs), provided enough data are available from each population under evaluation. Two sample hypotheses testing approaches as incorporated in ProUCL 4.0 are listed as follows.

1. Student's Two Sample t-Test to compare means - with equal dispersions - Parametric Test
2. Satterthwaite Two Sample t-Test to compare means - with unequal dispersions - Parametric Test

3. F Test to compare two variances (dispersions) – Parametric Test
4. Wilcoxon-Mann-Whitney (WMW) Test to compare two locations, comparability of two continuous distributions – Nonparametric Test
5. Quantile Test to compare the upper tails of two continuous distributions - Nonparametric Test
6. Gehan Test to compare two locations - Nonparametric Test

T-tests and F-test assume normality of the data sets under comparison. Some details of these approaches are described in ProUCL 4.0 Technical Guide. It should be noted that Gehan test, WMW test and Quantile test are also available for data sets with NDs. Gehan's test is specifically meant to be used on data sets with multiple detection limits. The Quantile test is a nonparametric test and is useful to detect a shift in the right tail of the site data distribution. The Quantile test when used in parallel with the Wilcoxon Mann Whitney (WMW) test provides the user with stronger evidence to make decisions about the comparability of site and background distributions, leading to more reliable conclusions whether the site has attained remediation levels or not. It is suggested that for best results, both WMW test and Quantile tests should be used on the same data set.

Note on Comparability of Data Sets

The samples collected from the two (or more) populations under comparisons should all be of the same type obtained using similar analytical methods and apparatus. In other words, the collected site and background samples should be all discrete or all composite (obtained using the same number of discrete samples, same design and pattern), and be collected from the same medium (soil) at similar depths (e.g., all surface samples or all subsurface samples) and time (e.g., during the same quarter in groundwater applications) using comparable (preferably same) analytical methods. Some good soil sample collection methods and sampling strategies are described in EPA, 2003 guidance document.

Note on Influence of Outliers and Use of Lognormal Distribution

Typically, in environmental data sets collected from impacted sites or monitoring wells (MWs), an outlier represents an observation coming from a potentially contaminated site location. This is especially true, when the data are collected from a site specific background area. The outlying observations need to be identified before computing the background statistics (and other estimates and test statistics) as outliers when present distort all statistics of interest, which in turn may lead to incorrect remediation and cleanup decisions for the site under investigation. For an example, inclusion of an outlier may distort the t-test statistic resulting in distorted and incorrect decision errors (Type 1 or Type 2 errors), which can lead to incorrect conclusion about the hypotheses testing. The incorrect decisions may adversely affect the human health and the environment.

The main objective of using a statistical procedure is to model the majority of the data representing the main dominant population, and not to accommodate a few low probability outliers that may yield inflated and impractical statistics, results, and incorrect conclusions. For an example, background threshold values (BTVs) and exposure point concentration (EPC) terms should be estimated by reliable statistics (and not distorted statistics) obtained using data sets representing the main dominant population under study (e.g., site, background). The low probability high outlying values contaminate the underlying left-censored or uncensored full data set from the population under study. The inclusion of outliers in a background data set needs to be justified before performing other relevant statistical analyses including the estimation of BTVs. If possible, all interested parties should be involved in decision making about the disposition (inclusion or exclusion) of outliers in a background data set. Typically, outlying locations (if any) with elevated concentrations need separate investigation.

It should be noted that the objective is to compute reliable background statistics based upon the majority of a defensible background data set representing the dominant background population. In the process of estimating the BTVs, it may not be desirable to accommodate a few low probability outlying observations (if any) by using a lognormal distribution (Singh, Singh, and Iaci, 2002). The use of a lognormal distribution often accommodates outliers and multiple populations, which in turn yields inflated UCLs and background statistics such as UPLs, percentiles, and UTLs.

The proper identification of multiple outliers is a complex issue based upon robust statistical methods, and is beyond the scope of ProUCL 4.0. For details of the robust outlier identification procedures, refer to Barnett and Lewis (1994), and Singh and Nocerino (1995). A more complicated problem arises when the collected background data set may represent a potentially mixture data set including observations from some of the site areas. The occurrence of mixture samples is quite common in many environmental applications. This is especially true when data sets are collected from large federal facilities (e.g., Navy Sites). For such cases, the underlying data set may consist of samples from the background areas as well as from some other potentially contaminated site areas. In this situation, first, one has to separate the background observations from the other site related observations. After the background data set has been properly extracted from a potentially a mixture sample, one can proceed with the computation of background statistics as available in ProUCL 4.0.

Appropriate population partitioning techniques (e.g., see Singh, Singh, and Flatman (1994)) can be used to extract a background data set from a potentially mixture data set. However, the population partitioning methods are beyond the scope of ProUCL 4.0. It should be noted that some of those methods will be available in Scout (EPA, 2000) software which is currently under revision and upgrades. For methods as incorporated in ProUCL, it is assumed that one is dealing with a sample from a "single" population representing a valid site-related background data set. Therefore, before using statistical methods to compute the various limits such as UCLs, UTLs, and UPLs, it is suggested that the user pre-processes the data set to identify potential outliers and mixture populations (if any).

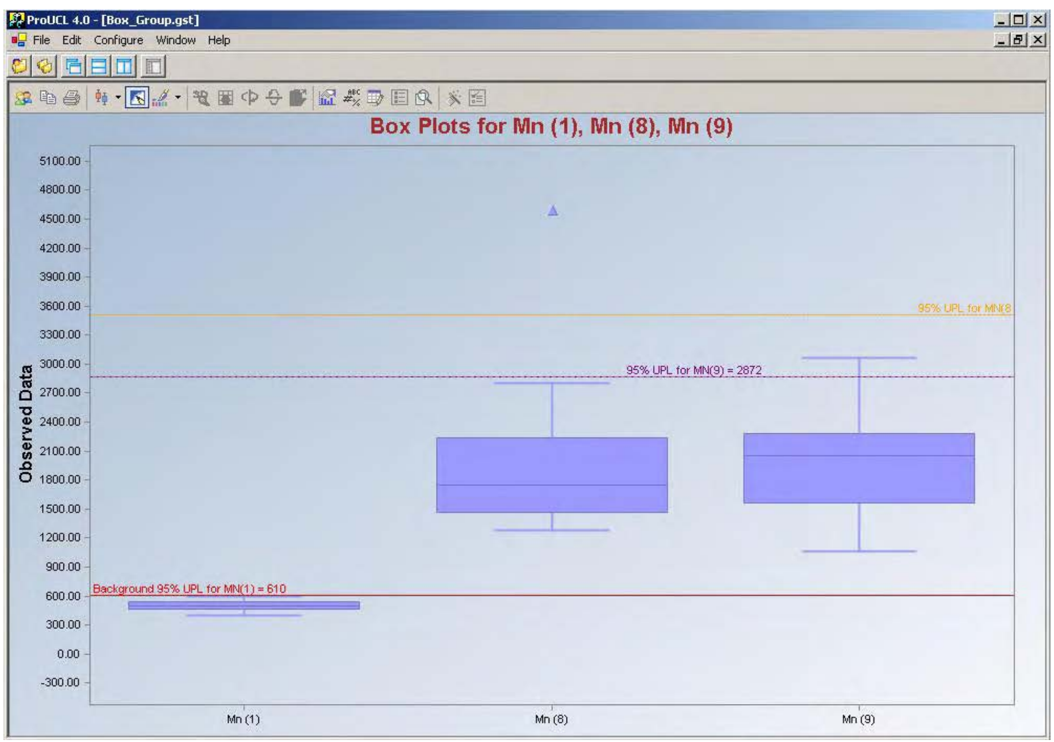
<u>Outlier Tests</u>

ProUCL 4.0 has a couple of classical outlier test procedures, such as the Dixon test and the Rosner test. Additionally, ProUCL 4.0 software has exploratory graphical methods including

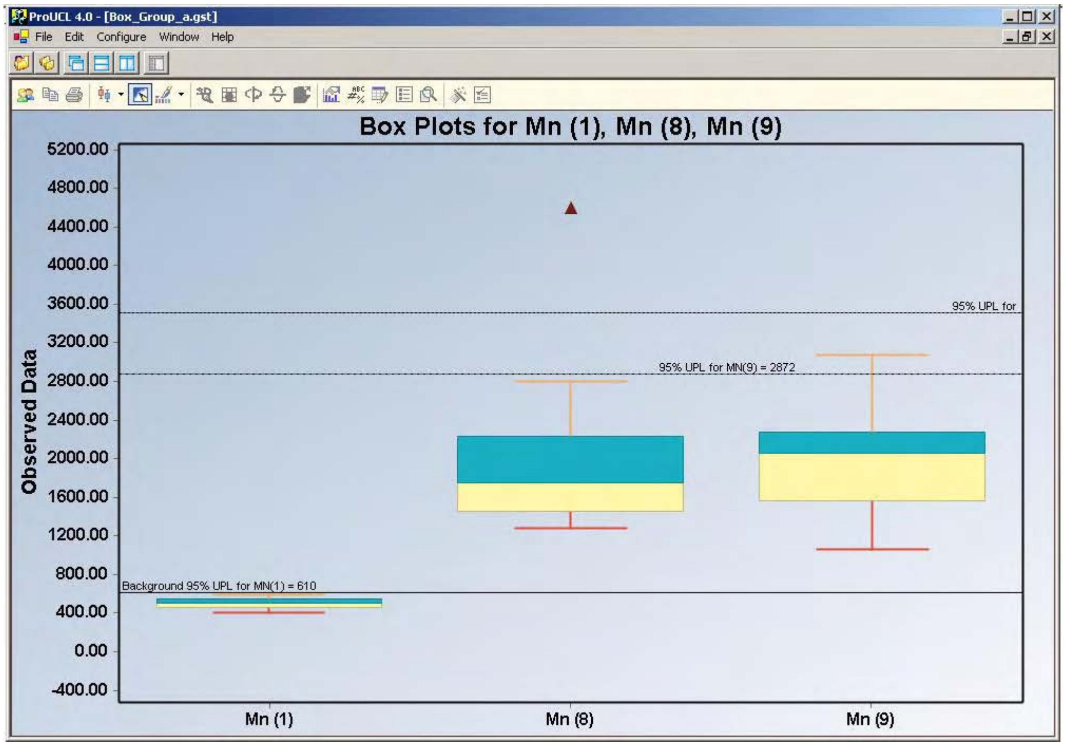
quantile-quantile (Q-Q) plots, box plots, and histograms. The graphical displays of Q-Q plot and box plot are also useful to visually identify outliers that may be present in a data set. It is noted that, the classical test statistics such as the Dixon test and the Rosner test get distorted by the presence of the same outlying observations that those tests are supposed to identify. Therefore, those test statistic (Dixon and Rosner) results should always be supplemented by the graphical displays to confirm the presence of outliers (and potential multiple populations) in a data set. Alternately, the use of robust and resistant outlier identification methods (Singh and Nocerino, 1995) is recommended to identify outliers. The robust outlier identification methods are beyond the scope of ProUCL 4.0.

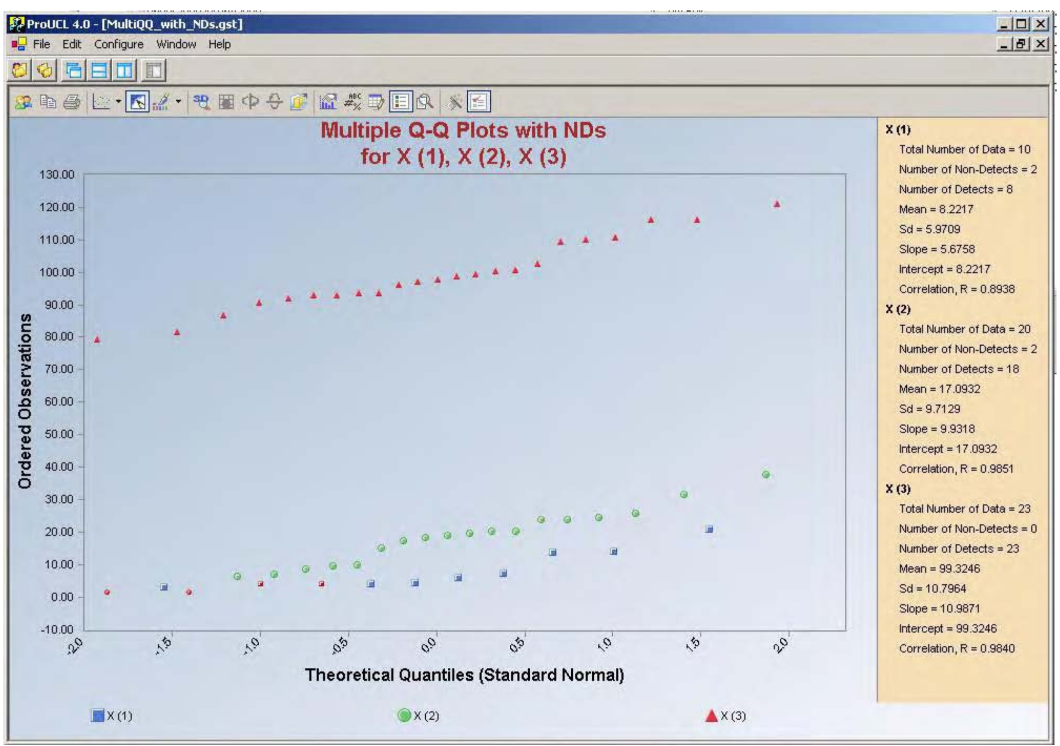
The proper disposition of outliers to include or not to include outliers in the computation of various statistics should be determined by the project team, site experts, and the decision makers involved in the project. In an effort to determine the influence of outliers on the statistics of interest, it is suggested to compute the various statistics based upon data sets with and without the outliers. This extra step should help the project team in determining the proper disposition of outliers. These issues have also been discussed in detail in ProUCL 4.0 Technical Guide.

Screen Shots Generated By ProUCL 4.0



(from MW89)





From (censor by grps)

X (1)	
Some Non-Parametric Statistics	
Number of Valid Samples	10
Number of Unique Samples	9
Minimum	3.202
Maximum	20.777
Second Largest	14.138
Mean	8.2217
First Quartile	4
Median	5.347
Third Quartile	13.98575
SD	5.9709101
Variance	35.651767
Coefficient of Variation	0.7262379
Skewness	1.2868074
Mean of Log-Transformed data	1.9005085
SD of Log-Transformed data	0.6522793
Data Follow Appr. Gamma Distribution at 5% Significance Level)	
Non-Parametric Background Statistics	
90% Percentile	20.1131
95% Percentile	20.777
99% Percentile	20.777
95% UTL with 90% Coverage	
Order Statistic	10
Achieved CC	1
UTL	20.777
95% BCA Bootstrap UTL with 90% Coverage	20.777
95% Percentile Bootstrap UTL with 90% Coverage	20.777
95% UPL	20.777
95% Chebyshev UPL	35.518622
Upper Limit Based upon IQR	28.964375
Note: UPL (or upper percentile for gamma distributed data) represents a preferred estimate of BTV	

X (2)	
Some Non-Parametric Statistics	
Number of Valid Samples	20
Number of Unique Samples	19
Minimum	1.5
Maximum	37.867
Second Largest	31.565
Mean	17.09315
First Quartile	8.787
Median	18.794
Third Quartile	23.9455
SD	9.7128685
Variance	94.339814
Coefficient of Variation	0.5682316
Skewness	0.1567791
Mean of Log-Transformed data	2.5790218
SD of Log-Transformed data	0.8911249
Data appear Normal at 5% Significance Level	
Non-Parametric Background Statistics	
90% Percentile	30.9882
95% Percentile	37.5519
99% Percentile	37.867
95% UTL with 90% Coverage	
Order Statistic	20
Achieved CC	1
UTL	37.867
95% BCA Bootstrap UTL with 90% Coverage	31.565
95% Percentile Bootstrap UTL with 90% Coverage	37.867
95% UPL	37.5519
95% Chebyshev UPL	60.476088
Upper Limit Based upon IQR	46.68325
Note: UPL (or upper percentile for gamma distributed data) represents a preferred estimate of BTV	

From (censor by grps)

Computer Requirements to Operate ProUCL 4.0

Minimum Hardware Requirements

- Intel Pentium 1.0 GHz
- 50 MB of hard drive space
- 512 MB of memory (RAM)
- CD-ROM drive
- Windows 98 or newer. ProUCL was thoroughly tested on NT-4, Windows 2000, and Windows XP Operating Systems. Limited testing has been conducted on Windows ME.

Software Requirements

ProUCL 4.0 has been developed in the Microsoft .NET Framework using the C# programming language. As such, to properly run ProUCL 4.0, the computer using the program must have the .NET Framework pre-installed. The downloadable .NET files can be found at one of the following two Web sites:

- http://msdn.microsoft.com/netframework/downloads/updates/default.aspx
  Note: *Download .Net version 1.1*

- http://www.microsoft.com/downloads/details.aspx?FamilyId=262D25E3-F589-4842-8157-034D1E7CF3A3&displaylang=en

The first Web site lists all of the downloadable .NET Framework files, while the second Web site provides information about the specific file (s) needed to run ProUCL 4.0. Download times are estimated at 57 minutes for a dialup connection (56K), and 13 minutes on a DSL/Cable connection (256K).

Installation

ProUCL 4.0 can be downloaded from TSC website at http://www.epa.gov/nerlesd1/tsc/tsc.htm. The same website can be used to download ProUCL 4.0 User Guide, Technical Guide and Factsheet. The website contains download and usage instructions.

Find More Information About ProUCL

The TSC website at http://www.epa.gov/nerlesd1/tsc/tsc.htm provides additional information. EPA technical issue papers used in the development of ProUCL are also available at the TSC website. For additional information, contact:

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Appendix C –Port Sites with Regulatory or Institutional Controls

Appendix C

Port Sites with Regulatory Constraints or Institutional Controls

April 2009

The following is a partial list of Port of Oakland sites identified with regulatory constraints or institutional controls (IC) that may have additional requirements that must be met before soil from other Port properties may be reused on the site.

Oakland International Airport Sites

Maritime Sites

- Howard Terminal (recorded land use restriction)
- Union Pacific Roundhouse (recorded land use restriction)
- Former Fleet & Industrial Supply Center Oakland (recorded land use restriction)
- Oakland Army Base (recorded land use restrictions on three areas, does not include soil)

Commercial Real Estate Sites

- Lot 12/Jack London Square Movie Theatre (recorded land use restrictions)
- Embarcadero Cove (recorded land use restrictions)

Appendix D – Arsenic Background Levels

From Science to Solutions

BASELINE
ENVIRONMENTAL CONSULTING

10 December 2008
Y7350-05.01161

Douglas P. Herman
Materials Management Program Coordinator
Port of Oakland
530 Water Street
Oakland, CA 94607

Subject: Evaluation of 95th Percentile Background Arsenic Concentrations for the Port of Oakland, California

Dear Doug:

At your request, BASELINE Environmental Consulting ("BASELINE') has evaluated background arsenic concentrations in subsurface materials for Port-owned properties. The work was performed in response to comments from Max Shahbazian of the San Francisco Bay Regional Water Quality Control Board ("Water Board") on the Draft Port-wide Soil Management Protocol, dated October 2008, submitted by the Port on 22 October 2008 to the Water Board for review. Mr. Shahbazian requested that the Port evaluate background arsenic concentrations as the 95th percentile concentrations for artificial fill and native soil underlying the Port. This letter report summarizes the data sets and methodology BASELINE used to calculate the 95th percentile background arsenic concentrations for fill and native soil.

Data Sources and Assumptions

Five sources of arsenic data were obtained by BASELINE for the evaluation of background arsenic concentrations. The sources of arsenic data are considered representative of Port-wide conditions; the data were collected from soil samples collected by the Port during previous subsurface investigations throughout the Port, including the Outer Harbor, Jack London Square area, and the Oakland International Airport ("OIA") as follows:

- Oakland International Airport (Port OIA database assembled by the Port for soil excavated in the OIA area);
- Former McGuire Chemical Company[1] leasehold ("McGuire") at Berths 24 to 26 in the Outer Harbor;

[1] BASELINE, 2004, Final Remedial Investigation Report, Former McGuire Chemical Company Leasehold, Port of Oakland, Outer Harbor Terminal, Oakland, California, January.

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Emeryville Petaluma San Francisco

- Jack London Square Area;[2]
- Howard Terminal[3] ("Howard") at Berths 67 and 68 in the Inner Harbor;
- 1991 Regional Approach data set (data assembled by BASELINE in 1991, as updated, for the Port for all soil samples collected in the Port area from 1985 through 1991 with limited updates through 1996).

The data from the five data sources, presented in Tables 1 through 5, were examined for information on stratigraphy (i.e., whether the samples were collected from fill, Bay Mud, Merritt Sand, or other media). Sample stratigraphy for the Jack London Square area, McGuire, and Howard data sets was identified in the respective reports from these investigations.

Sample stratigraphy for some of the Port OIA database was included in the Port OIA database. Where stratigraphy was not identified, BASELINE made the following assumptions:

- All samples from the report *Fill Material Investigation Report, Site Adjacent to Neil Armstrong and Edward White Ways, Metropolitan Oakland International Airport* (Kleinfelder, 2001) were fill samples.
- Samples collected from a depth of less than three feet below ground surface were fill samples.

Based on a review of the Port OIA database, BASELINE excluded 15 samples from the Port OIA database data set. Table 6 identifies the excluded samples and rationale for their removal from the data set prior to statistical analysis. Duplicate samples in the Port OIA database were averaged and treated as one sample for the 95th percentile calculations.

Stratigraphy for the 1991 Regional Approach soil data was identified using descriptions from well or boring logs. Where stratigraphy information was not available, BASELINE used the same assumption used above for the OIA database (i.e., samples collected from a depth of less than three feet below ground surface were fill samples).

BASELINE used the five data sources to preliminarily compile three data sets for analysis. Because stratigraphy for approximately 31 percent of the total samples from the five data sources was not identified, BASELINE compiled one data set that contained all data from the five data sources presented in Tables 1 through 5. The three data sets for calculation of the 95th percentile arsenic concentrations consisted of:

- All samples including fill, Bay Mud, Merritt Sand, and uncharacterized samples ("ALL Data Set");
- Fill samples only ("FILL Data Set");
- Native soil samples only (Bay Mud and Merritt Sand) ("NATIVE Data Set").

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[2] BASELINE, 2002, Soil and Groundwater Investigation, Jack London Square Area Parcels C through G, Oakland, California, February.

[3] BASELINE, 2001, Final Remedial Investigation Report, Howard Terminal, Oakland, California, March.

Table 7 summarizes the number of samples from each of the five data sources that were included in the ALL, FILL, and NATIVE Data Sets.

Data Analysis Methodology

BASELINE calculated the 95th percentile arsenic concentrations for the three data sets using ProUCL 4.00.02 ("ProUCL") (http://www.epa.gov/esd/tsc/software.htm). ProUCL is software developed by U.S. EPA that contains statistical methods applicable for various environmental analyses.

BASELINE used ProUCL to evaluate the distribution of the ALL, FILL, and NATIVE Data Sets (i.e., normal, log-normal, gaussian, or non-parametric). The distribution of the data determined the statistical method to be used in calculating the 95th percentile concentration. The number of non-detect data points and the variability of reporting limits for the non-detects also affected which method was used to calculate 95th percentiles.

Normal quantile-quantile ("Q-Q") plots graphically demonstrate if the data follow a normal distribution. If the data follow a normal distribution, the data points will plot along a straight line on the Q-Q plot; jumps and breaks in the Q-Q plots may suggest the presence of multiple populations in the data set. Figures 1 through 3 show Q-Q plots for the ALL, FILL, and NATIVE Data Sets. The Q-Q plots show that the NATIVE Data Set appears to follow a normal distribution and that the other data sets do not follow a normal distribution. The FILL Data Set shows a break in the data between 10 and 20 milligrams/kilogram ("mg/kg") (Y axis), potentially distinguishing background from non-background samples. BASELINE performed an additional goodness-of-fit analysis in ProUCL, which indicated that the ALL and FILL Data Sets also did not follow a log-normal or gaussian distribution; consequently non-parametric statistics were selected as the most appropriate for calculating the 95th percentile concentrations.

Non-parametric statistics were used to calculate the 95th percentile concentrations for all three data sets. Although the NATIVE Data Set appeared to follow a normal distribution, the data set contained some non-detect values. The Kaplan-Meier non-parametric method in ProUCL uses bootstrapping to estimate non-detect values, which is more rigorous than simple substitution methods (such as using one-half the reporting limit). Bootstrapping randomly replaces the non-detect values with different concentrations up to the reporting limit and performs multiple iterations to obtain a desired statistical value. ProUCL recommends using the Kaplan-Meier for data sets containing non-detects with multiple reporting limits.

Results

Table 8 summarizes the 95th percentile arsenic concentration for the FILL and NATIVE Data Sets. The 95th percentile arsenic concentrations for the FILL and NATIVE Data Sets are:

- 95th percentile arsenic concentration from fill: 16.4 mg/kg;
- 95th percentile arsenic concentration from native: 5.6 mg/kg.

The 95th percentile concentration for the ALL Data Set, which included 344 samples that were not characterized by material type, was 15.3 mg/kg. This concentration is similar to the FILL Data Set

95th percentile concentration (16.4 mg/kg), which could indicate that most uncharacterized samples were fill samples. **We recommend that the background arsenic concentration for Fill be 16.4 mg/kg and for Native soil, 5.6 mg/kg, in the Port area**.

Should you have any questions or need additional information, please do not hesitate to contact us at your convenience.

Sincerely,

Yane Nordhav, P.G.
Principal

Donna Bodine
Senior Environmental Scientist

DB:YN:cr

cc: Kathryn Purcell, SAIC

Attachments:

Figure 1: Normal Q-Q Plot for ALL Data Set
Figure 2: Normal Q-Q plot for FILL Data Set
Figure 3: Normal Q-Q Plot for NATIVE Data Set
Table 1: Summary of Arsenic Results, Soil, Oakland International Airport, California
Table 2: Summary of Arsenic Results, Soil, Howard Terminal, Oakland, California
Table 3: Summary of Arsenic Results, Soil, McGuire Chemical Company, Oakland, California
Table 4: Summary of Arsenic Results, Soil, Jack London Square Area, Oakland, California
Table 5: Summary of Arsenic Results, Soil, 1991 Regional Approach
Table 6: Summary of Samples Excluded from the OIA Soil Data Set
Table 7: Summary of Data Sources for 95th Percentile Arsenic Calculations
Table 8: 95th Percentile Arsenic Concentrations for FILL and NATIVE Data Sets

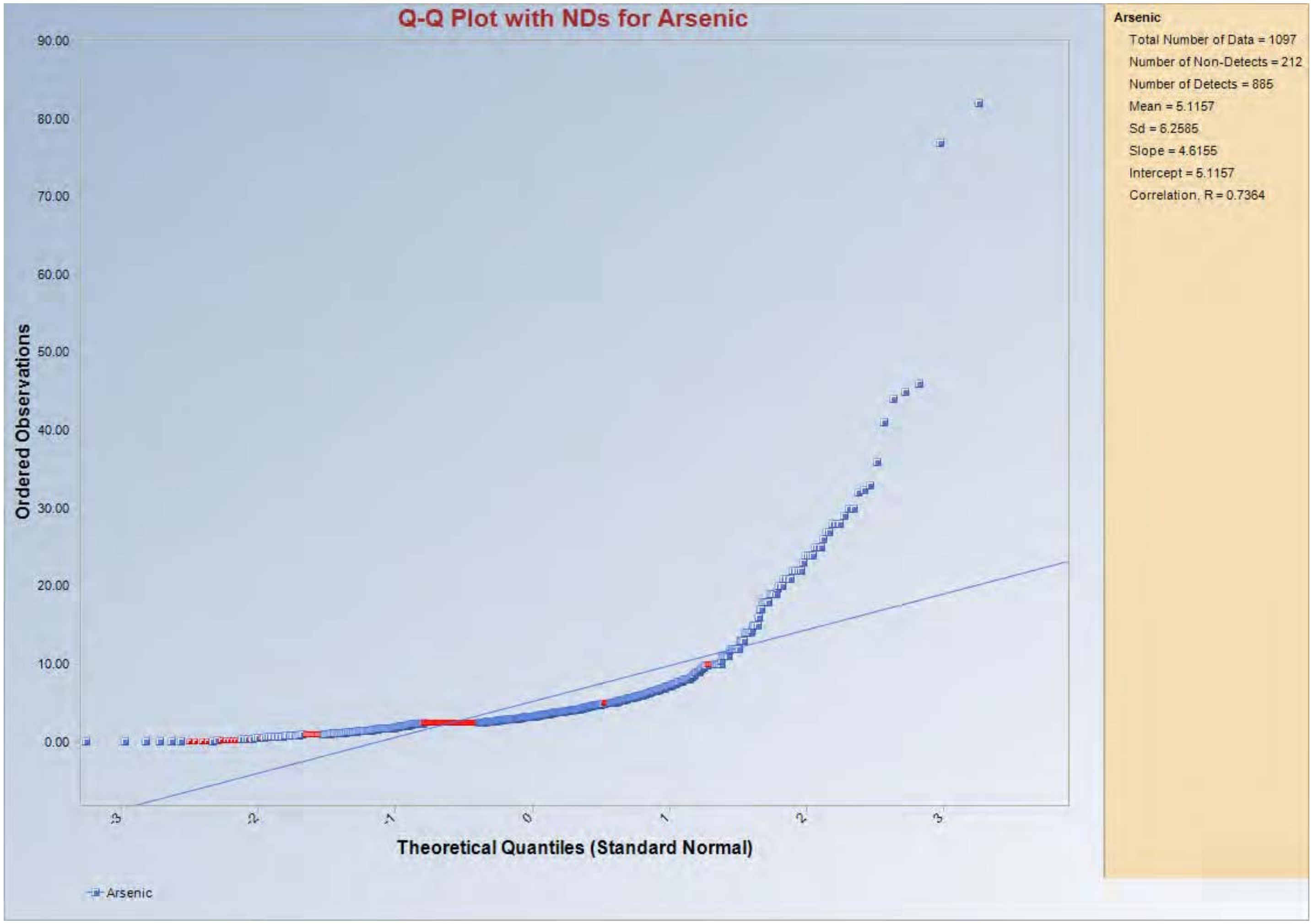

Figure 1: Q-Q Plot for ALL Data Set

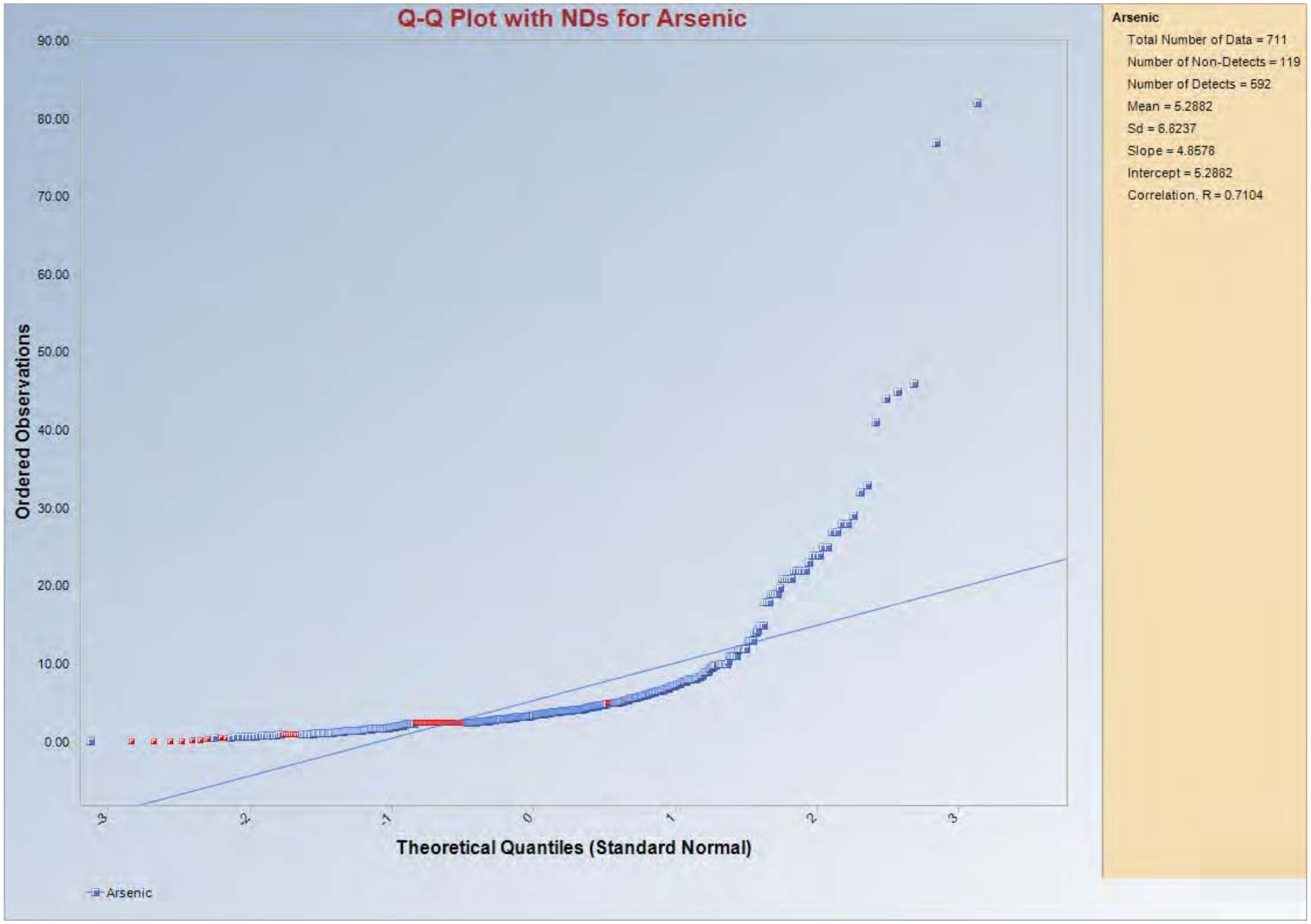

Figure 2: Q-Q Plot for FILL Data Set

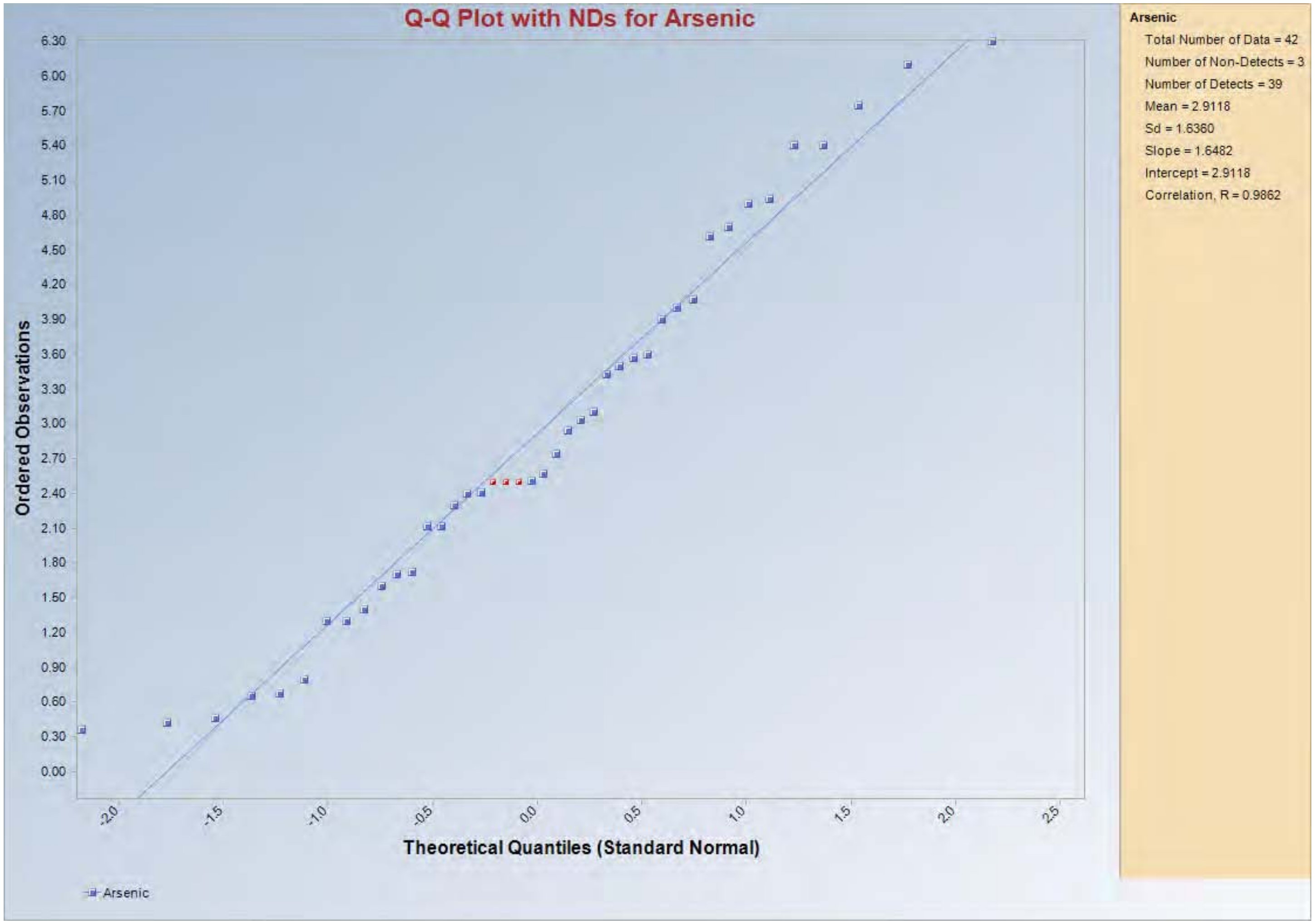

Figure 3: Q-Q Plot for NATIVE Data Set

TABLE 1
Summary of Arsenic Results, Soil,
OIA, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
BART-B-22B	3.1	1	30	BM	5/16/2003
BART-B-29B	5.4	1	15	BM	5/20/2003
HGR1-5-P1A1B5-4	2.3	1	4	BM	3/2/2005
HGR1-5-P1A1B7-3	4.9	1	3	BM	3/2/2005
HGR1-5-P1A2B2-7	3.6	1	7	BM	3/3/2005
HGR1-5-P1A2B4-6	3.5	1	6	BM	3/3/2005
HGR1-5-P2A1B-2-6	1.3	1	6	BM	4/7/2005
HGR1-5-P2A1B-4-4	6.1	1	4	BM	4/7/2005
AFC-B-8-2.5	ND	7.73	2.5	Fill	10/8/1996
AFC-B-9-1.5	8.04	6.39	1.5	Fill	10/8/1996
AIRW-B1-1.5	2	1	1.5	Fill	7/20/1992
AIRW-B1-2.0	11	1	2	Fill	7/20/1992
AIRW-B2-0.5	4	1	0.5	Fill	7/20/1992
AIRW-B2-1.5	3	1	1.5	Fill	7/20/1992
AIRW-B2-2.5	3	1	2.5	Fill	7/20/1992
AIRW-DSA-SW-E	4.7	1	2	Fill	12/6/2002
AIRW-GP1-2.0	ND	2.5	2	Fill	3/1/2000
AIRW-GP2-2.0	ND	2.5	2	Fill	3/1/2000
AIRW-GP3-2.5	ND	2.5	2.5	Fill	3/1/2000
AIRW-SMP-SW-E	3.3	1	2.4	Fill	12/10/2002
AIRW-SMP-SW-N	2.4	1	2.75	Fill	12/10/2002
AIRW-SMP-SW-S	2.4	1	2.6	Fill	12/10/2002
AIRW-SMP-SW-W	1.7	1	2.7	Fill	12/10/2002
AIRW-WP1-1.5	3	1	1.5	Fill	7/20/1992
AIRW-WP2-0.5	4	1	0.5	Fill	7/20/1992
AIRW-WP2-1.5	3	1	1.5	Fill	7/20/1992
AIRW-WP3-1.0	13	1	1	Fill	7/20/1992
AIRW-WP4-1.0	9	1	1	Fill	7/20/1992
AIRW-WP4-2.5	4	1	2.5	Fill	7/20/1992
ARP-A-KB11-1.0	ND	5	1	Fill	6/22/1999
ARP-A-KB7-1.0	ND	5	1	Fill	6/22/1999
ARP-A-KB9-1.5	ND	5	1.5	Fill	6/22/1999
ARP-B-KB1-1.0	ND	10	1	Fill	8/31/1999
ARP-B-KB6-1.0	ND	10	1	Fill	8/31/1999
ARP-B-KX-02-0.5	10	2.5	0.5	Fill	8/2/2000
ARP-B-KX-02-2.0	14	2.5	2	Fill	8/2/2000
ARP-B-KX-04-0.5	21	2.5	0.5	Fill	8/2/2000
ARP-B-KX-06-0.5	13	2.5	0.5	Fill	8/2/2000
ARP-B-KX-06-2.0	12	2.5	2	Fill	8/2/2000
ARP-B-KX-08-0.5	8.5	2.5	0.5	Fill	8/2/2000
ARP-B-KX-08-2.0	9.8	2.5	2	Fill	8/2/2000
CCH-1A	ND	2.5	0.5	Fill	6/23/1993
CCH-1B	1.8	0.5	2	Fill	6/23/1993
CCH-2A	3.1	2.5	0.5	Fill	6/23/1993
CCH-2B	1.9	0.5	2	Fill	6/23/1993
CCH-3A	14.3	5	0.5	Fill	6/23/1993
CCH-3B	5.8	2.5	2	Fill	6/23/1993
CCH-4A	6.9	2.5	0.5	Fill	6/23/1993

TABLE 1
Summary of Arsenic Results, Soil, OIA, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
CCH-4B	3	2.5	2	Fill	6/23/1993
CCH-5A	2.6	2.5	0.2	Fill	6/23/1993
CCH-5B	3.2	0.5	2	Fill	6/23/1993
CCH-6A	ND	0.5	0.5	Fill	6/23/1993
CCH-6B	1.3	0.5	2	Fill	6/23/1993
CCH-7A	1.8	0.5	0	Fill	6/23/1993
CCH-8A	3.1	2.5	0.5	Fill	6/23/1993
CCH-9A	2.9	2.5	0.5	Fill	6/23/1993
CCH-9B	ND	0.5	1	Fill	6/23/1993
CCH-TAR-1	1.7	0.5	0	Fill	6/23/1993
CCH-TAR-2	2.6	0.5	0	Fill	6/23/1993
CON-A-B-10-1.0	2	1	1	Fill	3/19/2002
CON-A-B-4-1.0	6.2	1	1	Fill	6/13/2002
CON-A-B-5-1.0	3.8	1	1	Fill	6/13/2002
CON-A-B-6-1.0	5.3	1	1	Fill	6/14/2002
CON-A-B-7-1.0	1.1	1	1	Fill	6/14/2002
CON-A-B-8-1.0	5	1	1	Fill	6/19/2002
CON-A-B-9-1.0	3.3	1	1	Fill	3/19/2002
EAP2-B-3-1A	1.2	0.21	2	Fill	3/11/2005
EP-UW-11	ND	2.5	2	Fill	12/28/1988
EP-UW-5	ND	2.5	2	Fill	12/28/1988
EZBH-I1-0.0	5.6	0.22	0	Fill	4/2/2003
EZBH-I10-0.0	4.2	0.23	0	Fill	4/2/2003
EZBH-I11-0.0	18	0.22	0	Fill	4/2/2003
EZBH-I11-0.0D	20	0.23	0	Fill	4/2/2003
EZBH-I2-0.0	1.7	0.2	0	Fill	4/2/1930
EZBH-I3-0.0	4.6	0.23	0	Fill	4/2/2003
EZBH-I4-0.0	7.2	0.24	0	Fill	4/2/2003
EZBH-I5-0.0	4.3	0.23	0	Fill	4/2/2003
EZBH-I6-0.0	3.8	0.24	0	Fill	4/2/2003
EZBH-I6-0.0D	4.1	0.22	0	Fill	4/2/2003
EZBH-I7-0.0	6.5	0.24	0	Fill	4/2/2003
EZBH-I8-0.0	4	0.23	0	Fill	4/2/2003
EZBH-I9-0.0	4.8	0.23	0	Fill	4/2/2003
EZBH-T1234-COMP	3.7	0.25	0	Fill	10/25/1999
GGC-MW-GGC1-1.5	4.6	2.5	1.5	Fill	4/22/1991
GGC-MW-GGC2-1.5	ND	3.5	1.5	Fill	4/22/1991
GGC-MW-GGC3-1.0	4.1	2.5	1	Fill	4/23/1991
GGC-MW-GGC4-1.0	6.1	2.5	1	Fill	4/23/1991
GGC-MW-GGC5-1.0	7.1	2.5	1	Fill	4/23/1991
GGC-MW-GGC6-1.5	ND	3.5	1.5	Fill	4/24/1991
GGC-MW-GGC7-1.5	4.5	2.5	1.5	Fill	4/24/1991
GGC-MW-GGC8-1.5	5.7	2.5	1.5	Fill	4/25/1991
GGC-MW-GGC9-1.0	3.2	2.4	1	Fill	4/25/1991
HGR1-5-P1A1B1-1.5	3.4	1	1.5	Fill	3/2/2005
HGR1-5-P1A1B2-1	3.2	1	1	Fill	3/2/2005
HGR1-5-P1A1B3-1	5.3	1	1	Fill	3/2/2005
HGR1-5-P1A1B4-1	4.9	1	1	Fill	3/2/2005

TABLE 1
Summary of Arsenic Results, Soil,
OIA, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
HGR1-5-P1A1B5-1	3.5	1	1	Fill	3/2/2005
HGR1-5-P1A1B6-1	4.5	1	1	Fill	3/2/2005
HGR1-5-P1A1B7-1	4.1	1	1	Fill	3/2/2005
HGR1-5-P1A1B8-1	5.8	1	1	Fill	3/2/2005
HGR1-5-P1A2B1-1	9.6	1	1	Fill	3/3/2005
HGR1-5-P1A2B2-1	5	1	1	Fill	3/3/2005
HGR1-5-P1A2B3-1	7	1	1	Fill	3/3/2005
HGR1-5-P1A2B4-1	7.8	1	1	Fill	3/3/2005
HGR1-5-P1A2B5-1	4.2	1	1	Fill	3/3/2005
HGR1-5-P1A2B6-1	6.3	1	1	Fill	3/3/2005
HGR1-5-P1A2B7-1	3.5	1	1	Fill	3/3/2005
HGR1-5-P1A2B8-1	3.9	1	1	Fill	3/3/2005
HGR1-5-P2A1B-1-2	25	1	2	Fill	4/7/2005
HGR1-5-P2A1B-2-2	3	1	2	Fill	4/7/2005
HGR1-5-P2A1B-3-2	5.6	1	2	Fill	4/7/2005
HGR1-5-P2A1B-4-2	3.3	1	2	Fill	4/7/2005
HGR1-5-P2A1B-5-2	6.6	1	2	Fill	4/7/2005
HGR1-5-P2A1B-6-2	5.2	1	2	Fill	4/7/2005
HGR1-5-P2A1B-7-2	2.5	1	2	Fill	4/7/2005
HGR1-5-P2A1B-8-2	4.1	1	2	Fill	4/7/2005
HGR1-5-P2A2B-1-2	2	1	2	Fill	4/7/2005
HGR1-5-P2A2B-2-2.5	4.7	1	2.5	Fill	4/7/2005
HGR1-5-P2A2B-3-3	1.1	1	3	Fill	4/7/2005
HGR1-5-P2A2B-4-3	4.3	1	3	Fill	4/7/2005
HGR1-5-P2A2B-5-3	8	1	3	Fill	4/7/2005
HGR1-5-P2A2B-6-2.5	1.3	1	2.5	Fill	4/7/2005
HGR1-5-P2A2B-7-3	12	1	3	Fill	4/7/2005
HGR1-5-P2A2B-8-3	4.9	1	3	Fill	4/7/2005
HGR6-SB1-1.5	2.6	0.26	1.5	Fill	8/26/2003
HGR6-SB1-1.5D	3.8	0.23	1.5	Fill	8/26/2003
HGR6-SB11-1.5	7.3	0.48	1.5	Fill	8/27/2003
HGR6-SB12-1.5	2.5	0.3	1.5	Fill	8/27/2003
HGR6-SB12-5.0	7.2	0.34	5	Fill	8/27/2003
HGR6-SB13-1.5	3.1	0.24	1.5	Fill	8/27/2003
HGR6-SB14-2.5	2.7	0.29	2.5	Fill	8/27/2003
HGR6-SB2-2.0	4	0.38	2	Fill	8/26/2003
HGR6-SB3-2.0	0.73	0.24	2	Fill	8/27/2003
HGR6-SB4-2.0	3.3	0.24	2	Fill	8/27/2003
HGR6-SB5-2.5	9.7	0.35	2.5	Fill	8/26/2003
HGR6-SB7-1.5	3.9	0.29	1.5	Fill	8/26/2003
HGR6-SB8-2.0	5.6	0.37	2	Fill	8/26/2003
HGR6-SB8-2.0D	8.1	0.43	2	Fill	8/26/2003
HGR6-SB9-2.0	8	0.3	2	Fill	8/26/2003
HGR8-B-1-1.0	4	3	1	Fill	7/26/1993
HGR8-B-2-1.0	ND	3	1	Fill	7/26/1993
HGR8-B-3-1.0	ND	3	1	Fill	7/26/1993
HGR9-1-1(ABCD)	4	0.24	2.5	Fill	8/11/1997
HGR9-1-2(ABCD)	4.2	0.25	2.5	Fill	8/11/1997

TABLE 1
Summary of Arsenic Results, Soil,
OIA, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
HGR9-2-1(ABCD)	6.2	0.25	2.5	Fill	8/11/1997
HGR9-2-3(ABCD)	5.7	0.24	2.5	Fill	8/13/1997
HGR9-2-5(ABCD)	7.3	0.24	2.5	Fill	8/13/1997
HGR9-3-1(ABCD)	3.3	0.25	2.5	Fill	8/12/1997
HGR9-3-4(ABCD)	4.8	0.24	2.5	Fill	8/12/1997
IRAC-1R-1-0.5	4.1	0.24	0.5	Fill	9/2/1998
IRAC-1R-10-1.0	7.7	0.24	1	Fill	9/3/1998
IRAC-1R-2-1.0	2.9	0.24	1	Fill	9/2/1998
IRAC-1R-3-1.0	1.6	0.24	1	Fill	9/2/1998
IRAC-1R-4-0.5	6.1	0.24	0.5	Fill	9/2/1998
IRAC-1R-5-1.0	5.5	0.25	1	Fill	9/2/1998
IRAC-1R-6-0.5	4.7	0.24	0.5	Fill	9/3/1998
IRAC-1R-7-0.5	7.8	0.25	0.5	Fill	9/3/1998
IRAC-1R-8-0.5	3.9	0.24	0.5	Fill	9/3/1998
IRAC-1R-9-1.0	7.5	0.25	1	Fill	9/3/1998
IRAC-1S-1-1.0	5	0.25	1	Fill	9/2/1998
IRAC-1S-2-1.0	4	0.24	1	Fill	9/2/1998
IRAC-1S-3-1.0	4.4	0.24	1	Fill	9/2/1998
IRAC-1S-4-1.0	4.7	0.24	1	Fill	9/2/1998
IRAC-1S-5-0.5	2.6	0.25	0.5	Fill	9/3/1998
IRAC-1S-6-1.0	4.1	0.25	1	Fill	9/2/1998
IRAC-2R-10-1.5	6.8	0.25	1.5	Fill	9/4/1998
IRAC-2R-1-1.5	8	0.24	1.5	Fill	9/4/1998
IRAC-2R-2-1.5	6.6	0.24	1.5	Fill	9/4/1998
IRAC-2R-3-1.5	5.2	0.24	1.5	Fill	9/4/1998
IRAC-2R-4-1.0	2.5	0.25	1	Fill	9/4/1998
IRAC-2R-5-1.0	3.5	0.24	1	Fill	9/4/1998
IRAC-2R-6-1.0	6.9	0.24	1	Fill	9/4/1998
IRAC-2R-7-1.5	4.1	0.25	1.5	Fill	9/4/1998
IRAC-2R-8-1.5	2.6	0.24	1.5	Fill	9/4/1998
IRAC-2R-9-1.5	1.6	0.24	1.5	Fill	9/4/1998
IRAC-2S-1-1.5	3.1	0.25	1.5	Fill	9/3/1998
IRAC-2S-2-1.0	1.7	0.25	1	Fill	9/3/1998
IRAC-2S-3-0.5	3.7	0.25	0.5	Fill	9/3/1998
IRAC-2S-4-1.0	4	0.24	1	Fill	9/4/1998
IRAC-3R-1-0.5	4.2	0.25	0.5	Fill	9/3/1998
IRAC-3R-2-1.0	3.7	0.24	1	Fill	9/3/1998
IRAC-3R-3-0.5	3.4	0.24	0.5	Fill	9/3/1998
IRAC-3R-4-0.5	4	0.24	0.5	Fill	9/3/1998
IRP-B10-1.0	5.1	1	1	Fill	4/30/2002
IRP-B11-1.0	4.6	1	1	Fill	4/30/2002
IRP-B12-1.0	1.9	1	1	Fill	4/30/2002
IRP-B13-1.0	6.5	1	1	Fill	5/2/2002
IRP-B15-1.5	3.9	1	1.5	Fill	5/1/2002
IRP-B16-1.0	5.7	1	1	Fill	5/1/2002
IRP-B17-1.0	3.7	1	1	Fill	5/1/2002
IRP-B18-1.0	3.2	1	1	Fill	5/1/2002
IRP-B19-1.0	2.4	1	1	Fill	5/1/2002

TABLE 1
Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
IRP-B20-1.0	4.5	1	1	Fill	5/1/2002
IRP-B21-1.5	7.9	1	1.5	Fill	5/1/2002
IRP-B22-1.0	2.8	1	1	Fill	5/2/2002
IRP-B23-1.0	2.9	1	1	Fill	5/2/2002
IRP-B24-1.0	5.7	1	1	Fill	5/2/2002
IRP-B25-1.0	4.6	1	1	Fill	5/2/2002
IRP-B26-1.0	2.3	1	1	Fill	5/2/2002
IRP-B27-1.0	3.1	1	1	Fill	5/2/2002
IRP-B28-1.0	8.4	1	1	Fill	5/2/2002
IRP-B7-1.0	13	1	1	Fill	5/2/2002
IRP-B8-1.0	3.7	1	1	Fill	4/30/2002
IRP-B9-1.0	4.3	1	1	Fill	4/30/2002
KIDS-KI-1a	ND	2.5	2	Fill	1/25/1989
KIDS-KI-9	ND	2.5	0	Fill	1/25/1989
LANG-DD-SS-1	ND	2.5	0	Fill	12/19/2000
LANG-DD-SS-10	3.4	2.5	0	Fill	12/19/2000
LANG-DD-SS-11	28	2.5	0	Fill	12/19/2000
LANG-DD-SS-12	3.5	2.5	0	Fill	12/19/2000
LANG-DD-SS-13	2.7	2.5	0	Fill	12/19/2000
LANG-DD-SS-14	3.9	2.5	0	Fill	12/19/2000
LANG-DD-SS-2	ND	2.5	0	Fill	12/19/2000
LANG-DD-SS-3	ND	2.5	0	Fill	12/19/2000
LANG-DD-SS-4	ND	2.5	0	Fill	12/19/2000
LANG-DD-SS-5	5.4	2.5	0.5	Fill	12/19/2000
LANG-DD-SS-6	5.3	2.5	0	Fill	12/19/2000
LANG-DD-SS-7	7.1	2.5	0	Fill	12/19/2000
LANG-DD-SS-8	3.7	2.5	0	Fill	12/19/2000
LANG-DD-SS-9	4	2.5	0	Fill	12/19/2000
M110-ERM-B10-2.5	23	10	2.5	Fill	4/17/2003
M110-ERM-B11-2.5	24	10	2.5	Fill	4/17/2003
M110-ERM-B12-2	27	10	2	Fill	4/17/2003
M110-ERM-B15-1	22	10	1	Fill	4/17/2003
M110-ERM-B22-1.5	25	10	1.5	Fill	4/17/2003
M110-ERM-B4-2.5	19	10	2.5	Fill	4/15/2003
M110-ERM-B5-2.5	21	10	2.5	Fill	4/15/2003
M110-ERM-B6-2.5	19	10	2.5	Fill	4/15/2003
M110-W-B-1-0	2.6	2.5	0.5	Fill	4/14/2003
M110-W-B-10-0	ND	2.5	0	Fill	4/15/2003
M110-W-B-11-0	ND	2.5	0.5	Fill	4/15/2003
M110-W-B-11-1.5S	29	10	1.5	Fill	4/15/2003
M110-W-B-12-0	ND	2.5	0.5	Fill	4/15/2003
M110-W-B-12-0.5S	33	10	0.5	Fill	4/15/2003
M110-W-B-13-0	2.8	2.5	0.5	Fill	4/15/2003
M110-W-B-14-0	ND	2.5	0	Fill	4/15/2003
M110-W-B-15-0	ND	2.5	0.5	Fill	4/15/2003
M110-W-B-16-0	ND	2.5	0.5	Fill	4/17/2003
M110-W-B-16-1.5S	24	10	1.5	Fill	4/17/2003
M110-W-B-17-0	ND	2.5	0.5	Fill	4/17/2003

TABLE 1
Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
M110-W-B-17-1.5S	28	10	1.5	Fill	4/17/2003
M110-W-B-2-0	2.6	2.5	0.5	Fill	4/14/2003
M110-W-B-21-0	ND	2.5	0.5	Fill	4/17/2003
M110-W-B-22-0	2.6	2.5	0.5	Fill	4/18/2003
M110-W-B-22-2.5S	22	10	2.5	Fill	4/18/2003
M110-W-B-23-0	ND	2.5	0.5	Fill	4/18/2003
M110-W-B-24-0	ND	2.5	0.5	Fill	4/14/2003
M110-W-B-25-0	ND	2.5	0	Fill	4/15/2003
M110-W-B-25-1.5S	82	10	1.5	Fill	4/15/2003
M110-W-B-26-0	ND	2.5	0.5	Fill	4/16/2003
M110-W-B-27-0	ND	2.5	0.5	Fill	4/16/2003
M110-W-B-28-0	3.2	2.5	0.5	Fill	4/16/2003
M110-W-B-29-0	3.1	2.5	0.5	Fill	4/16/2003
M110-W-B-29-1.5S	77	10	1.5	Fill	4/16/2003
M110-W-B-3-0	2.8	2.5	0.5	Fill	4/14/2003
M110-W-B-30-0	3.7	2.5	0.5	Fill	4/16/2003
M110-W-B-31-0	2.8	2.5	0.5	Fill	4/16/2003
M110-W-B-32-0	3.1	2.5	0.5	Fill	4/16/2003
M110-W-B-32-1.5S	22	10	1.5	Fill	4/16/2003
M110-W-B-33-0	3.9	2.5	0.5	Fill	4/16/2003
M110-W-B-33-2.5	4.3	2.5	2.5	Fill	4/16/2003
M110-W-B-34-0	32	2.5	0.5	Fill	4/17/2003
M110-W-B-35-0	5.9	2.5	0.5	Fill	4/17/2003
M110-W-B-36-0	ND	2.5	0.5	Fill	4/17/2003
M110-W-B-37-0	ND	2.5	0.5	Fill	4/17/2003
M110-W-B-38-0	ND	2.5	0.5	Fill	4/15/2003
M110-W-B-38-2.5S	21	10	2.5	Fill	4/15/2003
M110-W-B-39-0	ND	2.5	0.5	Fill	4/14/2003
M110-W-B-4-0	3.8	2.5	0.5	Fill	4/14/2003
M110-W-B-5-0	4.6	4.6	0.5	Fill	4/14/2003
M110-W-B-6-0	4.2	2.5	0.5	Fill	4/14/2003
M110-W-B-7-0	ND	2.5	0.5	Fill	4/17/2003
M110-W-B-7-1.5S	21	10	1.5	Fill	4/17/2003
M110-W-B-8-0	11	2.5	0.5	Fill	4/14/2003
M110-W-B-8-2S	46	10	2	Fill	4/14/2003
NAEW-KB10-1.0	ND	2.5	1	Fill	3/29/2001
NAEW-KB10-5.0	3.2	2.5	5	Fill	3/29/2001
NAEW-KB10-7.5	3.1	2.5	7.5	Fill	3/29/2001
NAEW-KB1-1.0	4.5	2.5	1	Fill	3/28/2001
NAEW-KB11-1.0	ND	2.5	1	Fill	3/28/2001
NAEW-KB11-6.0	4.1	2.5	6	Fill	3/28/2001
NAEW-KB11-7.5	2.5	2.5	7.5	Fill	3/28/2001
NAEW-KB12-2.0	ND	2.5	2	Fill	3/28/2001
NAEW-KB12-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB13-1.0	ND	2.5	1	Fill	3/28/2001
NAEW-KB13-6.0	21	2.5	6	Fill	3/28/2001
NAEW-KB13-7.0	2.6	2.5	7	Fill	3/28/2001
NAEW-KB14-2.0	ND	2.5	2	Fill	3/28/2001

TABLE 1
Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
NAEW-KB14-5.0	3.5	2.5	5	Fill	3/28/2001
NAEW-KB14-7.0	ND	2.5	7	Fill	3/28/2001
NAEW-KB1-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB15-1.5	ND	2.5	1.5	Fill	3/28/2001
NAEW-KB15-5.0	8.9	2.5	5	Fill	3/28/2001
NAEW-KB15-7.0	3.7	2.5	7	Fill	3/28/2001
NAEW-KB1-6.5	ND	2.5	6.5	Fill	3/28/2001
NAEW-KB16-1.0	4	2.5	1	Fill	3/28/2001
NAEW-KB16-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB16-7.0	ND	2.5	7	Fill	3/28/2001
NAEW-KB17-1.0	ND	2.5	1	Fill	3/28/2001
NAEW-KB17-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB17-6.5	ND	2.5	6.5	Fill	3/28/2001
NAEW-KB18-1.0	7.6	2.5	1	Fill	3/28/2001
NAEW-KB18-6.0	ND	2.5	6	Fill	3/28/2001
NAEW-KB18-7.0	ND	2.5	7	Fill	3/28/2001
NAEW-KB19-1.0	ND	2.5	1	Fill	3/29/2001
NAEW-KB19-5.0	2.7	2.5	5	Fill	3/29/2001
NAEW-KB19-6.0	ND	2.5	6	Fill	3/29/2001
NAEW-KB20-1.0	2.6	2.5	1	Fill	3/28/2001
NAEW-KB20-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB20-6.5	ND	2.5	6.5	Fill	3/28/2001
NAEW-KB2-10.5	ND	2.5	10.5	Fill	3/28/2001
NAEW-KB2-2.0	ND	2.5	2	Fill	3/28/2001
NAEW-KB2-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB3-2.0	3.6	2.5	2	Fill	3/28/2001
NAEW-KB3-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB3-9.5	ND	2.5	9.5	Fill	3/28/2001
NAEW-KB4-1.0	4.2	2.5	1	Fill	3/29/2001
NAEW-KB4-11.0	8.9	2.5	11	Fill	3/29/2001
NAEW-KB4-5.5	2.7	2.5	5.5	Fill	3/29/2001
NAEW-KB5-1.5	8.7	2.5	1.5	Fill	3/28/2001
NAEW-KB5-5.0	ND	2.5	5	Fill	3/28/2001
NAEW-KB5-9.5	ND	2.5	9.5	Fill	3/28/2001
NAEW-KB6-1.0	2.8	2.5	1	Fill	3/29/2001
NAEW-KB6-5.0	2.5	2.5	5	Fill	3/29/2001
NAEW-KB6-9.5	ND	2.5	9.5	Fill	3/29/2001
NAEW-KB7-10.0	ND	2.5	10	Fill	3/29/2001
NAEW-KB7-2.0	ND	2.5	2	Fill	3/29/2001
NAEW-KB7-5.5	2.5	2.5	5.5	Fill	3/29/2001
NAEW-KB8-1.0	3.5	2.5	1	Fill	3/29/2001
NAEW-KB8-5.0	6.3	2.5	5	Fill	3/29/2001
NAEW-KB8-8.5	3.5	2.5	8.5	Fill	3/29/2001
NAEW-KB9-1.0	4	2.5	1	Fill	3/29/2001
NAEW-KB9-10.0	ND	2.5	10	Fill	3/29/2001
NAEW-KB9-5.0	2.6	2.5	5	Fill	3/29/2001
RA-SB-10-1	5	1	1	Fill	9/26/1994
RA-SB-11-1	3	1	1	Fill	9/26/1994

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Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
RA-SB-7-1	4	1	1	Fill	9/16/1994
RA-SB-8-1	13	1	1	Fill	9/26/1994
RA-SB-9-1	4	1	1	Fill	9/26/1994
RRMA-B10-1.0	7.5	2.5	1	Fill	6/8/2000
RRMA-B11-1.0	3.9	2.5	1	Fill	6/8/2000
RRMA-B11-2.0	6.6	2.5	2	Fill	6/8/2000
RRMA-B1-2.0	4.5	2.5	2	Fill	5/4/2000
RRMA-B12-1.0	3.7	2.5	1	Fill	6/8/2000
RRMA-B12-2.0	5.7	2.5	2	Fill	6/8/2000
RRMA-B13-1.0	5.1	2.5	1	Fill	6/8/2000
RRMA-B13-2.0	9.5	2.5	2	Fill	6/8/2000
RRMA-B14-1.0	12	2.5	1	Fill	6/8/2000
RRMA-B14-2.0	8.4	2.5	2	Fill	6/8/2000
RRMA-B15-1.0	6.2	2.5	1	Fill	6/8/2000
RRMA-B15-2.0	3.2	2.5	2	Fill	6/8/2000
RRMA-B16-1.0	8.3	2.5	1	Fill	6/8/2000
RRMA-B16-2.0	7.4	2.5	2	Fill	6/8/2000
RRMA-B17-2.0	7.5	2.5	2	Fill	6/8/2000
RRMA-B18-2.0	7.2	2.5	2	Fill	6/8/2000
RRMA-B2-1.0	ND	2.5	1	Fill	5/4/2000
RRMA-B2-2.0	ND	2.5	2	Fill	5/4/2000
RRMA-B3-1.0	2.9	2.5	1	Fill	5/4/2000
RRMA-B3-2.0	3	2.5	2	Fill	Not provided
RRMA-B4-2.0	5.9	2.5	2	Fill	5/4/2000
RRMA-B5-2.0	5.7	2.5	2	Fill	5/4/2000
RRMA-B6-2.0	ND	2.5	2	Fill	5/4/2000
RRMA-B7-2.0	5	2.5	2	Fill	5/4/2000
RRMA-B8-1.0	ND	2.5	1	Fill	5/4/2000
RRMA-B8-2.0	5.2	2.5	2	Fill	5/4/2000
RRMA-E1-1	3.9	0.27	1	Fill	7/12/2004
RRMA-E2-1	6	0.23	1	Fill	7/12/2004
RRMA-KB19-1.0	ND	2.5	1	Fill	12/12/2000
RRMA-KB19-2.0	ND	2.5	2	Fill	12/12/2000
RRMA-KB20-1.0	2.5	2.5	1	Fill	12/12/2000
RRMA-KB20-2.0	3.6	2.5	2	Fill	12/12/2000
RRMA-KB21-1.0	2.8	2.5	1	Fill	12/12/2000
RRMA-KB21-2.0	3.9	2.5	2	Fill	12/12/2000
RRMA-KB22-1.0	4.4	2.5	1	Fill	12/12/2000
RRMA-KB22-2.0	4	2.5	2	Fill	12/12/2000
RRMA-KB23-1.0	3.5	2.5	1	Fill	12/12/2000
RRMA-KB23-2.0	ND	2.5	2	Fill	12/12/2000
RRMA-KB24-1.0	2.5	2.5	1	Fill	12/12/2000
RRMA-KB24-2.0	5.4	2.5	2	Fill	12/12/2000
RRMA-KB25-1.0	2.6	2.5	1	Fill	12/12/2000
RRMA-KB25-2.0	2.9	2.5	2	Fill	12/12/2000
RRMA-KB26-1.0	2.7	2.5	1	Fill	12/11/2000
RRMA-KB26-2.0	ND	2.5	2	Fill	12/11/2000
RRMA-KB27-1.0	ND	2.5	1	Fill	12/11/2000

TABLE 1
Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
RRMA-KB27-2.0	4.5	2.5	2	Fill	12/11/2000
RRMA-KB28-1.0	10	2.5	1	Fill	12/11/2000
RRMA-KB28-2.0	ND	2.5	2	Fill	12/11/2000
RRMA-KB29-1.0	ND	2.5	1	Fill	12/11/2000
RRMA-KB29-2.0	3.2	2.5	2	Fill	12/11/2000
RRMA-KB30-1.0	ND	2.5	1	Fill	12/11/2000
RRMA-KB30-2.0	4	2.5	2	Fill	12/11/2000
RRMA-KB31-1.0	4.6	2.5	1	Fill	12/11/2000
RRMA-KB31-2.0	4.5	2.5	2	Fill	12/11/2000
RRMA-KB32-1.0	6.7	2.5	1	Fill	12/11/2000
RRMA-KB32-2.0	2.7	2.5	2	Fill	12/11/2000
RRMA-KB33-1.0	ND	2.5	1	Fill	12/11/2000
RRMA-KB33-2.0	2.5	2.5	2	Fill	12/11/2000
RRMA-KB34-1.0	ND	2.5	1	Fill	12/11/2000
RRMA-KB34-2.0	3.2	2.5	2	Fill	12/11/2000
RRMA-KB35-1.0	41	2.5	1	Fill	12/11/2000
RRMA-KB35-2.0	44	2.5	2	Fill	12/11/2000
RRMA-KB36-1.0	2.5	2.5	1	Fill	12/11/2000
RRMA-KB36-2.0	2.8	2.5	2	Fill	12/11/2000
RRMA-KB37-1.0	ND	2.5	1	Fill	12/11/2000
RRMA-KB37-2.0	ND	2.5	2	Fill	12/11/2000
RRMA-KB38-1.0	3.3	2.5	1	Fill	12/11/2000
RRMA-KB38-2.0	2.5	2.5	2	Fill	12/11/2000
RRMA-N2-1	6.5	0.25	1	Fill	7/12/2004
RRMA-N3-1	5	0.21	1	Fill	7/12/2004
RRMA-S1-1	7.7	0.24	1	Fill	7/12/2004
RRMA-S2-1	1.8	0.22	1	Fill	7/12/2004
RRMA-S3-1	6.4	0.18	1	Fill	7/12/2004
RRMA-S4-1	3.6	0.18	1	Fill	7/12/2004
RRMA-T1-1	2.6	0.23	1	Fill	7/12/2004
RRMA-T2-1	5	0.27	1	Fill	7/12/2004
RRTC-KB-01-1.0	6.4	2.5	1	Fill	7/15/2002
RRTC-KB-02-1.0	7.8	2.5	1	Fill	7/15/2002
RRTC-KB-03-0.0	5.8	2.5	0	Fill	7/15/2002
RRTC-KB-03-1.0	10	2.5	1	Fill	7/15/2002
RRTC-KB-04-1.0	5	2.5	1	Fill	7/15/2002
RRTC-KB-05-0.0	7.2	2.5	0	Fill	7/16/2002
RRTC-KB-05-2.0	8.2	2.5	2	Fill	7/16/2002
RRTC-KB-06-0.0	11	2.5	0	Fill	7/16/2002
RRTC-KB-06-2.0	ND	2.5	2	Fill	7/16/2002
RRTC-KB-07-1.0	ND	2.5	1	Fill	7/15/2002
RRTC-KB-08-1.0	4.5	2.5	1	Fill	7/16/2002
RRTC-KB-09-1.0	9.9	2.5	1	Fill	7/16/2002
RRTC-KB-10-2.0	ND	2.5	2	Fill	7/16/2002
RRTC-KB-11-1.0	6.8	2.5	1	Fill	7/16/2002
RRTC-KB-12-1.0	11	2.5	1	Fill	7/16/2002
RRTC-KB-13-0.0	10	2.5	0	Fill	7/17/2002
RRTC-KB-13-2.0	ND	5	2	Fill	7/17/2002

TABLE 1
Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
RRTC-KB-14-0.0	4.3	2.5	0	Fill	7/17/2002
RRTC-KB-15-0.0	ND	2.5	0	Fill	7/17/2002
RRTC-KB-16-0.0	ND	5	0	Fill	7/12/2002
RRTC-KB-17-0.0	6.6	5	0	Fill	7/12/2002
RRTC-KB-18-0.0	ND	5	0	Fill	7/15/2002
RRTC-KB-19-0.0	5.8	5	0	Fill	7/12/2002
RRTC-KB-20-1.0	8.5	5	1	Fill	7/15/2002
RRTC-KB-21-1.0	9.4	5	1	Fill	7/15/2002
RRTC-KB-22-1.0	7.4	5	1	Fill	7/16/2002
RRTC-KB-23-0.0	10	5	0	Fill	7/17/2002
RRTC-KB-24-0.0	11	5	0	Fill	7/17/2002
RRTC-KB-24-2.0	8.1	2.5	2	Fill	7/17/2002
RRTC-KB-25-0.0	4.5	2.5	0	Fill	7/17/2002
RRTC-KB-25-2.0	3.6	2.5	2	Fill	7/17/2002
RRTC-KB-26-0.0	12	2.5	0	Fill	7/12/2002
RRTC-KB-26-3.0	5.5	2.5	2	Fill	7/12/2002
RRTC-OB-2-0.5	8	5	0.5	Fill	11/3/1995
RRTC-OB-2-2.0	ND	5	2	Fill	11/3/1995
RRTC-OB-3-0.0	8	5	0	Fill	11/3/1995
RRTC-OB-3-2.0	10	5	2	Fill	11/3/1995
RRTC-OB-4-0.0	ND	5	0	Fill	11/3/1995
RRTC-OB-4-1.0	ND	5	1	Fill	11/3/1995
RRTC-OB-5-0.0	9	5	0	Fill	11/3/1995
RRTC-OB-6-0.0	ND	5	0	Fill	11/3/1995
TAXI-3R-1-0.5	4.2	0.25	0.5	Fill	9/3/1998
TAXI-3R-2-1.0	3.7	0.24	1	Fill	9/3/1998
TAXI-3R-3-0.5	3.4	0.24	0.5	Fill	9/3/1998
TAXI-3R-4-0.5	4	0.24	0.5	Fill	9/3/1998
AFC-SB-1-4.0	ND	6.85	4		10/9/1996
AIRW-B1-4.0	ND	1	4		7/20/1992
AIRW-B2-3.5	2	1	3.5		7/20/1992
AIRW-DSA-B-4.0	ND	1	4		12/6/2002
AIRW-DSA-CW	2.3	1	0		12/11/2002
AIRW-DSA-SW-N	3.2	1	4		12/6/2002
AIRW-DSA-SW-S	2.6	1	4.4		12/6/2002
AIRW-DSA-SW-W	3.2	1	3.67		12/6/2002
AIRW-SMP-B-3.0	2	1	3		12/10/2002
AIRW-SMP-CW	1.4	1	0		12/11/2002
AIRW-WP1-3.0	2	1	3		7/20/1992
AIRW-WP2-3.0	2	1	3		7/20/1992
AIRW-WP3-4.0	2	1	4		7/20/1992
AIRW-WP4-4.0	ND	1	4		7/20/1992
ALS#2-ALS22-1	32.4	2	0		6/30/1993
ARP-A-KB11-10.0	ND	5	10		6/22/1999
ARP-A-KB11-5.0	ND	5	5		6/22/1999
ARP-A-KB7-10.0	ND	5	10		6/22/1999
ARP-A-KB7-5.0	ND	5	5		6/22/1999
ARP-A-KB9-10.0	ND	5	10		6/22/1999

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Summary of Arsenic Results, Soil,
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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
ARP-A-KB9-5.0	ND	5	5		6/22/1999
ARP-B-KB1-10.0	ND	10	10		8/31/1999
ARP-B-KB1-5.0	ND	10	5		8/31/1999
ARP-B-KB3-10.0	ND	10	10		9/1/1999
ARP-B-KB3-14.5	ND	10	14.5		9/1/1999
ARP-B-KB3-15.0	ND	10	15		9/1/1999
ARP-B-KB3-5.0	ND	10	5		9/1/1999
ARP-B-KB6-10.0	ND	10	10		8/31/1999
ARP-B-KB6-5.0	ND	10	5		8/31/1999
ARP-B-KX01-COMP	7.8	0.24	0		8/2/2000
ARP-B-KX-02-3.5	20	2.5	3.5		8/2/2000
ARP-B-KX-02-5.0	8.9	2.5	5		8/2/2000
ARP-B-KX02-COMP	5.3	0.24	0		8/2/2000
ARP-B-KX03-COMP	5.3	0.25	0		8/2/2000
ARP-B-KX-04-4.4	17	2.5	4.4		8/2/2000
ARP-B-KX-04-5.5	6.9	2.5	5.5		8/2/2000
ARP-B-KX04-COMP	4.3	0.24	0		8/2/2000
ARP-B-KX05-COMP	3.9	0.25	0		8/2/2000
ARP-B-KX06-COMP	6.3	0.25	0		8/2/2000
ARP-B-KX07-COMP	2.9	0.24	0		8/2/2000
ARP-B-KX-08-3.5	8.7	2.5	3.5		8/2/2000
ARP-B-KX-08-5.0	7.2	2.5	5		8/2/2000
ARP-B-KX08-COMP	4.2	0.25	0		8/2/2000
ARP-B-KX09-COMP	2.4	0.25	0		8/2/2000
ARP-B-KX10-COMP	3.9	0.25	0		8/2/2000
ARP-B-KX-11	20	2.5	0		8/21/2000
ARP-B-KX-12	14	2.5	0		8/21/2000
ARP-B-KX-13	12	2.5	0		8/21/2000
ARP-B-KX-14	14	2.5	0		8/21/2000
ARP-B-KX-15	9.4	2.5	0		8/21/2000
ARP-B-KX-16	9.8	2.5	0		8/21/2000
ARP-B-KX-17	8.9	2.5	0		8/21/2000
ARP-B-KX-18	6.7	2.5	0		8/21/2000
ARP-B-KX-19	3.3	2.5	0		8/21/2000
ARP-B-KX-20	3.1	2.5	0		8/21/2000
ARP-B-KX-21	ND	2.5	0		8/21/2000
BART-B-22A	1.2	1	3		5/16/2003
BART-B-23A	6.7	1	3		5/20/2003
BART-B-24A	6.8	1	5		5/20/2003
BART-B-25A	7.3	1	5		5/20/2003
BART-B-26A	3.9	1	3		5/20/2003
BART-B-27A	1.7	1	3		5/20/2003
BART-B-28A	1.4	1	3		5/20/2003
BART-B-29A	3.4	1	3		5/20/2003
CCH-7B	5.8	2.5	4		6/23/1993
CCH-7C	2.1	0.5	4.5		6/23/1993
CCH-8B	5.1	2.5	4		6/23/1993
CCH-9C	2.8	0.5	4		6/23/1993

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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
CON-A-B-10-3.0	2.1	1	3		3/19/2002
CON-A-B-1-3.0	2.4	1	3		6/13/2002
CON-A-B-2-3.0	1.8	1	3		6/13/2002
CON-A-B-3-3.0	2.7	1	3		6/13/2002
CON-A-B-4-3.0	2.8	1	3		6/13/2002
CON-A-B-5-3.0	1.5	1	3		6/13/2002
CON-A-B-6-3.0	2.6	1	3		6/14/2002
CON-A-B-7-3.0	ND	1	3		6/14/2002
CON-A-B-8-3.0	2.4	1	3		6/19/2002
CON-A-B-9-3.0	2.8	1	3		3/19/2002
EAP2-B-4-2A	1.1	0.21	5.5		2/25/2005
EAP2-B-5-2A	0.96	0.19	5.5		3/14/2005
EBMUD-SB1A-2-4	ND	1	2		12/13/1995
EP-MF23/24-S-1	ND	2.5	0		6/6/1991
EP-MF25/26-S-1	1.2		0		3/19/1992
EZBH-L1-COMP	3	0.25	0		10/25/1999
EZBH-L2-COMP	2	0.25	0		10/25/1999
EZBH-L3-3.0	0.36	0.25	3		10/25/1999
EZBH-L4-COMP	0.7	0.25	0		10/25/1999
EZBH-L5-COMP	3.2	0.25	0		10/25/1999
EZBH-LS-COMP	3.9	0.25	0		10/25/1999
EZBH-U1234-COMP	6	0.25	0		10/25/1999
EZBH-U5678-COMP	2.7	0.25	0		10/25/1999
HGR6-MW2-4.0	7.2	0.49	4		8/27/2003
HGR6-SB10-5.0	6.5	0.38	5		8/26/2003
HGR6-SB6-3.0	11	0.38	3		8/26/2003
HGR6-SB7-6.5	3.6	0.24	6.5		8/26/2003
HGR6-SB8-6.5	5.4	0.48	6.5		8/26/2003
HGR6-SB9-6.5	6	0.42	6.5		8/26/2003
HGR9-LF19-SP-1	ND	2.5	0		11/15/1991
HGR9-LF19-SP-2	ND	2.5	0		11/15/1991
HGR9-LF19-SP-5	ND	2.5	0		12/12/1991
HGR9-LF20-LH20	ND	2.5	0		12/12/1991
HRZ-N-SB10-11	4.89	0.5	11		1/23/2002
HRZ-N-SB1-3	4.71	0.5	3		1/23/2002
HRZ-N-SB2-4	5.29	0.5	4		1/23/2002
HRZ-N-SB3-3	4.51	0.5	3		1/24/2002
HRZ-N-SB4-11	3.33	0.5	11		1/23/2002
HRZ-N-SB5-12	3.94	0.5	12		1/23/2002
HRZ-N-SB7-10	5.01	0.5	10		1/23/2002
HRZ-N-SB8-24	5.54	0.5	24		1/23/2002
HRZ-N-SB9-16	3.49	0.5	16		1/23/2002
IRP-B10-3.0	4.3	1	3		4/30/2002
IRP-B11-3.0	3.8	1	3		4/30/2002
IRP-B12-3.0	5.2	1	3		4/30/2002
IRP-B13-3.0	6.3	1	3		5/2/2002
IRP-B14-3.0	3.3	1	3		5/1/2002
IRP-B15-3.0	4.1	1	3		5/1/2002

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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
IRP-B16-3.0	3.2	1	3		5/1/2002
IRP-B17-3.0	3.6	1	3		5/1/2002
IRP-B18-3.0	1.2	1	3		5/1/2002
IRP-B19-3.0	5.9	1	3		5/1/2002
IRP-B20-3.0	7.1	1	3		5/1/2002
IRP-B21-3.0	4.7	1	3		5/1/2002
IRP-B22-3.0	5.7	1	3		5/2/2002
IRP-B23-3.0	7.6	1	3		5/2/2002
IRP-B24-3.0	2.9	1	3		5/2/2002
IRP-B25-3.0	5.4	1	3		5/2/2002
IRP-B26-3.0	7.5	1	3		5/2/2002
IRP-B27-3.0	4.8	1	3		5/2/2002
IRP-B28-3.0	7	1	3		5/2/2002
IRP-B7-3.0	4.9	1	3		5/2/2002
IRP-B8-3.0	1.7	1	3		4/30/2002
IRP-B9-3.0	3.4	1	3		4/30/2002
KIDS-KI-6	ND	2.5	3.5		1/25/1989
KIDS-KI-8	ND	2.5	3		1/25/1989
L156-N Piping Run	0.72	0.25	3		6/25/2006
L156-Pipe Stock	18	0.25	0		6/25/2006
L156-S Piping Run	3.9	0.25	3		6/25/2006
L156-UST1-N Wall	2.9	0.25	7		6/22/2006
L156-UST1-S Wall	1.7	0.25	7		6/22/2006
L156-UST2-N Wall	3	0.25	7		6/22/2006
L156-UST2-S Wall	2.2	0.25	7		6/22/2006
L156-UST2-Stock	3	0.25	0		6/22/2006
L818-UST1-SP001	6.77	1.1	0		8/11/2000
L818-UST1-SP002A	6.12	1.09	0		8/11/2000
L818-UST1-SP002B	7.2	1.1	0		8/11/2000
L818-UST1-SP003	4.46	0.582	0		8/11/2000
L818-UST1-SP004	4.73	0.592	0		8/11/2000
L818-UST1-SP005	4.67	0.592	0		8/11/2000
M110-ERM-B1-3.5	18	10	3.5		4/15/2003
M110-ERM-B13-3.5	14	10	3.5		4/16/2003
M110-ERM-B14-4.5	36	10	4.5		4/17/2003
M110-ERM-B2-3.5	20	10	3.5		4/15/2003
M110-ERM-B23-4.5	26	10	4.5		4/17/2003
M110-W-B-10-3	ND	2.5	3		4/15/2003
M110-W-B-10-3.5S	19	10	3.5		4/15/2003
M110-W-B-10-6	ND	2.5	6		4/15/2003
M110-W-B-11-3	ND	2.5	3		4/15/2003
M110-W-B-11-8	ND	2.5	8		4/15/2003
M110-W-B-12-3	12	2.5	3		4/15/2003
M110-W-B-12-6	ND	2.5	6		4/15/2003
M110-W-B-1-3	ND	2.5	3		4/14/2003
M110-W-B-13-3	ND	2.5	3		4/15/2003
M110-W-B-13-8	ND	2.5	8		4/15/2003
M110-W-B-14-3	ND	2.5	3		4/15/2003

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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
M110-W-B-14-8	ND	2.5	8		4/15/2003
M110-W-B-15-8	ND	2.5	8		4/15/2003
M110-W-B-16-3	ND	2.5	3		4/17/2003
M110-W-B-17-3	ND	2.5	3		4/17/2003
M110-W-B-18-4.5	ND	2.5	4.5		4/18/2003
M110-W-B-18-8	ND	2.5	8		4/18/2003
M110-W-B-19-4	ND	2.5	4		4/18/2003
M110-W-B-20-3	ND	2.5	3		4/18/2003
M110-W-B-21-3	ND	2.5	3		4/17/2003
M110-W-B-22-3	ND	2.5	3		4/18/2003
M110-W-B-2-3	ND	2.5	3		4/14/2003
M110-W-B-23-3	2.6	2.5	3		4/18/2003
M110-W-B-24-3	ND	2.5	3		4/14/2003
M110-W-B-24-8	ND	2.5	8		4/14/2003
M110-W-B-2-4S	15	10	4		4/14/2003
M110-W-B-25-3	3.3	2.5	3		4/15/2003
M110-W-B-25-8	ND	2.5	8		4/15/2003
M110-W-B-26-12	2.9	2.5	12		4/16/2003
M110-W-B-26-3	ND	2.5	3		4/16/2003
M110-W-B-27-3	ND		3		4/16/2003
M110-W-B-27-8	ND	2.5	8		4/16/2003
M110-W-B-28-3	3.8	2.5	3		4/16/2003
M110-W-B-28-8	ND	2.5	8		4/16/2003
M110-W-B-29-3	ND	2.5	3		4/16/2003
M110-W-B-29-8	2.9	2.5	8		4/16/2003
M110-W-B-30-3	ND	2.5	3		4/16/2003
M110-W-B-30-8	2.8	2.5	8		4/16/2003
M110-W-B-31-3	9.4	2.5	3		4/16/2003
M110-W-B-31-3.5	6	2.5	3.5		4/16/2003
M110-W-B-32-3	ND	2.5	3		4/16/2003
M110-W-B-32-8	4.1	2.5	8		4/16/2003
M110-W-B-3-3	ND	2.5	3		4/14/2003
M110-W-B-3-3.5S	15	10	3.5		4/14/2003
M110-W-B-33-3	2.9	2.5	3		4/16/2003
M110-W-B-33-8	3.8	2.5	8		4/16/2003
M110-W-B-34-3	6.1	2.5	3		4/17/2003
M110-W-B-35-3	2.5	2.5	3		4/17/2003
M110-W-B-36-3	ND	2.5	3		4/17/2003
M110-W-B-37-4	ND	2.5	4		4/17/2003
M110-W-B-38-3	ND	2.5	3		4/15/2003
M110-W-B-38-8	ND	2.5	8		4/15/2003
M110-W-B-39-3	ND	2.5	3		4/14/2003
M110-W-B-39-8	ND	2.5	8		4/14/2003
M110-W-B-4-3	3	2.5	3		4/14/2003
M110-W-B-4-3.5S	16	10	3.5		4/14/2003
M110-W-B-5-3	2.7	2.5	3		4/14/2003
M110-W-B-5-3.5S	17	10	3.5		4/14/2003
M110-W-B-6-3	2.8	2.5	3		4/14/2003

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Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
M110-W-B-6-3.5S	30	10	3.5		4/14/2003
M110-W-B-7-3	3	2.5	3		4/17/2003
M110-W-B-8-3	12	2.5	3		4/14/2003
M110-W-B-9-4	ND	2.5	4		4/18/2003
NA-MF18-S-1-4	4.6	2.5	0		1/4/1996
NPORD-#1-Raider	12		4		5/13/1993
NPORD-#2-Raider	10		4		5/13/1993
NPORD-#3-Raider	10		2		5/13/1993
NPORD-#4-Raider	4.7		2		5/13/1993
RA-SB-10A-10	5	1	10		9/26/1994
RA-SB-10A-5	5	1	5		9/26/1994
RA-SB-11-5	3	1	5		9/26/1994
RA-SB-7-10	6	1	10		9/16/1994
RA-SB-8-5	6	1	5		9/26/1994
RA-SB-9-5	8	1	5		9/26/1994
RRMA-B10-4.0	4.8	2.5	4		6/8/2000
RRMA-B1-4.0	ND	2.5	4		5/4/2000
RRMA-B17-4.0	5.7	2.5	4		6/8/2000
RRMA-B18-4.0	6.5	2.5	4		6/8/2000
RRMA-B4-4.0	ND	2.5	4		5/4/2000
RRMA-B5-4.0	3.4	2.5	4		5/4/2000
RRMA-B6-4.0	ND	2.5	4		5/4/2000
RRMA-B7-4.0	3	2.5	4		5/4/2000
RRMA-B9-4.0	11	2.5	4		6/8/2000
RRMA-E1-4	3	0.25	4		7/12/2004
RRMA-E2-4	3.2	0.26	4		7/12/2004
RRMA-E3-3	4.4	0.2	3		7/12/2004
RRMA-KB19-4.0	ND	2.5	4		12/12/2000
RRMA-KB20-4.0	ND	2.5	4		12/12/2000
RRMA-KB21-4.0	ND	2.5	4		12/12/2000
RRMA-KB22-4.0	ND	2.5	4		12/12/2000
RRMA-KB23-4.0	ND	2.5	4		12/12/2000
RRMA-KB24-4.0	3.2	2.5	4		12/12/2000
RRMA-KB25-4.0	5.6	2.5	4		12/12/2000
RRMA-KB26-4.0	ND	2.5	4		12/11/2000
RRMA-KB27-4.0	2.5	2.5	4		12/11/2000
RRMA-KB28-4.0	ND	2.5	4		12/11/2000
RRMA-KB29-4.0	3.4	2.5	4		12/11/2000
RRMA-KB30-4.0	3.5	2.5	4		12/11/2000
RRMA-KB31-4.0	8.7	2.5	4		12/11/2000
RRMA-KB32-4.0	ND	2.5	4		12/11/2000
RRMA-KB33-4.0	ND	2.5	4		12/11/2000
RRMA-KB34-4.0	ND	2.5	4		12/11/2000
RRMA-KB35-4.0	28	2.5	4		12/11/2000
RRMA-KB36-4.0	ND	2.5	4		12/11/2000
RRMA-KB37-4.0	ND	2.5	4		12/11/2000
RRMA-KB38-4.0	7.4	2.5	4		12/11/2000
RRMA-N1-4	2.4	0.26	4		7/12/2004

TABLE 1
Summary of Arsenic Results, Soil,
OIA, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
RRMA-N2-4	5.3	0.24	4		7/12/2004
RRMA-N2-8	4	0.23	8		7/12/2004
RRMA-N3-4	2.7	0.23	4		7/12/2004
RRMA-N3-8	3.8	0.21	8		7/12/2004
RRMA-S1-10	5.3	0.19	10		7/12/2004
RRMA-S1-5	3.8	0.24	5		7/12/2004
RRMA-S2-10	4.6	0.19	10		7/12/2004
RRMA-S2-3	4.7	0.23	3		7/12/2004
RRMA-S3-10	3.6	0.24	10		7/12/2004
RRMA-S3-5	5.6	0.23	5		7/12/2004
RRMA-S4-12	3.1	0.15	12		7/12/2004
RRMA-S4-5	5.5	0.22	5		7/12/2004
RRMA-SP-1	4.5	2.5	0		12/7/2001
RRMA-SP-2	3	2.5	0		12/11/2001
RRMA-SP-3	2.8	2.5	0		12/11/2001
RRMA-SP-4	3.1	2.5	0		12/12/2001
RRMA-StockComp	ND	2.5	0		7/2/2002
RRMA-T1-7	2.1	0.24	7		7/12/2004
RRTC-KB-01-3.0	24	2.5	3		7/15/2002
RRTC-KB-02-4.0	9.3	2.5	4		7/15/2002
RRTC-KB-04-4.0	5	2.5	4		7/15/2002
RRTC-KB-07-4.0	ND	2.5	4		7/15/2002
RRTC-KB-08-4.0	5.6	2.5	4		7/16/2002
RRTC-KB-09-4.0	4.7	2.5	4		7/16/2002
RRTC-KB-11-3.0	3.3	2.5	3		7/16/2002
RRTC-KB-12-3.0	7.8	2.5	3		7/16/2002
RRTC-KB-20-3.0	6.7	5	3		7/15/2002
RRTC-KB-21-3.0	5.5	5	3		7/15/2002
RRTC-KB-22-3.0	30	5	3		7/16/2002

Source: OIA Port Database, Port of Oakland.

TABLE 2
Summary of Arsenic Results, Soil
Howard Terminal, Oakland, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth	Type of Material	Sample Date
H-R1 3.0, 6.0	4.1	0.25	3.0, 6.0	Fill	3/16/1998
H-R2 1.5	5.1	0.25	1.5	Fill	3/16/1998
H-R2 3	2.9	0.25	3.0	Fill	3/16/1998
H-R2 5.5	4.2	0.24	5.5	Fill	3/16/1998
H-R3 1.5	3.4	0.25	1.5	Fill	3/17/1998
H-R3 3.0, 6.0, 9.0	1.3	0.25	3.0, 6.0, 9.0	Fill	3/17/1998
H-R4 1.7	5.7	0.24	1.7	Fill	3/18/1998
H-R4 5.5	15	0.24	5.5	Fill	3/18/1998
H-S1 3	22	0.25	3.0	Fill	3/16/1998
H-S1 5.5	12	0.24	5.5	Fill	3/16/1998
H-S2 2.5	0.96	0.25	2.5	Fill	3/17/1998
H-S2 6.0, 9.0, 12.0	1.1	0.25	6.0, 9.0, 12.0	Fill	3/17/1998
MW-H1 3.5, 7.5	3.6	0.25	3.5, 7.5	Fill	3/16/1998 and 3/17/1998
MW-H1 7.5	1.9	0.25	7.5	Fill	3/16/1998
MW-H1 9	2.4	0.24	9.0	Fill	3/16/1998
MW-H2 3	15	0.24	3.0	Fill	3/17/1998
MW-H2 6	18	0.24	6.0	Fill	3/17/1998
MW-H3 2.5, 6.0	6.4	0.25	2.5, 6.0	Fill	3/18/1998
MW-H4 3.0, 12.0	1.8	0.25	3.0, 12.0	Fill	3/24/1998
MW-H4 7	0.99	0.25	7.0	Fill	3/24/1998
MW-H4 9	3.1	0.25	9.0	Fill	3/24/1998
MW-H5 2.5, 5.5, 7.5	3.3	0.25	2.5, 5.5, 7.5	Fill	3/23/1998
MW-H6 2.5	4.9	0.25	2.5	Fill	3/25/1998
MW-H6 6	2	0.25	6.0	Fill	3/25/1998
MW-H6 9	1.9	0.25	9.0	Fill	3/25/1998
Q-I-1 3.5	3.9	0.25	3.5	Fill	3/18/1998
Q-I-1 8.5	2.8	0.24	8.5	Fill	3/18/1998
Q-I-2 3	1.8	0.25	3.0	Fill	3/17/1998
SB-R1 4	4.8	0.25	4.0	Fill	3/27/1998
SB-R1 6	3.6	0.24	6.0	Fill	3/27/1998
SB-R2 10.5	5.8	0.25	10.5	Fill	3/23/1998
SB-R2 3.5	45	0.25	3.5	Fill	3/27/1998
SB-R2 6.5	4.9	0.25	6.5	Fill	3/23/1998
SB-R3 3	3.9	0.25	3.0	Fill	3/26/1998
SB-R3 5.5	3.0	0.25	5.5	Fill	3/26/1998
SB-R3 6.5	1.2	0.25	6.5	Fill	3/26/1998
SB-R4 3.0, 6.0	22	0.25	3.0, 6.0	Fill	3/27/1998
SB-S2 3.5	3.2	0.24	3.5	Fill	3/25/1998
SB-S2 6.5	2.4	0.25	6.5	Fill	3/25/1998
SB-S2 8	3.3	0.25	8.0	Fill	3/25/1998
SB-S2 9.5	2.2	0.25	9.5	Fill	3/25/1998
SB-S3 12	2.8	0.25	12.0	Fill	3/24/1998
SB-S3 3.0, 4.5	2.4	0.25	3.0, 4.5	Fill	3/24/1998
SB-S3 8.5	4.7	0.25	8.5	Fill	3/24/1998
SB-S4 3	4.2	0.25	3.0	Fill	3/26/1998
SB-S4 5.5	1.4	0.25	5.5	Fill	3/26/1998
SB-S5 3.0, 9.0	27	0.25	3.0, 9.0	Fill	3/26/1998
SB-S6 10.5	2.1	0.25	10.5	Fill	3/25/1998
SB-S6 3	3.7	0.25	3.0	Fill	3/25/1998
SB-S6 5	3.3	0.25	5.0	Fill	3/25/1998
SB-S6 7.5	3.3	0.25	7.5	Fill	3/25/1998
SB-S7 4	5.1	0.25	4.0	Fill	3/24/1998
SB-S7 5.5	6.5	0.24	5.5	Fill	3/24/1998
SB-S7 7.5	1.6	0.25	7.5	Fill	3/24/1998

TABLE 2
Summary of Arsenic Results, Soil
Howard Terminal, Oakland, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth	Type of Material	Sample Date
SB-S8 8	9.8	0.25	8.0	Fill	3/23/1998
SBW-R1 3	ND	0.25	3.0	Fill	3/20/1998
SBW-R1 5.5	1.3	0.25	5.5	Fill	3/20/1998
SBW-R2 1	5.9	0.24	1.0	Fill	3/20/1998
SBW-R2 6	1.4	0.24	6.0	Fill	3/20/1998
SBW-R3 1.5	6.1	0.25	1.5	Fill	3/20/1998
SBW-R3 3.5	0.73	0.25	3.5	Fill	3/20/1998
SBW-R4 3	ND	0.25	3.0	Fill	3/19/1998
SBW-R4 5.5, 9.0	2.6	0.25	5.5, 9.0	Fill	3/19/1998
SBW-S1 1.0, 3.5, 6.0	2.5	0.25	1.0, 3.5, 6.0	Fill	3/25/1998

Source: BASELINE, 2001.
Note: multiple sample depths are for composite samples.

TABLE 3
Summary of Arsenic Results, Soil,
McGuire Chemical Company, Oakland, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
B-MG1 11.0-11.5	1	0.23	11.0-11.5	Fill	10/1/2001
B-MG1 2.5-3.0	1.9	0.25	2.5-3.0	Fill	10/1/2001
B-MG1 8.0-8.5	1.2	0.24	8.0-8.5	Fill	10/1/2001
B-MG10 4.0-4.5	4.7	0.23	4.0-4.5	Fill	10/2/2001
B-MG10 7.0-7.5	2.5	0.24	7.0-7.5	Fill	10/2/2001
B-MG2 3.5-4.0	1.9	0.23	3.5-4.0	Fill	10/1/2001
B-MG2 8.0-8.5	1.2	0.23	8.0-8.5	Fill	10/1/2001
B-MG3 13.0-13.5	2.2	0.24	13.0-13.5	Fill	10/1/2001
B-MG3 2.0-2.5	2.7	0.25	2.0-2.5	Fill	10/1/2001
B-MG4 4.0-4.5	1.2	0.24	4.0-4.5	Fill	10/1/2001
B-MG4 7.0-7.5	1.5	0.23	7.0-7.5	Fill	10/1/2001
B-MG5 4.0-4.5	6.7	0.24	4.0-4.5	Fill	10/2/2001
B-MG6 3.5-4.0	0.83	0.24	3.5-4.0	Fill	10/2/2001
B-MG6 7.0-7.5	0.9	0.23	7.0-7.5	Fill	10/2/2001
B-MG7 4.0-4.5	1.8	0.24	4.0-4.5	Fill	10/2/2001
B-MG7 7.5-8.0	2.5	0.21	7.5-8.0	Fill	10/2/2001
B-MG8 3.5-4.0	2.5	0.24	3.5-4.0	Fill	10/2/2001
B-MG8 7.5-8.0	1.1	0.23	7.5-8.0	Fill	10/2/2001
B-MG9 4.0-4.5	0.66	0.24	4.0-4.5	Fill	10/2/2001
B-MG9 7.0-7.5	1.4	0.23	7.0-7.5	Fill	10/2/2001
MW-MG1A 3.5-4.0	2.8	0.24	3.5-4.0	Fill	9/21/2001
MW-MG1A 7.0-7.5	0.52	0.24	7.0-7.5	Fill	9/21/2001
MW-MG2A 4.5-5.0	0.82	0.21	4.5-5.0	Fill	9/18/2001
MW-MG2A 7.5-8.0	1	0.24	7.5-8.0	Fill	9/18/2001
MW-MG3A 4.5-5.0	4.6	0.28	4.5-5.0	Fill	9/19/2001
MW-MG3A 6.5-7.0	2.3	0.24	6.5-7.0	Fill	9/19/2001
MW-MG4A 3.5-4.0	1.3	0.23	3.5-4.0	Fill	9/19/2001
MW-MG4A 7.0-7.5	0.88	0.24	7.0-7.5	Fill	9/19/2001
MW-MG5A 3.5-4.0	0.9	0.23	3.5-4.0	Fill	9/19/2001
MW-MG6A 28.0-28.5	1.3	0.21	28.0-28.5	Fill	9/24/2001
MW-MG6A 3.5-4.0	6.1	0.22	3.5-4.0	Fill	9/24/2001
MW-MG6A 8.0-8.5	5.6	0.24	8.0-8.5	Fill	9/24/2001
MW-MG7A 3.5-4.0	1.5	0.21	3.5-4.0	Fill	9/25/2001
MW-MG7A 6.5-7.0	1.3	0.22	6.5-7.0	Fill	9/25/2001
MW-MG6A 38.5-39.0	1.3	0.23	38.5-39.0	MS	9/24/2001

Source: BASELINE, 2004.
Note: MS = Merritt Sand

TABLE 4
Summary of Arsenic Results, Soil,
Jack London Square Area, Oakland, California

Sample ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
B-7F 8.0-8.5	4.7	0.23	8.0-8.5	BM	10/18/2001
MW-3F 9.5-10.0	3.9	0.24	9.5-10.0	BM	10/24/2001
B-1D 2.5-3	6.4	0.22	2.5-3	Fill	10/19/2001
B-1E 3-3.5	18	0.23	3-3.5	Fill	10/16/2001
B-1E 7.5-8.0	3.2	0.23	7.5-8.0	Fill	10/19/2001
B1F 2.0-2.5	2.9	0.24	2.0-2.5	Fill	10/17/2001
B1F 6.0-6.5	15	0.25	6.0-6.5	Fill	10/17/2001
B-1G 2.0-2.5	2.5	0.23	2.0-2.5	Fill	10/18/2001
B-1G 6.0-6.5	1.0	0.23	6.0-6.5	Fill	10/18/2001
B-2D 2.5-3.0	4.7	0.24	2.5-3.0	Fill	10/19/2001
B-2D 5.5-6.0	0.68	0.24	5.5-6.0	Fill	10/19/2001
B-2E 2.0-2.5	3.3	0.24	2.0-2.5	Fill	10/19/2001
B-2F 3.5-4.0	4.3	0.25	3.5-4.0	Fill	10/17/2001
B-2F 5.5-6.0	0.79	0.24	5.5-6.0	Fill	10/17/2001
B-2G 1.5-2.0	1.7	0.24	1.5-2.0	Fill	10/18/2001
B-2G 7.5-8.0	0.73	0.25	7.5-8.0	Fill	10/18/2001
B-3F 1.5-2.0	8.0	0.22	1.5-2.0	Fill	10/17/2001
B-3F 7.0-7.5	5.5	0.25	7.0-7.5	Fill	10/17/2001
B-4F 2.5-3.0	3.8	0.25	2.5-3.0	Fill	10/17/2001
B-4F 7.0-7.5	6.1	0.23	7.0-7.5	Fill	10/17/2001
B-5F 3.5-4.0	2.4	0.23	3.5-4.0	Fill	10/17/2001
B-5F 6.5-7.0	3.2	0.22	6.5-7.0	Fill	10/17/2001
B-7F 2.0-2.5	5.9	0.24	2.0-2.5	Fill	10/18/2001
B-7F 6.0-6.5	0.46	0.25	6.0-6.5	Fill	10/18/2001
B-8F 3.0-3.5	3.9	0.23	3.0-3.5	Fill	10/18/2001
B-8F 7.5-8.0	0.82	0.24	7.5-8.0	Fill	10/18/2001
B-9F 3.0-3.5	6.7	0.24	3.0-3.5	Fill	10/18/2001
B-9F 7.5-8.0	2.4	0.24	7.5-8.0	Fill	10/18/2001
MW-1D 2.5-3.0	2.9	0.23	2.5-3.0	Fill	10/23/2001
MW-1E 2.5-3	4.5	0.24	2.5-3	Fill	10/23/2001
MW-1E 9.0-9.5	3.0	0.22	9.0-9.5	Fill	10/23/2001
MW-1F 2.5-3.0	1.1	0.25	2.5-3.0	Fill	10/24/2001
MW-1F 5.0-5.5	0.72	0.25	5.0-5.5	Fill	10/24/2001
MW-1G 3.0-3.5	2.1	0.25	3.0-3.5	Fill	10/22/2001
MW-2D 2.0-2.5	6.5	0.23	2.0-2.5	Fill	10/23/2001
MW-2E 2.0-2.5	12	0.23	2.0-2.5	Fill	10/23/2001
MW-2E 5.5-6.0	3.0	0.24	5.5-6.0	Fill	10/23/2001
MW-2F 3.0-3.5	1.8	0.24	3.0-3.5	Fill	10/24/2001
MW-2F 8.5-9.0	1.6	0.25	8.5-9.0	Fill	10/24/2001
MW-2G 3.5-4.0	19	0.23	3.5-4.0	Fill	10/22/2001
MW-3F 2.5-3.0	5.2	0.22	2.5-3.0	Fill	10/24/2001
MW-3F 7.0-7.5	3.3	0.22	7.0-7.5	Fill	10/24/2001
B-1D 7.5-8.0	0.36	0.23	7.5-8.0	MS	10/19/2001
B-1G 8.0-8.5	2.4	0.23	8.0-8.5	MS	10/18/2001
B-2D 7.5-8.0	1.4	0.24	7.5-8.0	MS	10/19/2001
B-2G 9.0-9.5	0.65	0.23	9.0-9.5	MS	10/18/2001
MW-1D 5.5-6.0	0.79	0.21	5.5-6.0	MS	10/23/2001
MW-1G 8.5-9.0	4.0	0.24	8.5-9.0	MS	10/22/2001
MW-2D 7.5-8.0	0.67	0.23	7.5-8.0	MS	10/23/2001
MW-2G 9.5-10.0	6.3	0.23	9.5-10.0	MS	10/22/2001

Source: Baseline, 2002.

TABLE 5
Summary of Arsenic Results, Soil
1991 Regional Approach

Site Location-Site ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
Blockbuster - BH-1-4.5	ND	1.00	4.5	Fill	11/4/1994
Blockbuster - BH-2-4.5	ND	1.00	4.5	Fill	11/4/1994
Blockbuster - BH-3-4.5	ND	1.00	4.5	Fill	11/4/1994
Blockbuster - BH-4-4.5	ND	1.00	4.5	Fill	11/4/1994
Blockbuster - BH-5-4.5	ND	1.00	4.5	Fill	11/4/1994
Blockbuster - BH-6-4.5	ND	1.00	4.5	Fill	11/4/1994
EmbCove - 14151920	18	0.00	0.5	Fill	2/6/1985
EmbCove - BORING10	14	2.00	4		2/6/1985
EmbCove - BORING10	13	Not available	7.5		2/6/1985
EmbCove - BORING10	0.017	Not available	1	Fill	2/6/1985
EmbCove - BORING10	0.046	Not available	6		2/6/1985
EmbCove - BORING10	0.054	Not available	10		2/6/1985
EmbCove - BORING10	0.32	Not available	11		2/6/1985
EmbCove - BORING10	0.16	Not available	13		2/6/1985
EmbCove - BORING10	0.058	Not available	14		2/6/1985
EmbCove - GRID11	6	0.00	1	Fill	2/6/1985
EmbCove - GRID24	8	2.00	1	Fill	2/6/1985
EmbCove - IN781314	8	2.00	0.5	Fill	2/6/1985
EmbCove - INT2389	11	2.00	0.5	Fill	2/6/1985
EmbCove - WELL9	0.024	Not available	5		2/6/1985
EmbCove - WELL9	0.13	Not available	10		2/6/1985
EmbCove - WELL9	0.072	Not available	15		2/6/1985
GasLoadCtr - BOAK-1-1	2.1	1.00	0.5	Fill	3/14/1991
GasLoadCtr - BOAK-1-1	ND	1.00	2.5	Fill	3/14/1991
GasLoadCtr - BOAK-1-1	ND	1.00	4		3/14/1991
GasLoadCtr - BOAK-2-1	2.7	1.00	0.5	Fill	3/14/1991
GasLoadCtr - BOAK-2-1	1.5	1.00	2	Fill	3/14/1991
GasLoadCtr - BOAK-2-1	1.3	1.00	5.5		3/14/1991
GasLoadCtr - BOAK-3-1	3.9	1.00	0.5	Fill	3/14/1991
GasLoadCtr - BOAK-3-1	3.5	1.00	2	Fill	3/14/1991
GasLoadCtr - BOAK-3-1	3.5	1.00	4		3/14/1991
GasLoadCtr - BOAK-4-1	2.9	1.00	2.5	Fill	3/18/1991
GasLoadCtr - BOAK-4-1	8	1.00	4		3/18/1991
GasLoadCtr - BOAK-4-2	14	1.00	2.5	Fill	3/18/1991
GasLoadCtr - BOAK-5-1	10.5	1.00	1	Fill	3/18/1991
GasLoadCtr - BOAK-5-1	19.7	1.00	2.5	Fill	3/18/1991
GasLoadCtr - BOAK-5-1	2.8	1.00	4		3/18/1991
GasLoadCtr - COMPS1-4	18	1.00			2/1/1993
GasLoadCtr - MWOAK1-1	1.1	1.00	3.5	Fill	3/12/1991
GasLoadCtr - MWOAK1-1	5.6	1.00	5		3/12/1991
GasLoadCtr - MWOAK1-1	ND	1.00	6.5		3/12/1991
GasLoadCtr - MWOAK2-1	2	1.00	5.5		3/13/1991
GasLoadCtr - MWOAK2-1	ND	1.00	7		3/13/1991
GasLoadCtr - MWOAK2-1	1.8	1.00	9		3/13/1991
LaniKai - LKS34&35	ND	2.50			5/9/1990
Lot 1 - JLS11/13	1.2	0.00	5		10/10/1986
Lot 12 - B11	3.7	2.50	1.5	Fill	10/31/1994
Lot 13 - B12	4.1	2.50	1.5	Fill	10/31/1994
Lot 14 - B13	2.8	2.50	2	Fill	10/31/1994
Lot 15 - B14	ND	2.50	5.5	MS	10/31/1994
Lot 16 - B15	3.7	2.50	1	Fill	10/31/1994
Lot 17 - B16	5.4	2.50	4.5	MS	10/31/1994

TABLE 5
Summary of Arsenic Results, Soil
1991 Regional Approach

Site Location-Site ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
Lot 18 - COMP-U	1.9	0.24			8/10/1995
Lot 19 - L12B-1	3.3	2.50	2.5	Fill	11/23/1993
Lot 2 - JLS-15	2.8	0.00	5		10/10/1986
Lot 20 - L12B-2	6.8	2.50	4.5	Fill	11/23/1993
Lot 21 - L12B-3	ND	2.50	6.5	MS	11/23/1993
Lot 22 - L12B-4	ND	2.50	5.5	MS	11/23/1993
Lot 23 - L12B-5	ND	2.50	2	Fill	11/23/1993
Lot 24 - TRNCH#24	7.5	Not available	6		9/8/1987
Lot 3 - JLS9	4.4	0.00	3		10/10/1986
Oakport - B	3.1	0.50	2	Fill	8/20/1990
Oakport - B	5.4	0.50	4	Fill	8/20/1990
Oakport - C	5.6	0.50	2	Fill	8/21/1990
Oakport - C	2.4	0.50	4.5	Fill	8/21/1990
Oakport - D	2.8	0.50	2	Fill	8/21/1990
Oakport - D	5.2	0.50	4	Fill	8/21/1990
Oakport - E	3.4	0.50	2	Fill	8/20/1990
Oakport - E	2.1	0.50	5	Fill	8/20/1990
Oakport - F	1	0.50	2	Fill	8/21/1990
Oakport - F	2.8	0.50	4.5	Fill	8/21/1990
Oakport - G	1.5	0.50	2	Fill	8/21/1990
Oakport - I	3.1	0.50	2	Fill	8/20/1990
Oakport - I	4.1	0.50	4	Fill	8/20/1990
Oakport - J	3.3	0.50	2	Fill	8/20/1990
Oakport - J	3	0.50	4.5	Fill	8/20/1990
Oakport - K	3.8	0.50	2.5	Fill	8/20/1990
Oakport - K	4.1	0.50	4.5	Fill	8/20/1990
Oakport - M	3.9	0.50	2	Fill	8/20/1990
Oakport - MO-3-4	1.7	Not available	10	BM	4/19/1989
Oakport - MWOP1	4.6	0.50	2.5	Fill	8/16/1990
Oakport - MWOP1	1.6	0.50	6	BM	8/16/1990
Oakport - MWOP2	2.7	0.50	2	Fill	8/16/1990
Oakport - MWOP2	1.2	0.50	5.5	Fill	8/16/1990
Oakport - MWOP3	2.4	0.50	2	Fill	8/16/1990
Oakport - MWOP3	2.5	0.50	5.5	Fill	8/16/1990
Oakport - N	3.6	0.50	2	Fill	8/20/1990
Oakport - N	3.3	0.50	4	Fill	8/20/1990
Oakport - O	10	0.50	2	Fill	8/20/1990
Oakport - O	6.4	0.50	3.5	Fill	8/20/1990
Oakport - P	4	0.50	2	Fill	8/20/1990
Oakport - P	4.7	0.50	6	Fill	8/20/1990
Outside of Howard - DSSO10-6	1	1.00	0	Fill	3/11/1991
Outside of Howard - DSSO11-6	4.1	1.00	0	Fill	3/11/1991
Outside of Howard - DSSO7-6	ND	1.00	0	Fill	3/11/1991
Outside of Howard - DSSO8-6	1.5	1.00	0	Fill	3/11/1991
Outside of Howard - DSSO9-6	1.8	1.00	0	Fill	3/11/1991
Port Building - PBC1	2.2	Not available	9.5		1/13/1988
Port Building - PBC2	2.4	Not available	8.5		1/13/1988
Port Building - PBC3	2.4	Not available	8.5		1/13/1988
Sherex - B1	1.6	Not available	6.5	Fill	8/27/1986
Sherex - B10	1.4	Not available	4.5	Fill	8/27/1986
Sherex - B11	1.1	Not available	4.5	Fill	8/27/1986
Sherex - B12	ND	0.08	4.5	Fill	8/27/1986

TABLE 5
Summary of Arsenic Results, Soil
1991 Regional Approach

Site Location-Site ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
Sherex - B2	1	Not available	7.5	Fill	8/27/1986
Sherex - B3	ND	0.08	7	Fill	8/27/1986
Sherex - B4	2.2	Not available	4.5	Fill	8/27/1986
Sherex - B5	3.5	Not available	7	Fill	8/27/1986
Sherex - B6	1.8	Not available	4.5	Fill	8/27/1986
Sherex - B7	1.8	Not available	4.5	Fill	8/27/1986
Sherex - B8	ND	0.08	7	Fill	8/27/1986
Sherex - B9	ND	0.08	4.5	Fill	8/27/1986
Sherex - TEST 1-1	24	0.10	0	Fill	10/28/1988
Sherex - TEST 1-2	5.4	0.10	0	Fill	10/28/1988
Sherex - TEST 2	9.1	0.10	0	Fill	10/28/1988
Site A - SB1-1.5	3.44	0.34	1.5	Fill	8/21/1996
Site A - SB1-12.5	2.57	0.00	12.5	BM	8/21/1996
Site A - SB1-13.0	3.43	0.31	13	BM	8/21/1996
Site A - SB1-4.0	1.57	0.40	4	Fill	8/21/1996
Site A - SB1-8.0	1.32	0.43	8	Fill	8/21/1996
Site A - SB2-1.5	4.3	0.44	1.5	Fill	8/21/1996
Site A - SB2-12.5	2.74	0.42	12.5	BM	8/21/1996
Site A - SB2-15.5	2.41	0.34	15.5	BM	8/21/1996
Site A - SB2-3.5	ND	3.97	3.5	Fill	8/21/1996
Site A - SB2-6.5	2.33	0.44	6.5	Fill	8/21/1996
Site A - SB3-1.0	3.04	0.50	1	Fill	8/22/1996
Site A - SB3-10.5	2.12	0.40	10.5	BM	8/22/1996
Site A - SB3-13.0	0.423	0.36	13	BM	8/22/1996
Site A - SB3-16.0	0.462	0.46	16	MS	8/22/1996
Site A - SB3-6.0	1.57	0.45	6	Fill	8/22/1996
Site A - SB4-1.5	ND	0.38	1.5	Fill	8/22/1996
Site A - SB4-12.0	2.51	0.50	12	BM	8/22/1996
Site A - SB4-14.5	5.75	0.43	14.5	BM/MS	8/22/1996
Site A - SB4-3.0	1.36	0.33	3	Fill	8/22/1996
Site A - SB4-7.0	1.01	0.38	7	Fill	8/22/1996
Site A - SB5-1.0	4.09	0.49	1	Fill	8/22/1996
Site A - SB5-13.0	3.03	0.37	13	BM	8/22/1996
Site A - SB5-17.0	1.72	0.49	17	MS	8/22/1996
Site A - SB5-4.5	1.77	0.36	4.5	Fill	8/22/1996
Site A - SB5-8.5	2.1	0.33	8.5	Fill	8/22/1996
Site A - SB6-1.5	2.92	0.45	1.5	Fill	8/23/1996
Site A - SB6-14.0	4.07	0.46	14	BM	8/23/1996
Site A - SB6-27.5	3.57	0.38	27.5	MS	8/23/1996
Site A - SB6-3.5	1.23	0.40	3.5	Fill	8/23/1996
Site A - SB6-9.5	3.35	0.30	9.5	Fill	8/23/1996
Site A - SB7-1.0	1.71	0.46	1	Fill	8/23/1996
Site A - SB7-11.5	2.12	0.46	11.5	BM	8/23/1996
Site A - SB7-12.5	2.94	0.43	12.5	BM	8/23/1996
Site A - SB7-3.5	1.6	0.34	3.5	Fill	8/23/1996
Site A - SB7-6.5	2.2	0.36	6.5	Fill	8/23/1996
Site A - SB8-1.5	1.67	0.49	1.5	Fill	8/23/1996
Site A - SB8-11.0	4.94	1.37	11	BM	8/23/1996
Site A - SB8-12.5	4.62	1.47	12.5	BM	8/23/1996
Site A - SB8-3.5	3.01	0.50	3.5	Fill	8/23/1996
Site A - SB8-6.0	1.75	0.39	6	Fill	8/23/1996
Site A - SBCOMP1	1.28	0.31			8/21/1996

TABLE 5
Summary of Arsenic Results, Soil
1991 Regional Approach

Site Location-Site ID	Arsenic Concentration (mg/kg)	Reporting Limit (mg/kg)	Sample Depth (feet bgs)	Type of Material	Sample Date
Site A - SBCOMP2	1.77	0.38			8/21/1996
Site A - SBCOMP3	1.25	0.38			8/21/1996
Site A - SBCOMP4	0.839	0.29			8/22/1996
Site A - SBCOMP5	0.759	0.31			8/22/1996
Site A - SBCOMP6	1.42	0.36			8/22/1996
St B West - SCALE4E	ND	0.25			3/12/1994
St B West - SCALE4W	ND	0.25			3/12/1994
St B West - SCALE7E	ND	0.25			3/12/1994
St B West - SCALE7W	ND	0.25			3/12/1994
St B West - TR1-C-1	2.9	2.50			3/7/1994
St B West - TR1-C-2	25	2.50			3/7/1994
St B West - TR2-C-1	2.8	2.50			3/7/1994
St B West - TR2-C-2	2.7	2.50			3/7/1994
Station C - DSSOAK-1	1.5	1.00	0	Fill	3/18/1991
Station C - DSSOAK-2	1.5	1.00	0	Fill	3/18/1991
Station C - DSSOAK-3	1.5	1.00	0	Fill	3/18/1991
Station C - HBOAK-1	1.5	1.00	1.5	Fill	3/13/1991
Station C - HBOAK-2	1.6	1.00	1.5	Fill	3/13/1991
Station C - HBOAK-3	1.4	1.00	1.5	Fill	3/13/1991
Station C - HBOAK4-1	2.9	1.00	0.5	Fill	3/18/1991
Station C - HBOAK4-1	2.5	1.00	2	Fill	3/18/1991
Station C - HBOAK4-1	4.7	1.00	2.5	Fill	3/18/1991
Station C - HBOAK5-1	2.9	1.00	1	Fill	3/18/1991
Station C - HBOAK5-1	1.9	1.00	2.5	Fill	3/18/1991
Station C - HBOAK5-1	1.7	1.00	4.5	Fill	3/18/1991
Station C - HBOAK6-1	2.7	1.00	1	Fill	3/18/1991
Station C - HBOAK6-1	4.8	1.00	2	Fill	3/18/1991
Station C - HBOAK6-1	11.8	1.00	2.5	Fill	3/18/1991
Station C - HBOAK6-2	3.4	1.00	2	Fill	3/18/1991
Station C - HBOAK7-1	3.6	1.00	0.5	Fill	3/18/1991
Station C - HBOAK7-1	6	1.00	1.5	Fill	3/18/1991
Station C - HBOAK7-1	1	1.00	4.5	Fill	3/18/1991
Station C - HBOAK7-2	3.7	1.00	0.5	Fill	3/18/1991
Station C - HBOAK8-1	1.9	1.00	0.5	Fill	3/18/1991
Station C - HBOAK8-1	3.8	1.00	1	Fill	3/18/1991
Tidewater Bus Pk - COMPOS.1	4.79	0.05	1	Fill	4/29/1988
Unocal on High St - SB-1	1.3	0.50			8/23/1988
Unocal on High St - SB11	2.4	0.50			8/26/1988
Unocal on High St - SB12	2.3	0.50			8/26/1988
Unocal on High St - SB13	2.7	0.50			8/26/1988
Unocal on High St - SB14	2.5	0.50			8/26/1988
Unocal on High St - SB2	1.8	0.50			8/23/1988
Unocal on High St - SB3	0.8	0.50			8/23/1988
Unocal on High St - SB4	2.4	0.50			8/24/1988
Unocal on High St - SB5	1	0.50			8/24/1988
Unocal on High St - SB6	2.9	0.50			8/24/1988
Unocal on High St - SB7	1.4	0.50			8/24/1988
Unocal on High St - SB9	1.5	0.50			8/24/1988

TABLE 6
Summary of Samples Excluded from the Port OIA Data Set

Sample ID	Rationale for Exclusion from the Data Set
AFC-SB-10-8.5	Could not verify units for concentration
AFC-SB-11-3.0	Could not verify units for concentration
AFC-SB-4-4.0	Could not verify units for concentration
AFC-SB-5-4.5	Could not verify units for concentration
AFC-SB-6-2.5	Could not verify units for concentration
AFC-SB-8-2.0	Could not verify units for concentration
AFC-SB-9-3.5	Could not verify units for concentration
AIRW-DSA-WS	This is a groundwater sample, not a soil sample
AIRW-SD-S1	This is storm drain sediment, not a soil sample
HGR9-Con1-comp	Composite concrete sample
HGR9-Con2-comp	Composite concrete sample
HGR9-Con3-comp	Composite concrete sample
L311-LF17-BACK	This is UST backfill material; origin is uncertain
M110-W-B-27-3	No arsenic concentration for this sample
RRMA-RollComp	Composite soil sample from roll-off bins

TABLE 7
Summary of Data Sources for 95th Percentile Arsenic Calculations

	ALL Data Set		FILL Data Set		NATIVE Data Set		No. Samples with Unidentified Material Type
	No. of Samples	% of Data Set	No. of Samples	% of Data Set	No. of Samples	% of Data Set	
Port OIA Database	744	68	448	63	8	19	288
McGuire	35	3	34	5	1	2	0
Howard	64	6	64	9	0	0	0
Jack London Square	50	5	40	6	10	24	0
1991 Regional Approach	204	19	125	18	23	55	56
Total	**1,097**	*100*	**711**	*100*	**42**	*100*	344

TABLE 8
95th Percentile Arsenic Concentrations for FILL and NATIVE Data Sets
Port of Oakland

Data Set	95th Percentile Arsenic Concentration (mg/kg)
FILL	16.4
NATIVE (Bay Mud and Merritt Sand)	5.6

Note:

The 95th percentile concentrations were calculated using the non-parametric Kaplan-Meier ("KM") Method in ProUCL 4.00.02. ProUCL recommends the KM method when data sets have non-detects with multiple reporting limits.