FUGRO WEST, INC.

GEOTECHNICAL INVESTIGATION
NASA AMES SVS BOILER PLANT PROJECT
MOFFETT FIELD, CALIFORNIA

Prepared for:
AECOM

May 2011
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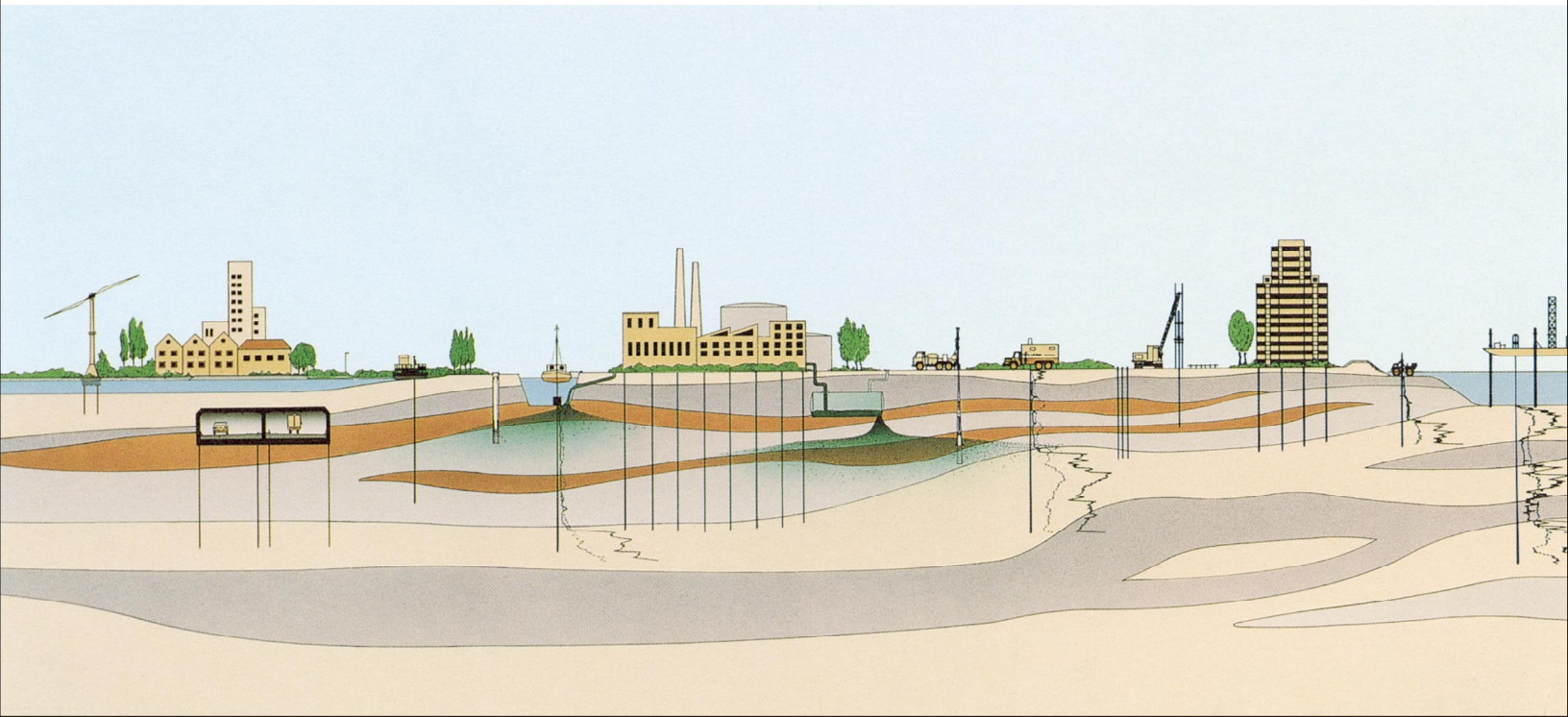

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May 23, 2011
Project No. 04.71110005

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California 94035-1000

Attention: Mr. Gregory Hite

Subject: Geotechnical Investigation
NASA Ames SVS Boiler Plant Project
Moffett Field, California

Dear Mr. Hite:

We are pleased to submit this geotechnical report presenting the results of our field exploration, laboratory testing program, engineering analysis and recommendations for design and construction of the proposed SVS Boiler Plant Project at the NASA Ames Research Center, in Moffett Field.

We appreciate this opportunity to be of continued service to AECOM. Please contact Mr. Bernard Wair at (510) 267-4456 if you have any questions or comments regarding the information presented in this report.

Sincerely,

FUGRO WEST, INC.

REGISTERED PROFESSIONAL ENGINEER
COREY T. DARE
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BRW/CTD
Copies Submitted: (PDF) Addressee

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1.0 INTRODUCTION

This report presents the results of a geotechnical study performed by Fugro West, Inc. (Fugro) for the proposed NASA Ames SVS Boiler Plant at Moffett Field, California. The site location is shown on the Vicinity Map – Plate 1.

1.1 PROJECT DESCRIPTION

The site is located in the northern portion of the NASA Ames Research Center campus at Moffett Field. As shown on the Site Plan, Plate 2, the site is located between Hunsacker Road to the north, Boyd Road to the south, and Mark Avenue to the east. The site is located adjacent to and to the north of Building N231.

We understand that the project will consist of replacing the existing SVS Boiler located in Building N234A with a new boiler located to the north of Building N231. The new boilers will be supported on an approximately 140-foot by 75-foot concrete pad. We understand that each boiler weighs approximately 150,000 pounds, for a total weight of 450,000 pounds, and that the deareator tank and platform weigh approximately 210,000 pounds.

The proposed Boiler Tank is to be located in the area of Vacuum Spheres #5 and #6. Each sphere was/is approximately 75 feet in diameter and supported on a shallow foundation system. Vacuum Sphere #5 has been previously demolished. The foundations for Vacuum Sphere #5 still remain in place.

For our use, we received the following plans sets:

- "SVS Boiler Plant," prepared by AECOM, dated January 31, 2011, Sheets M1 to M5,
- "12 Inch Hypersonic Helium Tunnel, Foundations for Vacuum Spheres," date not legible, Sheet 331-5903M-15.
- "12 Inch Hypersonic Helium Tunnel, Vacuum Storage Vessels, Piping Layout, and Details," dated July 2, 1959, Sheet 331-5903M-3.

1.2 SCOPE OF SERVICES

Our scope of services was presented in our proposal dated January 13, 2011. Our scope of services included:

- Review of existing subsurface data in our files for previous projects at Moffett Field, as well as, published geologic maps;
- Exploration of the subsurface conditions by advancing two Cone Penetration Tests (CPTs) and drilling two exploratory borings;

- Evaluation of the physical and engineering properties of the subsurface soils by visually classifying the samples and performing laboratory tests on selected samples;
- Correlation of CPT interpretations with visual classification and laboratory testing on samples collected from our exploratory borings;
- Engineering analysis to evaluate geologic hazards, site earthwork, foundations, slabs-on-grade, and pavements; and
- Preparation of this report summarizing our findings and presenting our conclusions and recommendations.

2.0 EXPLORATION AND LABORATORY TESTING

The following sections describe the investigations and testing performed to characterize the subsurface conditions at the site.

2.1 FIELD EXPLORATION

Our field investigation consisted of a site reconnaissance, advancing two CPTs, and drilling two exploratory borings. The approximate locations of our CPTs and borings are shown on the Site Plan – Plate 2.

Fugro Consultants advanced two CPT soundings on February 8, 2011, to a maximum depth of 100 feet below ground surface. Shear wave velocity measurements were taken at five-foot intervals during CPT-2 to determine the average shear wave velocity of the top 30 meters of the soil profile (V_{S30}).

Pitcher Drilling, of Palo Alto, California, drilled two borings on February 9, 2011, to depths of 31 to 41 feet, using truck-mounted, rotary-wash drilling equipment. Both borings were hand-augered to a depth of 5 feet. Boring B-1 was advanced by advanced by rotary-wash drilling to the final depth of 31 feet. Boring B-2 was then advanced with a solid flight auger to a depth of 10 feet, the depth at which ground water was encountered, then advanced by rotary-wash drilling to the final depth of 41 feet. To provide site-specific correlations of CPT data, Boring B-2 was performed within 5 feet of CPT-2.

The CPTs and borings were permitted and backfilled in accordance with Santa Clara Valley Water District guidelines.

Logs of the borings and CPTs, as well as, details regarding the field explorations, are included in Appendix A. The subsurface and ground water conditions encountered during our field investigation are summarized in Sections 4.3 and 4.4, respectively.

Three samples were collected from the top 5 feet of Boring B-1 for chemical testing. Chemical testing is discussed in Section 6.5 and Appendix C.

2.2 GEOTECHNICAL LABORATORY TESTING

The soil samples collected during our field investigation were transported to our laboratory for review and confirmation of field classifications. Laboratory testing was performed on selected samples. Laboratory tests included:

- Index and classification tests (moisture content, unit weight, fines content, Atterberg Limits),
- Two consolidation tests, and
- Strength tests (one Unconsolidated, Undrained Triaxial compression, pocket penetrometer, torvane).

Details of our geotechnical laboratory testing program are discussed in Appendix B. The results of the laboratory tests are presented in Appendix B and on the boring logs at the appropriate depths.

3.0 GEOLOGIC AND SEISMIC SETTING

3.1 REGIONAL GEOLOGY

The San Francisco Bay Area is located in the Coast Ranges Geomorphic Province, a region of northwest-southeast trending valleys and ridges, dominated by strike-slip faults of the San Andreas Fault system.

The site is located at the northern end of the Santa Clara Valley. The Santa Clara Valley is a sediment-filled trough at the southern end of the San Francisco Bay. Valley sediments are comprised of unconsolidated, alluvial deposits that slope gently to the north, toward the San Francisco Bay. Based on the alluvium thickness map of the Santa Clara Valley by Bishop and Williams (1974), the site is underlain by approximately 500 feet of alluvium.

The site is mapped as Holocene alluvial fan deposits, fine-grained facies (Q_{hff}) (California Geological Survey, 2006; Witter et al, 2006). Holocene alluvial fan deposits are mapped on the broader, more gently sloping portions of the Santa Clara Valley. Fan deposits in this area are dominated by clay and silt, with interbedded lobes of coarser alluvium (sand and occasional gravel). Deposits of coarse material within these fine-grained materials are elongated in the down fan or down valley direction (Witter et al, 2006).

3.2 REGIONAL SEISMICITY

The San Francisco Bay Area is considered one of the most seismically active regions in the United States. Significant earthquakes that have occurred in the Bay Area are associated with crust movements along a system of sub-parallel fault zones that generally trend in a northwesterly direction. The principal active faults in the Bay Area include the San Andreas, Hayward, Calaveras, and San Gregorio Faults. The approximate distances and directions from the site to major active faults are presented Table 1. Each of these faults is capable of

generating strong ground motions at the site. We performed a site-specific seismic hazard analysis in accordance with Section 21 of ASCE 7-05. The results of our seismic hazard analyses and seismic design parameters are presented in Section 7.2 and Appendix C.

Table 1. Regional Active Faults

Fault	Approximate Distance from Site	Direction from Site	Characteristic Magnitude
Monte Vista – Shannon	9½ km (6 mi)	South	6.5
San Andreas	14 km (8½ mi)	Southwest	8.05
Calaveras	22 km (13½ mi)	Northeast	7.0
Hayward –Rodgers Creek	17½ km (10½ mi)	Northeast	7.3
San Gregorio	32 km (20 mi)	West	7.5

4.0 SITE CONDITIONS

4.1 SURFACE CONDITIONS

The site is located in the northern portion of the NASA Ames Research Center campus at Moffett Field. As shown on the Site Plan, Plate 2, the site is north of building N231 and south of building N238A. At the time of our field investigation, the site was relatively flat and paved with asphalt concrete. Site grades are presently at approximately Elevation 15 feet (NGVD 1929) (USGS, 1981).

The ground surface within the project area consists of asphalt concrete pavement, with the exception of the area within the Sphere #5 foundation which consists of aggregate base.

4.2 EXISTING VACUUM SPHERE FOUNDATIONS

The proposed Boiler Tank is to be located in the area of Vacuum Spheres #5 and #6. Each sphere was/is approximately 75 feet in diameter and supported on a shallow foundation system. Vacuum Sphere #5, which is located in the western portion of the proposed Boiler Plant, has been previously demolished. Vacuum Sphere #6 still remains in the eastern portion of the foundation footprint.

The foundation system of each structure remains in place. Based on the existing foundation plans, the foundation systems consist of 12 pedestal footings bearing at approximately 6½ feet below the ground surface. Each footing is approximately 9½ feet wide, square, and approximately 2‘-4” thick. At the center of each footing is a 3½ foot, square section that extends to the ground surface. The individual foundations are tied together with an approximately 24” deep by 12” wide grade beam.

4.3 SUBSURFACE CONDITIONS

Our borings and CPTs encountered alluvial soils consisting stiff to very stiff clays with interbedded sand layers to a depth of 100 feet, the maximum depth explored.

Boring B-2 was performed within the footprint of Vacuum Sphere #5, which had previously been demolished. Boring B-2 encountered approximately 1 foot of aggregate base over the native clayey soils. Plasticity Index (PI) tests performed on samples of the near-surface clays resulted in PIs ranging from 36 to 47, indicating high plasticity and expansion potential. Based on consolidation testing for this project and previous consolidation tests preformed in the same geologic unit at Moffett Field, the clays appear to be moderately compressible and slightly to moderately over-consolidated. The clays were generally stiff to very stiff; results of strength tests appear on the boring logs at the appropriate depths (Plates A-2 to A-5) and on Plate B-4. Interpreted undrained shear strength profiles are shown on the CPT logs (Plates A-7 through A-9).

Our CPTs and borings encountered interbedded layers of medium dense to dense, poorly-graded sands and clayey sands.

The shear wave velocity measurements indicate that the top 30 meters (100 feet) of the soil profile has an average shear wave velocity (V_{S30}) of approximately 265 meters per second (870 feet per second). The shear wave velocity profile measured at CPT-1 is shown on Plate A-10.

4.4 GROUNDWATER

Free ground water was encountered in boring B-2 at a depth of 10 feet. Free ground water was not observed in boring B-1 due to rotary wash circulation. Our borings and CPTs were backfilled immediately following drilling.

The Seismic Hazard Report for the Mountain View Quadrangle (CGS, 2006) shows a historic-high ground water depth of less than 5 feet bgs. Bishop and Williams (1974) reported historic ground water levels of 4 to 9 feet bgs in the vicinity of the site. Previous geotechnical studies by Fugro and others at Moffett Field to the north of the site reported ground water depths between 4 and 9 feet bgs (Harding Lawson Associates, 1990; Montgomery Watson Harza, 2001; Fugro, 2003).

Fluctuations in groundwater level may occur due to a number factors including: variations in rainfall, seasonal variations, underground drainage patterns, tidal influence, and other factors not evident at the time measurements were made. For our analyses, we assumed a design ground water depth of 5 feet below ground surface, which represents the depth that is likely to occur during the life of the project.

5.0 GEOLOGIC HAZARDS

5.1 FAULT RUPTURE

As shown in Table 1, the site is approximately 9½ kilometers (6 miles) from the nearest active fault. The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone (known formerly as a Special Studies Zone). Surface fault rupture through the site is not anticipated.

5.2 STRONG GROUND SHAKING

Strong ground shaking can be expected at the site during moderate to severe earthquakes in the general region. Seismic design parameters are presented in Section 7.2 for both the *California Building Code* (CBSC, 2010).

5.3 LIQUEFACTION

As shown on Plate 3, the site is located within a Seismic Hazard Zone for liquefaction (CGS, 2006). The term liquefaction has been used to describe the seismic behavior of saturated soils. The phenomenon is generally characterized as loss of strength and stiffness during and following seismic shaking. Soils most susceptible to liquefaction are loose, clean, poorly graded, saturated sands. Witter, et al. (2006) mapped the site as moderately susceptible to liquefaction based on shallow ground water and the presence of lenses of fine sand and silt.

We performed a detailed liquefaction analysis following the procedures recommended by Idriss and Boulanger (2008). Site-specific correlations of CPT data were made based on comparisons between CPT-2 and Boring B-2, which were located approximately 5 feet apart. We considered a design ground water depth of 5 feet for our analysis.

5.3.1 Design Ground Motion for Liquefaction Analysis

Liquefaction assessment requires consideration of both peak ground acceleration (PGA) and earthquake magnitude. As discussed in Section 7.2, we performed site-specific seismic hazard analysis. Our analysis resulted in a peak ground acceleration of 0.46g. The majority of the hazard is associated with a Magnitude 7.9 event on the San Andreas Fault. The effect of earthquake magnitude is incorporated into liquefaction analysis using Magnitude Scaling Factors (MSFs). For our analysis, we used an MSF of 0.90.

5.3.2 Liquefaction Triggering Analysis

We based our liquefaction triggering analysis primarily on our CPT data. Visual classification and laboratory test results from our borings were used for site-specific correlation of CPT data. Our analysis indicates that some of the sand layers may liquefy during a large seismic event. Potentially-liquefiable layers were identified below a depth of 11 feet, were generally less than 2½ feet thick, and had cumulative thicknesses of less than 6 feet at each exploration location.

5.3.3 Consequences of Liquefaction

Soil liquefaction can result in ground surface rupture, bearing failure, lateral spreading, and settlement at the ground surface. Due to the presence of a stiff, non-liquefiable capping layer and the depth and discontinuous nature of the potentially-liquefiable layers, ground surface rupture and bearing failure are not anticipated at this site.

Lateral spreading refers to horizontal displacement of relatively flat-lying alluvial material toward an open or “free” face such as an open body of water, channel, or excavation. Since there is no free face within an appropriate distance from the site, the probability of lateral spreading occurring is considered to be low.

Post-liquefaction volumetric strain and settlement were estimated using the procedure by Ishihara and Yoshimine (1992), as modified by Idriss and Boulanger (2008). Calculated total liquefaction-induced settlements ranged from approximately ½ inch to 1½ inches at CPT-1 and CPT-2, respectively.

The maximum differential settlement between the two exploration points CPT-1 and CPT-2 is estimated to be approximately 1 inch, measured across a horizontal distance of 75 feet (i.e., an angular distortion of 1/900). For these reasons, we recommend that foundations be designed to accommodate a differential settlement of 1” occurring over a horizontal distance of 75 feet. Specific foundation recommendations are presented in Section 7.3.

5.4 SEISMICALLY-INDUCED SETTLEMENT

Strong ground shaking can also cause settlement of unsaturated soils above the ground water table. Soils considered susceptible to seismically-induced settlement are generally loose, cohesionless soils and poorly compacted fills. The surficial soils encountered in our borings and CPTs were cohesive and relatively stiff; therefore, seismically-induced settlement of the unsaturated near-surface soils is not anticipated.

5.5 TSUNAMI

The term tsunami describes ocean waves or similar waves in closed bodies of water caused by underwater seismic disturbance or submerged landslides. The California Geologic Survey has recently published tsunami inundation maps for the Moffett Field area. The site is not located within a currently designated tsunami inundation hazard zone (CGS, 2009). A copy of the CGS Tsunami Inundation Map is included in Appendix D. The map indicates that the tsunami waves would likely only impact the shoreline at the south end of the San Francisco Bay and may reach further inland in creeks or waterways. Since the site is located over 10,000 feet from the south end of the San Francisco Bay and is not located adjacent to a creek, the potential for tsunami inundation may be considered low. Additional tsunami protection measures are not necessary.

6.0 DISCUSSIONS AND CONCLUSIONS

The project is feasible from a geotechnical standpoint, provided that the conclusions and recommendations presented in this report are incorporated into the project design and specifications. The principal geotechnical considerations are discussed in the following sections.

6.1 FOUNDATION SUPPORT

The structures may be supported on reinforced concrete mat foundations. The long-term total and differential static settlement of foundations, as well as, liquefaction-induced settlement, and expansive soil movement should be taken into account in the design of the foundations. Long-term, static total and differential settlements may be calculated based on the modulus of subgrade reaction (MSR) values presented in Section 7.3. As discussed in Section 5.3, our analysis also indicates that up to 1½ inch of liquefaction-induced settlement may occur during a large earthquake, with up to an estimated 1" of differential settlement over a horizontal distance of 75 feet.

The proposed mat foundation may be supported on the existing pedestal foundations, provided that the mat foundation is designed for increased stresses at each existing footing. Geotechnical design recommendations are presented in Section 7.3.

If the existing foundations are not incorporated into the Boiler Plant foundation system, we recommend that the upper, 3½-foot square portion be removed to prevent hard spots from adversely impacting the proposed mat foundation; the 9½ foot square portions of the vacuum sphere foundation may remain in place. The resulting excavations should be backfilled in accordance with the recommendations presented in Section 7.1.

6.2 EXPANSIVE SOILS

The native clayey soils exhibit high plasticity and expansion potential. Expansive soils are subject to volume change with changes in moisture content. The earthwork recommendations presented in Section 7.1 are intended to reduce the potential for damage to the proposed structures due to volume change of the expansive soils. Additional design recommendations for exterior slabs-on-grade are presented in Section 7.6.

6.3 SOIL CORROSIVITY

Fugro has performed soil corrosion evaluations for several recent projects at Moffett Field: Building N266 (2003), N258 and N255B Power Improvement project (2007), Collaborative Support Facility (2008), and Water Storage Tank (2009).

The soils at Moffett Field may be considered non-corrosive to buried Portland cement concrete improvements and corrosive to buried ferrous metallic improvements. Buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending on the critical nature of the improvements. Buried metallic pressure piping such as ductile iron firewater pipelines should be protected

against corrosion by coating, polyethylene encasement, and/or cathodic protection. If desired, a certified corrosion engineer should be consulted regarding the impact of these soils on the proposed structures and long-term corrosion control design recommendations.

6.4 CONSTRUCTION CONSIDERATIONS

Excavations will be required to construct foundations, install utilities, and to remove existing utilities. Excavations that will be deeper than 5 feet and will be entered by workers should be shored or sloped for safety in accordance with Occupational Safety and Health Administration (OSHA) standards.

If earthwork is performed during the dry season, moisture conditioning may be required to raise the in situ moisture contents to near optimum moisture content (per ASTM D1557). If earthwork is performed during or shortly after wet weather conditions, the moisture content of the onsite soils could be appreciably above optimum. Consequently, subgrade preparation and fill placement may be difficult. Additional recommendations for wet weather construction can be provided at the time of construction, if required.

As previously discussed, groundwater may be encountered as shallow as 4 feet below ground surface; therefore, temporary dewatering may be necessary to perform the deeper excavations. Selection and design of temporary dewatering systems should be the responsibility of the contractor.

Temporary shoring and construction slopes are discussed in Section 7.4.

6.5 ENVIRONMENTAL TESTING

We collected three samples of soil from the upper 5 feet of Boring B-1 for chemical testing. A complete discussion of sampling, chemical testing, and results are presented in Appendix C. Based on our limited testing, no chemical concentrations were detected above the ESL criteria for a construction worker exposure scenario. On this basis, we conclude that the chemical results do not preclude re-use of the soil at the site as long as standard dust control methods and Best Management Practices are utilized. The data also suggests that if soils are to be disposed off-site, they will likely be considered non-hazardous and suitable for disposal at a Class II or Class III landfill. Depending on the landfill requirements, additional sampling and analyses may be required prior to arranging soil disposal at the selected landfill. We recommend that AECOM provide a copy of this report to the Contractor to assist with onsite management or offsite disposal of soil excavated from beneath Sphere #6.

If the soils are going to be removed from the site and reused elsewhere, additional testing may be required. If stained or obviously contaminated soil is encountered during site grading and construction, Fugro recommends that the Contractor notify AECOM and/or Fugro immediately, so that appropriate investigation or chemical testing is performed if necessary.

7.0 RECOMMENDATIONS

7.1 SITE PREPARATION AND GRADING

7.1.1 Subgrade Preparation

Following removal of the existing pavements, the subgrade soil in areas to receive engineered fill, foundations, pavements, or flatwork should be scarified to a depth of at least 6 inches, moisture conditioned to at least 3 percent above laboratory optimum moisture content, and compacted to 87 to 92 percent relative compaction as determined by ASTM D1557 (i.e., Modified Proctor test).

The compacted surface should be firm and unyielding and should be protected from damage caused by traffic or weather. Subgrade soils should be kept moist during construction. If the subgrade is allowed to become dry, it should be moisture conditioned to eliminate shrinkage cracks.

As previously discussed in Section 6.2, the existing foundations may or may not be incorporated into the Boiler Plant foundations system. If the existing foundations are not incorporated into the new foundations, the upper column (3½-foot square) portion should be removed. The resulting excavations should be backfilled and compacted in accordance with the recommendations presented in Sections 7.1.2 and 7.1.3.

7.1.2 Engineered Fill Materials

Imported materials used for engineered fill should not contain rocks or lumps larger than 4 inches in greatest dimension, contain no more than 15 percent larger than 2.5 inches, and have a Plasticity Index of less than 25.

The on-site soil may be used for engineered fill provided that it is compacted as discussed below.

7.1.3 Fill Placement and Compaction

Engineered fill consisting of imported material or on-site soil which is not expansive should be compacted to at least 90 percent relative compaction as determined by ASTM D1557 at a moisture content slightly above laboratory optimum. Engineered fill consisting of native expansive soils should be compacted to 87 to 92 percent relative compaction at a moisture content of at least 3 percent laboratory optimum. The upper six inches of soil beneath asphalt concrete pavements should be compacted to at least 92 percent relative compaction. Fill material should be spread and compacted in lifts not exceeding 8 inches in pre-compacted thickness. Soil should be backfilled using mechanical means only; no jetting. In order to achieve satisfactory compaction of the subgrade and fill materials, it may be necessary to adjust the water content at the time of construction. This may require that water be added to soils that are too dry, or that aeration be performed for soils that are too wet.

7.1.4 Pipe Bedding and Trench Backfill

Utility pipes should be bedded and shaded with clean, granular material conforming to the manufacturer's specifications. Above the pipe shading, trenches should be backfilled with materials satisfying the criteria described above for fill, placed in lifts of approximately 8 inches in pre-compacted thickness. Trench backfill material should be compacted as discussed in Section 7.1.3, with the exception that if imported "clean" sand is used for trench backfill, it should be compacted to at least 95 percent relative compaction as determined by ASTM D1557, with sufficient water to prevent the soil from "bulking" during compaction. The upper 3 feet of trench backfill below slabs and pavements should be compacted to at least 92 percent relative compaction.

Where utility trenches backfilled with sand enter beneath foundations, the trenches should be backfilled with an impermeable plug at the exterior of the foundation. The plugs can be composed of compacted clayey soil, compacted bentonite, or a bentonite-cement or sand-cement slurry mixture. The plugs should be at least 2 feet thick and should ideally extend at least 2 feet beyond the edges and bottom of the trench to 'key in' the plug. The plug should also extend to within 1 foot of the lowest adjacent grade.

All utility trenches that extend below curbs and gutters should also be plugged as described above. The plug should be located below the curb and gutter.

7.1.5 Surface Drainage

Ponding of surface water should not be allowed adjacent to the structures or on slabs. Positive surface gradients should be provided adjacent to the structures to direct surface water away from foundations and slabs toward suitable discharge facilities.

7.2 SEISMIC DESIGN

Our borings and CPTs encountered stiff alluvial soils to a depth of 100 feet, the maximum depth explored. Bishop and Williams (1974) indicate that the alluvium underlying the site is on the order of 500 feet thick. Shear wave velocity measurements indicate that the average shear wave velocity of the top 30 meters of the soil profile (V_{S30}) is approximately 265 m/s, which is consistent with published values for this geologic unit (Wills and Clahan, 2006). Based on this information, the site may be characterized as Site Class D, described as a "stiff soil" profile. Our explorations did not encounter the criteria (Plasticity Index, water content, and undrained shear strength) which would merit classifying the site as Site Class E. In our opinion, the thin layers of potentially-liquefiable soils encountered do not merit classifying the site as Site Class F.

We previously performed a site-specific seismic hazard analysis for the N234a SVS Deaerator Tank / Feedwater Tank replacement project in accordance with ASCE 7-*05 Chapter*

21 (Fugro, 2010). The Deaerator Tank project is located approximately 150 feet to the southeast of the proposed Boiler Plant. The subsurface conditions at the Deaerator tank are consistent with those encountered at the proposed Boiler Plant (i.e. deep, stiff alluvial soils). The measured V_{S30} at each location was 265 m/s. Due to the site proximity and the similar soil conditions, the results of our previous site-specific study may be used for design of the SVS Boiler Plant.

Code-based seismic design parameters in accordance with ASCE 7-05 Chapter 11 are presented in Table 2. *Code-based seismic design parameters are presented for reference and comparison only.*

Table 2. Code-Based Seismic Design Parameters

Parameter/Coefficient	Reference	Parameter/ Coefficient	Value
Soil Profile Type	Table 20.3-1	Site Class	D
Mapped MCE Spectral Acceleration Parameters	Figure 22-3	S_s	1.50
	Figure 22-4	S_1	0.60
Site Coefficients	Table 11.4-1	F_a	1.00
	Table 11.4-2	F_v	1.50
Site-Specific MCE Spectral Acceleration Parameters	Equation 11.4-1	S_{MS}	1.50
	Equation 11.4-2	S_{M1}	0.90
Design Spectral Acceleration Parameters	Equation 11.4-3	S_{DS}	1.00
	Equation 11.4-4	S_{D1}	0.60
Long-Period Transition	Figure 22-16	T_L	12 seconds

** Latitude: 37.4184, Longitude: -122.0599

Our site-specific seismic hazard analysis included both deterministic and probabilistic hazard analyses. Details of our site-specific hazard analysis are presented in Appendix E. Site-specific seismic design parameters are presented in Table 3.

Table 3. Site-Specific Seismic Design Parameters

Parameter/Coefficient	Reference	Parameter/ Coefficient	Value
Design Spectral Acceleration Parameters	Equation 21.3-1	S_{DS}	1.00
	Equation 21.3-1	S_{D1}	0.60

. Code-based and site-specific design response spectra are presented on Plate 4. The spectral ordinates of the site-specific seismic design spectrum are presented in Table 4. The spectral acceleration for periods not listed may be determined by linear interpolation between the tabulated values.

Table 4. Site-Specific Design Response Spectrum Ordinates

Period (seconds)	Spectral Acceleration (g's)
0	0.46
0.05	0.57
0.1	0.81
0.12	0.88
0.2	1.00
0.3	1.00
0.4	0.95
0.5	0.90
0.6	0.84
0.75	0.77
1.0	0.60
1.5	0.40
2.0	0.30
2.5	0.24
3.0	0.20
4.0	0.15
5.0	0.12

7.3 FOUNDATIONS

We recommend that the proposed Boiler Plant be supported on a structural mat foundation. For our analyses, we assumed the mat foundation would be approximately 140 by 75 feet, as presently planned, and that loading is similar to the design loads discussed in Section 1.1. If the final foundation dimensions or loading are significantly different than the assumed dimensions and loading, we should review and adjust our bearing capacity and settlement estimates, as appropriate.

We understand that the existing 3½ foot square portions of the existing foundations may be left in-place or may be removed. Design recommendations each case are discussed below. The 9½-foot square portions of the existing foundations may remain in place and will have no effect on the new foundation design.

Mats foundations may be designed for an average allowable bearing pressure (dead plus live loads) of 1,000 pounds per square foot (psf) for dead plus live loads. The weight of the mat foundations should be included in the design bearing pressure. For portions of the mat which are below grade, the net weight of the mat should be included in the bearing pressure calculation (i.e. weight of concrete below grade – weight of soil removed). A unit weight of soil of 125 pounds per cubic foot may be used to calculate the net load.

Long-term, static total and differential settlements may be calculated based on a modulus of subgrade (MSR) reaction of 5 pounds per cubic inch (pci) at the center of the mat and an MSR of 10 pci along the edges, where MSR is the bearing pressure divided by the settlement. If the 3½ foot square portions of the existing foundations are left in place, the increased stress in the mat foundations may be calculated using an MSR of 150 pci at each of the existing footings.

Under the seismic load condition, the mat foundation may be designed for a maximum allowable bearing pressure of 3,000 psf. Elastic deformation during seismic loading may be calculated using a modulus of subgrade reaction of 20 pci, where the pressure is considered the net load under the seismic condition (i.e. maximum pressure under seismic loading – static pressure).

The mat should be designed to accommodate a liquefaction-Induced differential settlement of approximately 1" over a distance of 75 feet (ratio of 1/900) anywhere within the mat foundation. The elastic deformation under seismic loading and liquefaction-induced settlement criteria need not be considered to occur simultaneously, and therefore should be evaluated individually; mat foundations and utility connections should be designed for whichever criteria results in the most conservative design.

Resistance to lateral loads may be provided through a combination of friction along the base of foundations and passive pressures acting on the sides of foundations. If the 3½ foot square portions of the existing foundations are left in place and are structurally connected to the new mat foundation, the passive pressure may also be considered to act against the existing foundations.

A friction coefficient of 0.30 times the dead load may be used to evaluate the allowable frictional resistance along the bottom of foundations. The friction coefficient is based on a factor of safety of 1.5.

A passive pressure equal to an equivalent fluid pressure of 300 pounds per cubic foot (pcf) can be used for lateral load resistance against the sides of foundations perpendicular to the direction of loading where the footing is poured neat against undisturbed material. The upper 1-foot of soil should be ignored, unless the soil is confined by a pavement or slab. The passive resistance is based on a factor of safety of 2 and should limit deformations to about ¼ inch.

7.4 TEMPORARY SHORING AND CONSTRUCTION SLOPES

Construction may require either temporary slopes or shoring for excavations. The Contractor should incorporate all appropriate requirements of OSHA into the design of the temporary construction slopes and shoring system.

7.4.1 Temporary Construction Slopes

If temporary slopes are required, the Contractor should be aware that in no case should slope height, inclination, and excavation depths exceed those specified in local, state, or federal

safety regulations. Specifically, one needs to be aware of the current OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, Subpart P. In areas next to adjacent existing shallow foundations, we recommend that open excavations not be performed within 1.5:1 (horizontal: vertical) slope extended downward from the bottom edge of adjacent foundations.

Fugro recommends the Contractor, or his specialty subcontractor, design temporary construction slopes to conform to the OSHA "Guidelines for Excavations and Temporary Sloping." The Contractor should determine temporary slope inclinations based on the subsurface conditions exposed at the time of construction.

In selecting the temporary slope, the Contractor should evaluate the potential of shallow soil movement, which may potentially jeopardize the existing nearby facilities.

If temporary slopes are left open for extended periods of time, exposure to weathering and rain could have detrimental effects such as sloughing and erosion. Temporary slopes should be protected from excessive drying or saturation during construction. We recommend that all vehicles and other surcharge loads be kept at least 10 feet away from the top of temporary slopes.

7.4.2 Temporary Shoring

Temporary shoring should be sufficiently rigid to minimize damage to the adjacent facilities (streets, utilities, buildings, etc.) caused by deflection of the sides of the excavation.

We recommend that the geotechnical and structural engineers review the final temporary shoring plan to establish compliance with the anticipated soil conditions encountered at the site. In addition, we recommend that the geotechnical engineer's representative observe the installation of the temporary shoring systems. The Contractor should incorporate all appropriate requirements of OSHA into the design of the temporary shoring system.

7.5 FLEXIBLE PAVEMENT DESIGN

We developed the following pavement sections based on Topic 608 of the State of California Department of Transportation Highway Design Manual (Caltrans, 2008) and assumed traffic indices. We assumed a design R-value of 10 and a minimum asphalt concrete thickness of 4.0 inches for our analysis. Pavement sections in Table 5 correspond to a pavement design life of 20 years.

The traffic indices used in our design were established assuming a typical mix of automobile and "delivery or garbage" truck type of use in the proposed development once construction has been completed. However, if the pavements are planned to be placed prior to, or during construction, the traffic indices and pavement sections may not be adequate for support of what is typically more frequent and heavier construction traffic. Therefore, if the pavement sections will be used for construction access, our firm should be consulted to provide recommendations for alternative pavement sections capable of supporting the heavier use. If

requested, we could provide recommendations for a phased placement of the asphalt concrete to minimize the potential for mechanical scars caused by construction traffic on the finished grade.

Table 5. Pavement Design Alternatives

Traffic Condition	*Pavement Components*		*Total Thickness (inches)*
	Asphalt Concrete (inches)	*Caltrans Class 2 Aggregate Base (inches)*	
Automobile Parking (T.I. = 4.5)	4.0	6.0	10.0
Automobile Access (T.I. = 5.5)	4.0	10.0	13.0
Heavy Truck Access (T.I. = 6.5)	4.0	13.0	17.0

The traffic indices should provide the indicated pavement lives with only a normal amount of pavement maintenance. Selection of the design traffic parameters, however, was based on engineering judgment, and not on an equivalent wheel load analysis developed from a traffic study or furnished to us.

Asphalt concrete, aggregate base and preparation of the pavement subgrade should conform to and be placed in accordance with the recommendations presented in Section 7.1. Pavement subgrades should be stable (i.e., should not visibly deflect) under the load of conventional proof-rolling equipment prior to both aggregate base and asphalt concrete placement.

In areas where pavements will abut planted areas, the pavement aggregate base layer, pavement section subgrade soils and trench backfill should be protected against saturation. Concrete curbs should extend at least to the bottom of the aggregate base layer, forming a concrete barrier between the landscaped areas and the pavement section. In addition, a compacted impermeable soil plug, as described in Section 7.1.6, should be constructed within any lateral or other trench backfill that passes beneath the curb and gutter and under the adjoining pavement. In addition, water should never be allowed to pond behind the curb and gutter during or after the completion of construction.

Aggregate base for use in flexible pavements should conform to Caltrans Standard Specification Section 26-1.02A for Class 2 Aggregate Base. The Aggregate Base used in the pavement sections should be compacted to 95 percent relative compaction (per ASTM D1557) and should be firm and unyielding.

7.6 MISCELLANEOUS SLABS-ON-GRADE

Walkways and pavement curbs and gutters constructed on expansive soils should be supported directly on native soils prepared in accordance with the recommendations provided in

Section 7.1. Eliminating base rock beneath slabs will reduce the potential for migration of landscape irrigation water into pavement and walkway subgrade. Curbs should extend to the bottom of the pavement and base rock layer. Subgrade soils should be kept moist (i.e., at least 3 percent over laboratory optimum moisture content) prior to placement of concrete. The water content of subgrade soils should be tested by the Geotechnical Engineer prior to placement of concrete.

7.7 ADDITIONAL GEOTECHNICAL SERVICES

Fugro should review geotechnical aspects of the plans and specifications to check for conformance with our recommendations. The analyses, designs, opinions, and recommendations submitted in this report are based in part upon the data obtained from the subsurface explorations for this project and upon the conditions existing when services were conducted. Variations of subsurface conditions from those analyzed or characterized in this report are possible, as may become evident during construction. In the event of changed conditions, certain analyses or assumptions may need to be revised.

We recommend that Fugro be retained to provide geotechnical services during site grading and foundation construction to observe compliance with the design recommendations presented in this report. Our presence will also allow us to modify our recommendations if unanticipated subsurface conditions are encountered. During construction, our field engineer should observe and test the following:

- Soil conditions exposed by site grading and foundation excavations, to confirm the soil conditions are consistent with those encountered during our field exploration and that foundation excavations conform to the minimum recommended dimensions; and
- Fill placement and compaction, including backfill of utilities and compaction of aggregate base.

8.0 LIMITATIONS

Our services consist of professional opinions, conclusions, and recommendations that are made in accordance with generally accepted geotechnical engineering principles and practices.

The analyses and recommendations contained in this report are based on the data obtained from the subsurface explorations conducted for this study and relevant previous explorations. These explorations indicate subsurface conditions only at specific locations and times, and only to the depths penetrated. Variations may exist and conditions not observed or described in this report could be encountered during construction. Our conclusions and recommendations are based on our analysis of the observed conditions. If conditions other than those described in this report are encountered, we should be notified so that we can provide additional recommendations, if warranted.

This report has been prepared for the exclusive use of AECOM and their consultants for specific application to the proposed SVS Boiler Plant Project at the NASA Ames Research Center, in Moffett Field, California. In the event that there are any changes in the ownership, nature, design, or location of the proposed project, or if any future additions are planned, the conclusions and recommendations contained in this report should not be considered valid unless (1) the project changes are reviewed by Fugro, and (2) conclusions and recommendations presented in this report are modified or verified in writing. Reliance on this report by others must be at their risk unless we are consulted on the use or limitations. We cannot be responsible for the impacts of any changes in geotechnical standards, practices, or regulations subsequent to performance of services without our further consultation. We can neither vouch for the accuracy of information supplied by others, nor accept consequences for non-consulted use of segregated portions of this report.

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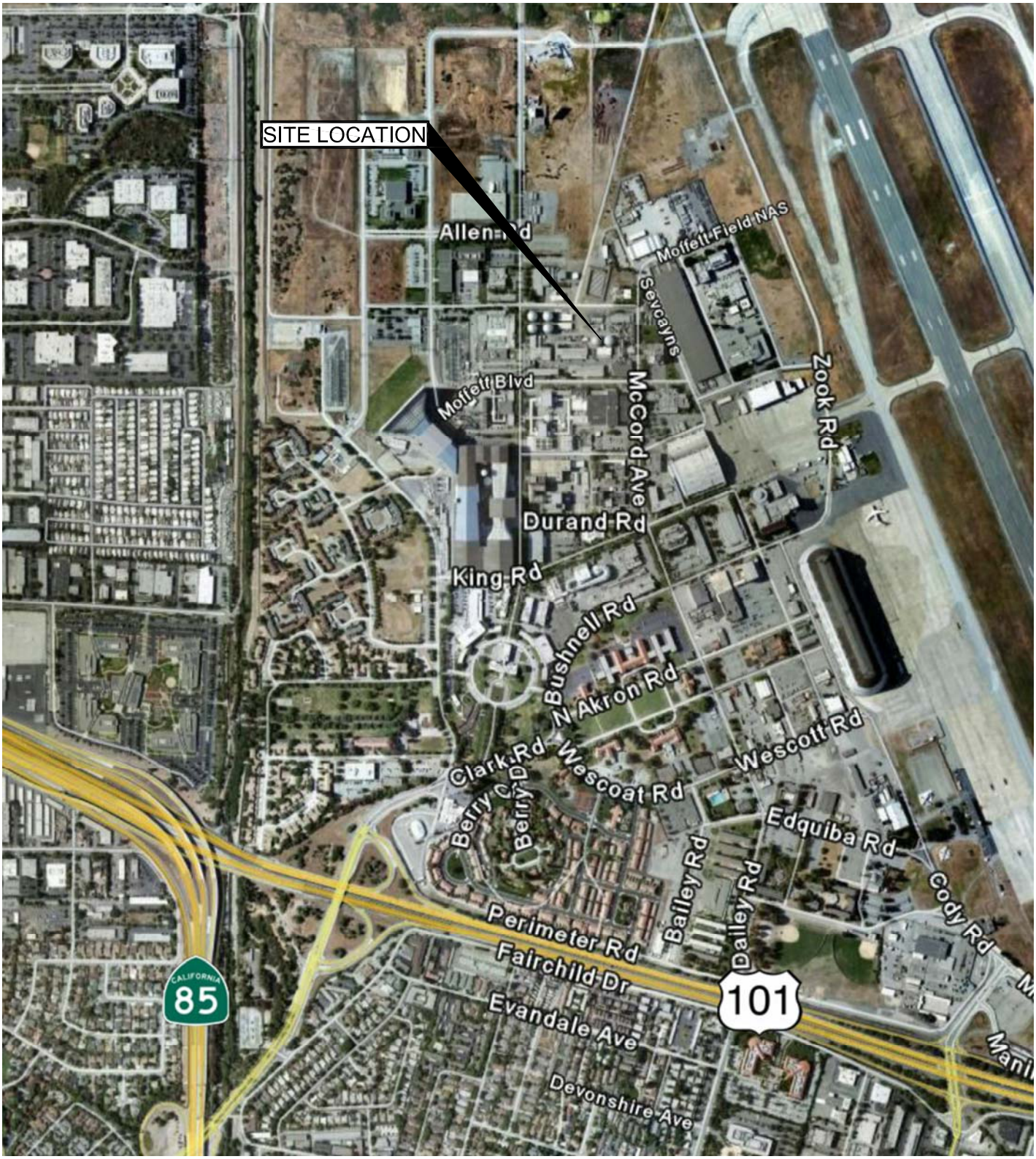
PLATES



SOURCE: Google Earth Pro.

VICINITY MAP
NASA Ames SVS Boiler Plant
Moffett Field, California

NORTH
0 1000 2000
FEET

PLATE 1

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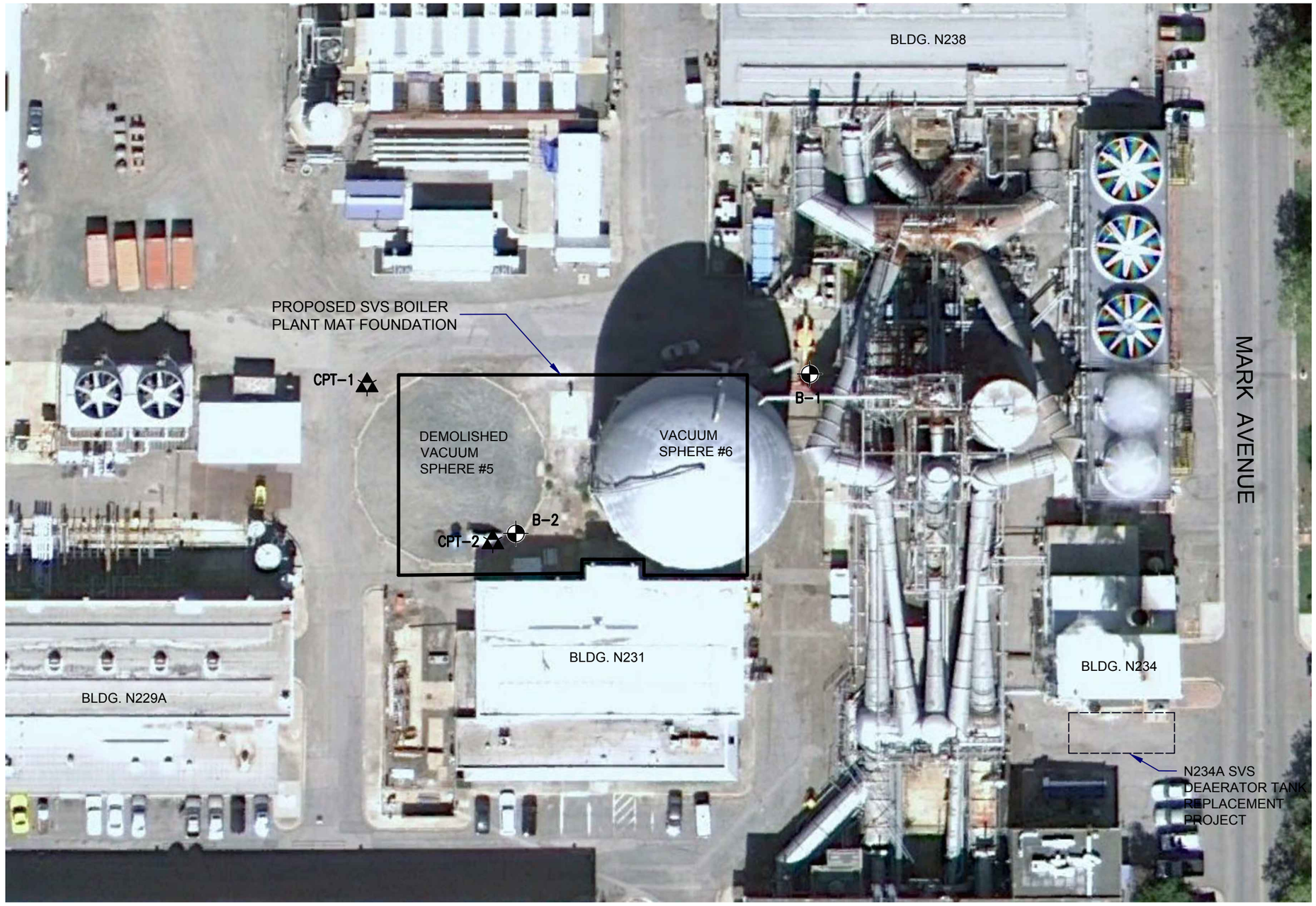

BASE MAP SOURCE: Google Earth Pro, 2011.

LEGEND

B-1 EXPLORATORY BORING

CPT-1 CONE PENETRATION TEST

NORTH

0 40 80
FEET

SITE PLAN
NASA Ames SVS Boiler Plant
Moffett Field, California

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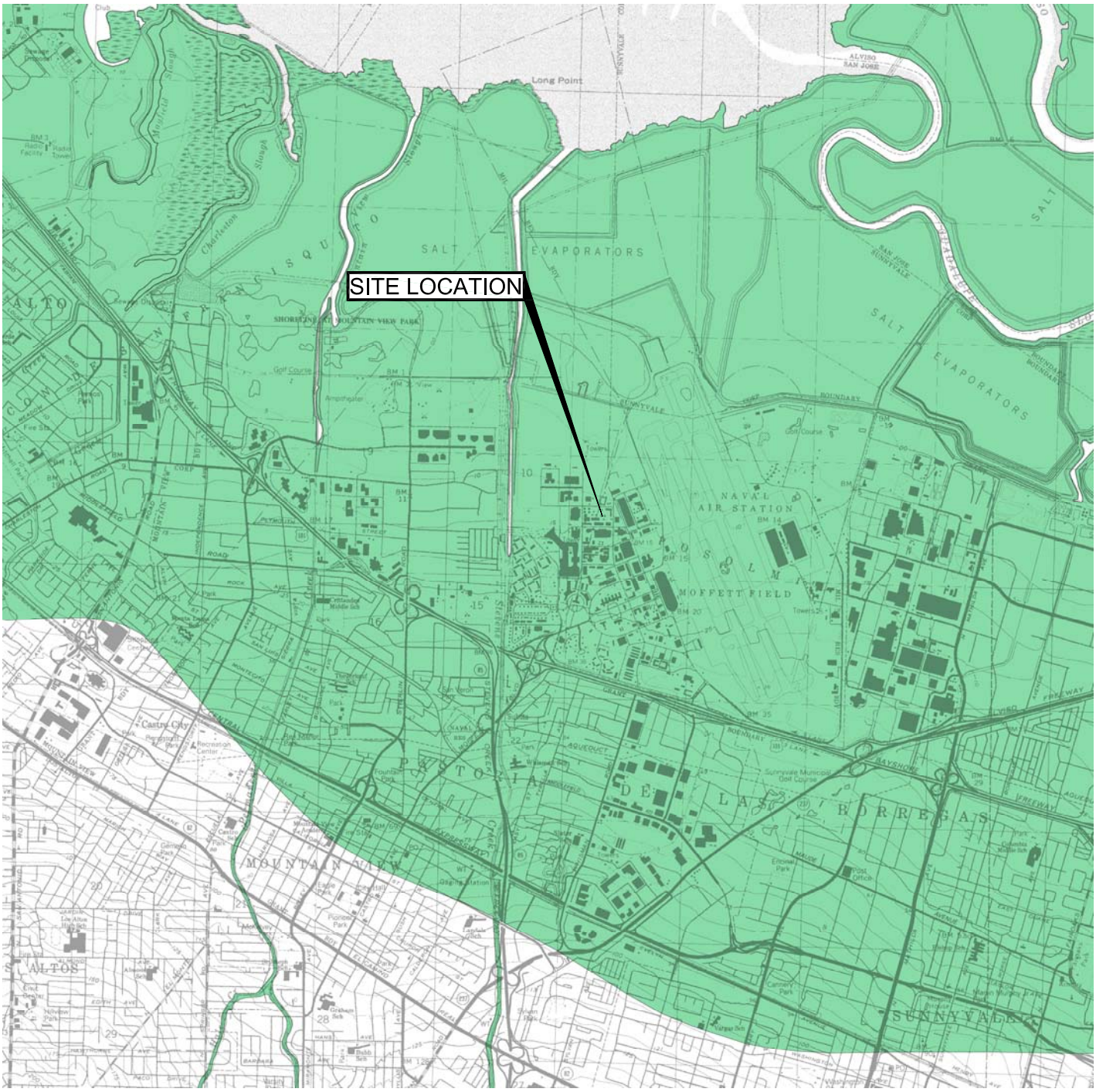

SOURCE: Seismic Hazard Zone Map, Mountain View Quadrangle, California Geological Survey, 2006.

Liquefaction

Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground-water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NORTH

0 4000 8000
FEET

LIQUEFACTION HAZARD ZONE MAP
NASA Ames SVS Boiler Plant
Moffett Field, California

PLATE 3

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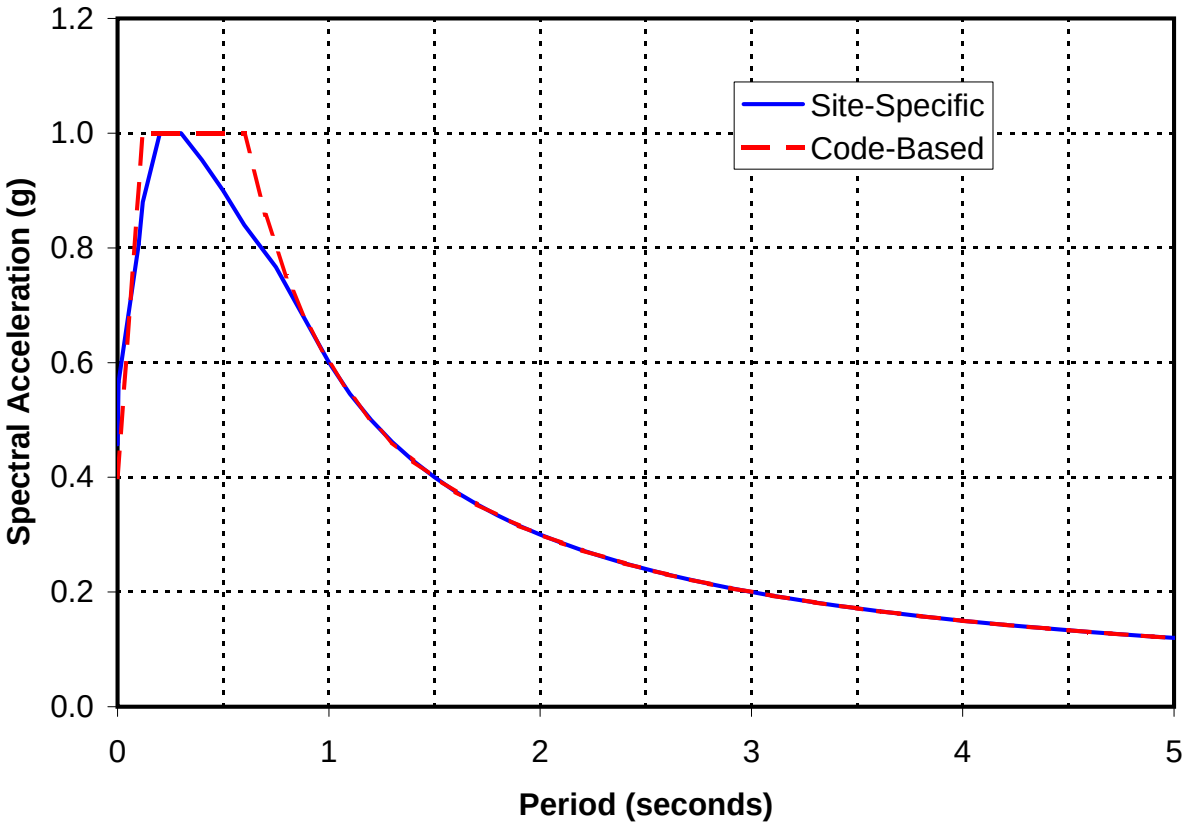


DESIGN RESPONSE SPECTRUM
NASA Ames SVS Boiler Plant
Moffett Field, California

APPENDIX A
FIELD EXPLORATIONS

APPENDIX A
FIELD EXPLORATIONS

Our field exploration consisted of a site reconnaissance and a subsurface exploration program. Our subsurface exploration included performing two Cone Penetration Tests (CPTs) and drilling two conventional geotechnical borings. The approximate locations of our borings and CPTs are shown on the Site Plan - Plate 2. Boring and CPT logs are included in this appendix.

Two CPTs were performed on February 8, 2011 by Fugro Consultants, of Oakland, California. The CPTs were advanced using a truck-mounted rig with a 20-ton push capacity. The CPTs were pushed to a maximum depth of 100 feet below ground surface (bgs).

Two exploratory borings were drilled on February 9, 2011 by Pitcher Drilling, of Palo Alto, California. The borings were drilled using a truck-mounted, CME-55 drill rig with rotary wash drilling equipment. The borings were advanced to a maximum depth of 50 feet bgs.

Soil samples were obtained using either a standard split spoon sampler (2-inch outer diameter, 1 3/8-inch inner diameter), Modified California sampler (3-inch outer diameter, 2 3/8-inch inner diameter), or a Shelby Tube (3-inch outer diameter, 2 7/8-inch inner diameter). Sampler types are indicated on the boring logs at the appropriate depth. The symbols used for each sampler type are shown on Terms and Symbols sheet, Plate A-1. The Standard Penetration Test (SPT) N-value (or blow count) is defined as the number of blows required to drive a 2-inch outside diameter split-barrel sampler 12-inches, after an initial penetration of 6-inches, using a 140-pound hammer falling freely for 30-inches. The blow counts were recorded by our engineer in the field per six-inch interval and are presented on the boring logs. Samples were driven using an automatic trip hammer. N-values from samples obtained using the Modified California sampler are not considered standard N-values because of the larger diameter.

Recovered soil samples were visually examined and classified in the field in accordance with the Unified Soil Classification System (USCS) and ASTM D2488. Soil samples were transported to our laboratory for further examination, confirmation of classification and laboratory testing.

The attached CPT and boring logs and related information show our interpretation of the subsurface conditions at the dates and locations indicated; we do not warrant they are representative of subsurface conditions at other locations and times.

CLASSIFICATION AND MATERIAL SYMBOLS

MAJOR DIVISIONS PER ASTM D2488-06			MAJOR GROUP NAMES AND MATERIAL SYMBOLS	
COARSE-GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	Clean gravels less than 5% fines	GW	Well-Graded GRAVEL
			GP	Poorly Graded GRAVEL
		Gravels with more than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	Clean sand less than 5% fines	SW	Well-Graded SAND
			SP	Poorly Graded SAND
		Sands with more than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid Limit Less than 50%		ML	SILT
			CL	Lean CLAY
			OL	ORGANIC SILT
	SILTS AND CLAYS Liquid Limit Greater than 50%		MH	Elastic SILT
			CH	Fat CLAY
			OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	Peat or Highly Organic Soils

Notes:
Classification of soils on the boring logs is in general accordance with ASTM D2488, or D2487 if appropriate laboratory data are available.
The geologic formation is noted in bold font at the top of interpreted interval on the boring logs.

OTHER MATERIAL SYMBOLS

- Debris or Mixed Fill
- Pavement with Aggregate Base

SAMPLER TYPE

- SPT (Driven) 1-3/8" ID 2" OD
- Modified California (Driven) 2-3/8" ID 3" OD
- Modified California (Driven) 1-7/8" ID 2-1/2" OD
- Shelby Tube (Pushed) 2-7/8" ID 3" OD
- Pitcher Barrel (Rotary-cut) 2-7/8" ID
- Osterberg (Piston) 2-7/8" ID
- 101 Geobarrel (Rotary-cut) 2-7/8" ID
- Rock Core (Rotary-cut) See log for size
- Vibracore (Vibrated) See log for size
- Push-core (Pushed) See log for size
- Collected from Auger
- Other See log for details

Note: Refer to text of report for additional details or other sampler types.

BLOW COUNT

Number of blows required to drive sampler each of three 6-in. intervals, as measured in the field (uncorrected). An SPT hammer (140 lb., falling 30-in.) was used unless otherwise noted on the boring log. For example:

Blow Count	Description
5 7 8	5, 7, and 8 blows for first, second, and third interval, respectively.
35 50/3"	35 blows for the first interval. 50 blows for the first 3 inches of the second interval. Lack of third value implies that driving was stopped 3 inches into the second interval.
WOH WOH 5	"WOH" indicates that the weight of the hammer was sufficient to advance the sampler over the first two intervals. 5 blows were required to advance the sampler over the third interval.

N-VALUE

The N-Value represents the blowcount for the last 12 inches of the sample drive if three 6-inch intervals were driven. N-value presented is independant of impact energy. If 50 hammer blows were insufficient to drive through either the second or the third interval, the total number of blows and total length driven are reported (excluding the first interval). "ref" (refusal) indicates that 50 blows were insufficient to drive through the first 6-inch interval.

Parenthesis indicate that an approximate correction has been applied for non-SPT drive samplers. For example, a factor of 0.63 is commonly used to adjust blow counts obtained using a 3-inch outside diameter modified California sampler to correspond to Standard Peneteration Test.

UNDRAINED SHEAR STRENGTH

A value of undrained shear strength is reported. The value is followed by a letter code indicating the type of test that was performed, as follows:

U - Unconfined Compression
Q - Unconsolidated Undrained Triaxial
T - Torvane
P - Pocket Penetrometer
M - Miniature Vane
F - Field Vane
R - R-value

OTHER TESTS

Field or laboratory tests without a dedicated column on the boring log are reported in the Other Tests column. A letter code is used to indicate the type of test. For certain tests, a value representing the test result is also provided. Typical letter codes are as follows. Additional codes may be used. Refer to the report text and the laboratory testing results for additional information.

k - Permeability (cm/s)
Consol - Consolidation
Gs - Specific Gravity
MA - Particle Size Analysis
EI - Expansion Index
OVM - Organic Vapor Meter

WATER LEVEL SYMBOLS

- Initial water level
- Final water level
- Seepage encountered

INCREASING MOISTURE CONTENT

Dry
Moist
Wet

CONSISTENCY OF COHESIVE SOIL

CONSISTENCY	UNDRAINED SHEAR STRENGTH (KIPS PER SQUARE FOOT)
Very Soft	< 0.25
Soft	0.25 to 0.50
Medium Stiff	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	> 4.0

Note: In absence of test data, consistency has been estimated based on manual observation.

APPARENT DENSITY OF COHESIONLESS SOIL

APPARENT DENSITY	N-VALUE
Very Loose	0 to 4
Loose	5 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	> 49

TERMS AND SYMBOLS USED ON BORING LOGS

PLATE A-1

LOCATION: NW of Vacuum Sphere #6

SURFACE EL: 15.0 ft +/- (rel. datum)

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
						3" Ashalt							
					6/6"	6" Aggregate Base							
						Fat CLAY (CH): black, dry, high plasticity				56	37		
					12/12"	grades to dark gray, moist below 2.0'							
					6/6"								
5						stiff below 5.5'							
					15/30"		85 90	33 29		69	47	2.0 Q 2.0 P 0.9 T	Consol
						Lean CLAY (CL): brown, moist, medium plasticity, hard nodules							
			3 6 9	15	15/18"			21					
10						Lean CLAY with SAND (CL): brown, moist to wet, mottled light gray, medium plasticity, low to medium toughness							
			1 1 2	3	15/18"	increasing sand with depth below 11.0'		25					
						mottled with strong brown							
			2 3 5	8	15/18"	Sandy SILT (ML): soft, brown, wet, fine grained							
15									57				
						increase fines							
			3 3 5	8	15/18"	Lean CLAY (CL): brown, moist, mottled strong brown, medium plasticity, medium toughness		33					
20													
			100 psi 300 psi		28/30"		100	26				2.2 P 1.0 T	
						Poorly-graded SAND with silt (SP-SM): medium dense, brown, wet, fine to coarse grained, mostly fine sand							
			10 11 5	16	9				8				

Continued

BORING DEPTH: 31.5 ft
BACKFILL: Grout
DEPTH TO WATER: Not Measured
FIELDWORK DATES: February 9, 2011 to February 9, 2001
DRILLING METHOD: 4-in. dia. Rotary Wash

HAMMER TYPE: Automatic Trip
RIG TYPE: CME-55
DRILLED BY: Pitcher Drilling, James
LOGGED BY: A.Sperske
CHECKED BY:

LOG OF BORING NO. B-01
Nasa Ames SVS Boiler Plant
Moffett Field, California

FWI STANDARD LOG BETA02 G:\JOBDOCS\04.71110005 NASA AMES SVS BOILER\EXPLORATIONS\GINT\2011\BORINGS_20110215.GPJ OGEM_LIB_MARCH2011.GLB 3/21/11 12:55 p

LOCATION: NW of Vacuum Sphere #6

SURFACE EL: 15.0 ft +/- (rel. datum)

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
				16	18"	Lean CLAY (CL): very stiff, brown, wet, mottled gray, hard nodules, medium plasticity, low to medium toughness, trace fine sand							
			200 psi 350 psi		18/18"		103	22				3.0 P 1.2 T	
30			6 8 8	16	18/18"	Lean CLAY with SAND (CL): brown, moist, mottled gray, medium plasticity, increase sand with depth gray sand inclusions at 30.3'							

NOTES:
1. Terms and symbols defined on Plate A-1.

FWI STANDARD LOG BETA02 G:\JOBDOCS\04.71110005 NASA AMES SVS BOILER\EXPLORATIONS\GINT\2011\BORINGS_20110215.GPJ OGEM_LIB_MARCH2011.GLB 3/21/11 12:55 p

LOG OF BORING NO. B-01
Nasa Ames SVS Boiler Plant
Moffett Field, California

LOCATION: SW of Demolished Vacuum Sphere #5

SURFACE EL: 15.0 ft +/- (rel. datum)

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
						Gravel at surface							
						Fat CLAY (CH): very stiff, dark gray, moist, high plasticity, high toughness, trace sand and gravel to 2.5'							
					18/18"			31		56	37		
5			3 7 12	12	16 .5/18"							2.3 P	
								25					
			175 psi 300 psi		24/24"	Lean CLAY with SAND (CL): brown, moist, medium plasticity, increase sand with depth	108	18				4.5 P 3.6 T 2.0 P	
10						CLAYEY SAND (SC): brown, wet, fine grained, decrease fines with depth							
			2 4 7	11	12/18"	Poorly-graded SAND with clay and gravel (SP-SC): medium dense, brown, wet, fine to coarse sand, mostly fine, fine gravels, gravel up to 1" diameter, subrounded to subangular			10				
			9 10 13	23	10 .5/18"								
15			7 12 12	24	9/18"				5				
						Lean CLAY (CL): brown, moist, mottled gray, medium plasticity, medium toughness							
			4 7 5	12	15 .5/18"	4" clayey sand seam at 18.9', wet, fine sand		23					
20						Lean CLAY with SAND (CL): medium stiff, brown, moist, medium plasticity, low toughness, fine sand							
			100 psi 175 psi		29/30"		100	25		34	17	1.5 P 1.4 T	Consol
												0.8 P	

Continued

BORING DEPTH: 41.0 ft
BACKFILL: Grout
DEPTH TO WATER: 10.0 ft
FIELDWORK DATES: February 9, 2011 to February 9, 2001
DRILLING METHOD: 4-in. dia. Rotary Wash

HAMMER TYPE: Automatic Trip
RIG TYPE: CME-55
DRILLED BY: Pitcher Drilling, James
LOGGED BY: A.Sperske
CHECKED BY:

FWI STANDARD LOG BETA02 G:\JOBDOCS\04.71110005 NASA AMES SVS BOILER\EXPLORATIONS\GINT\2011\BORINGS_20110215.GPJ OGEM_LIB_MARCH2011.GLB 3/21/11 12:55 p

LOG OF BORING NO. B-02
Nasa Ames SVS Boiler Plant
Moffett Field, California

LOCATION: SW of Demolished Vacuum Sphere #5

SURFACE EL: 15.0 ft +/- (rel. datum)

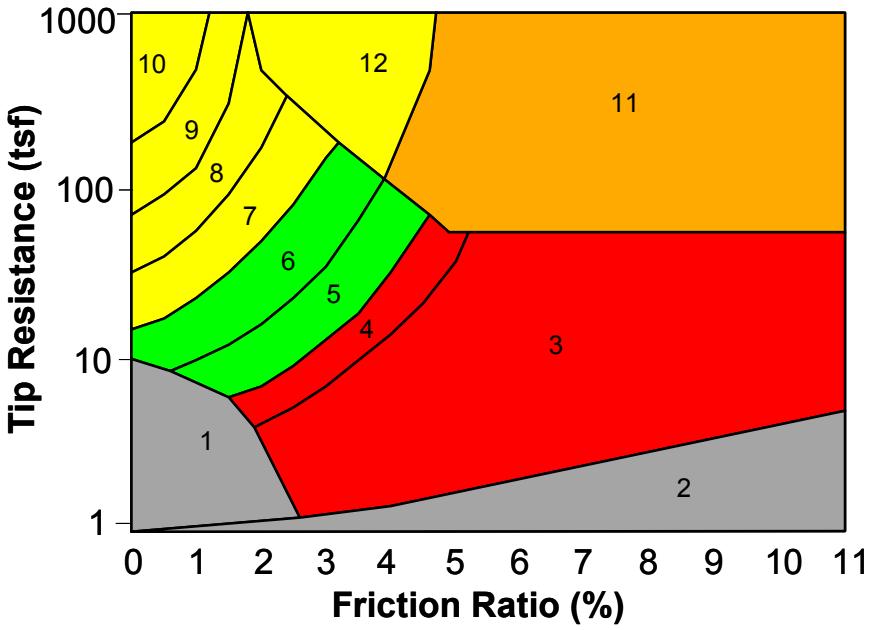
DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
			150 psi		30/30"	soft to medium stiff, increase sand with depth below 25.0'							
							104	22				0.6 P 1.0 T	
						grades to sandy clay below 28.0'						0.5 P 0.4 T	
			7 16 17	33	16/18"	Poorly-graded SAND with CLAY (SP-SC): medium dense, brown, wet, fine to coarse grained, mostly fine to medium sand, some fine gravels, trace gravels up to 1" diameter, subrounded to subangular							
30													
			1 0 3	3	7/18"	Clayey SAND (SC): loose, brown, wet, fine grained sand, mottled strong brown 1" fine to coarse grained sand, little fines at 32.0'		25	36				
			11 12 13	25	9/18"	Poorly-graded SAND with clay and gravel (SP-SC): medium dense, brown, wet, fine to coarse grained sand decrease fines below 34.0' trace iron oxide staining at 34.5'			5				
35													
			8 12 21	33	13/18"	Clayey SAND (SC): dense, brown, wet, fine grained sand less than 1/4" interbedded clay lenses from 36.3' to 36.5'			15				
40			3 1 13	14	12/18"	medium dense, few fine gravels below 39.5'			25				

NOTES:
1. Terms and symbols defined on Plate A-1.

FWI STANDARD LOG BETA02 G:\JOBDOCS\04.71110005 NASA AMES SVS BOILER\EXPLORATIONS\GINT\2011\BORINGS_20110215.GPJ OGEM_LIB_MARCH2011.GLB 3/21/11 12:55 p

LOG OF BORING NO. B-02
Nasa Ames SVS Boiler Plant
Moffett Field, California

COLOR LEGEND FOR FRICTION RATIO TRACES



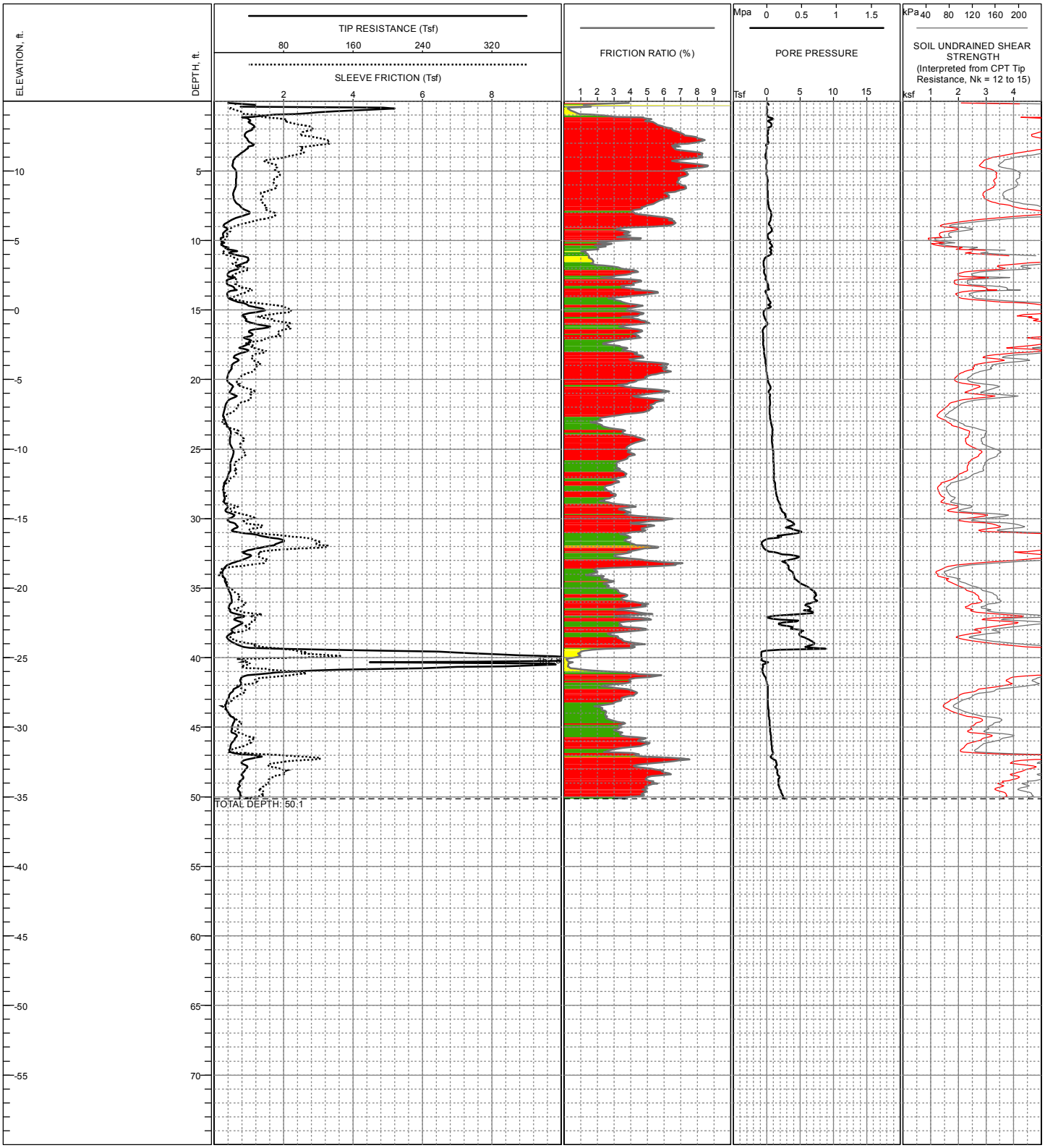
Zone	Soil Behavior Type	U.S.C.S.
1	Sensitive Fine-grained	OL-CH
2	Organic Material	OL-OH
3	Clay	CH
4	Silty Clay to Clay	CL-CH
5	Clayey Silt to Silty Clay	MH-CL
6	Sandy Silt to Clayey Silt	ML-MH
7	Silty Sand to Sandy Silt	SM-ML
8	Sand to Silty Sand	SM-SP
9	Sand	SW-SP
10	Gravelly Sand to Sand	SW-GW
11	Very Stiff Fine-grained *	CH-CL
12	Sand to Clayey Sand *	SC-SM

*overconsolidated or cemented

CPT CORRELATION CHART
(Robertson and Campanella, 1988)

KEY TO CPT LOGS
NASA AMES SVS BOILER
Moffett Field, California

G:\jobdocs\04.71110005 NASA AMES SVS Boiler\Explorations\CPT\2011\Logs\2011_03_17_CPTLogs\MXD\KeytoCPT-RC88.mxd, 03/31/11, hlopez



SURFACE EL: 15.0ft +/- (NGVD29)
COMPLETION DEPTH: 50.1ft
TESTDATE: 2/8/2011

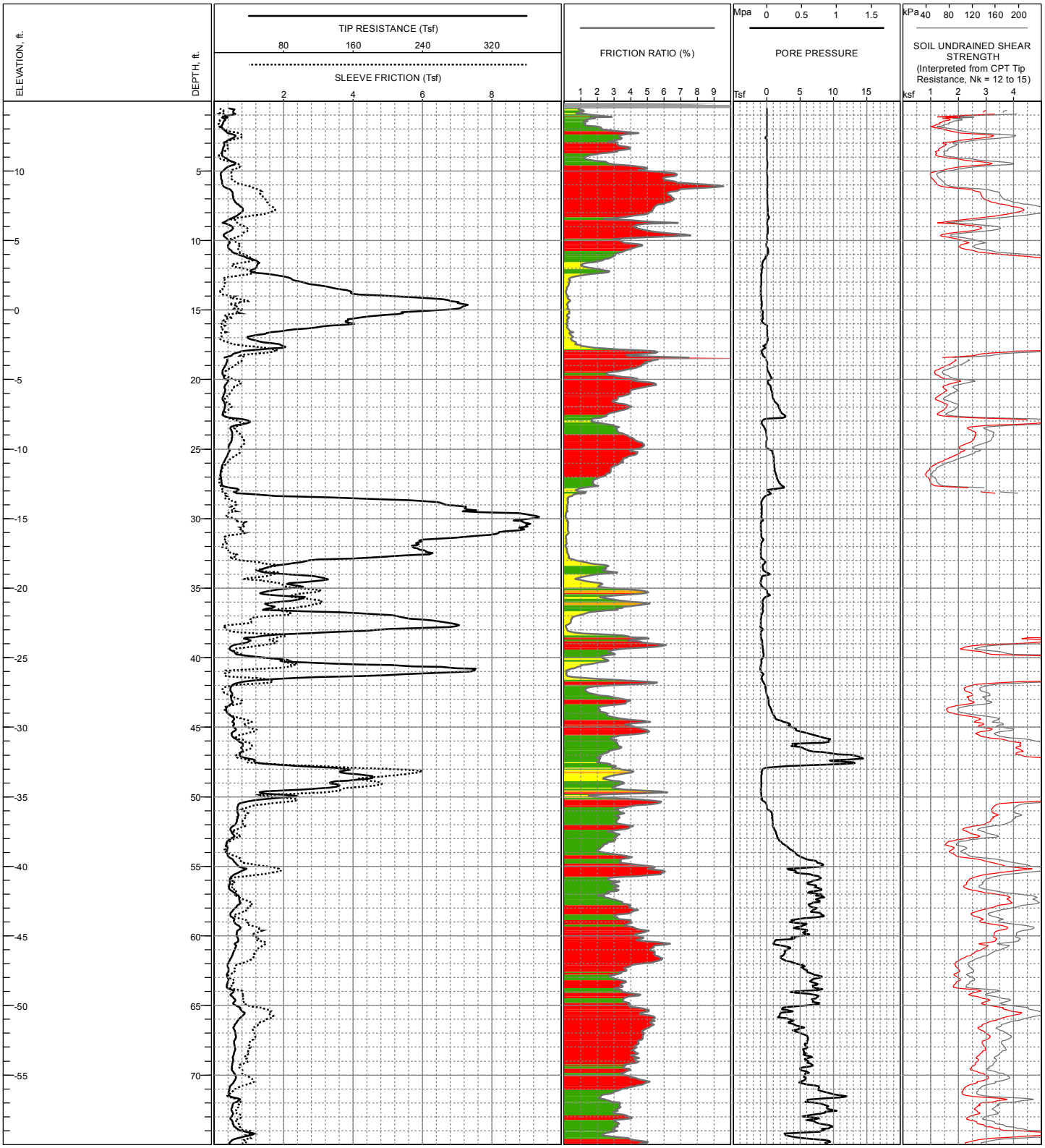
EXPLORATION METHOD: CPT
PERFORMED BY: FUGRO
REVIEWED BY: B Wair
CONE AREA RATIO: 0.60

LOG OF CPT NO: CPT-01

NASA AMES SVS BOILER

Moffett Field, California

G:\jobdocs\04.71110005 NASA AMES SVS Boiler\Explorations\CPT\2011\Logs\2011_03_17_CPTLogs\MXD\CPT_Logs.mxd,03/31/2011,hlopez



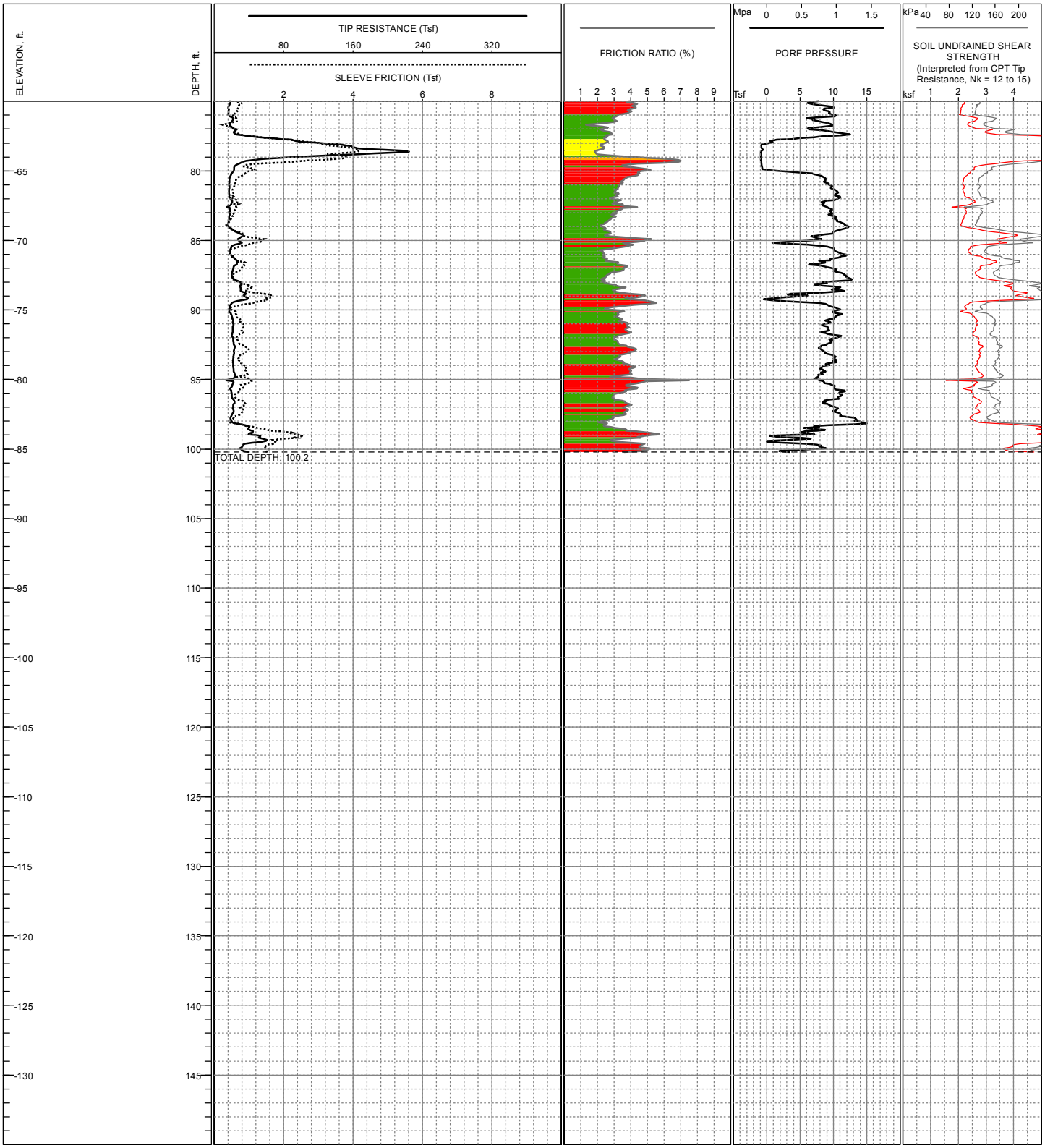
SURFACE EL: 15.0ft +/- (NGVD29)
COMPLETION DEPTH: 100.2ft
TESTDATE: 2/8/2011

EXPLORATION METHOD: CPT
PERFORMED BY: FUGRO
REVIEWED BY: B Wair
CONE AREA RATIO: 0.60

LOG OF CPT NO: CPT-02

NASA AMES SVS BOILER
Moffett Field, California

G:\jobdocs\04.71110005 NASA AMES SVS Boiler\Explorations\CPT\2011\Logs\2011_03_17_CPTLogs\MXD\CPT_Logs.mxd,03/31/2011,hlopez



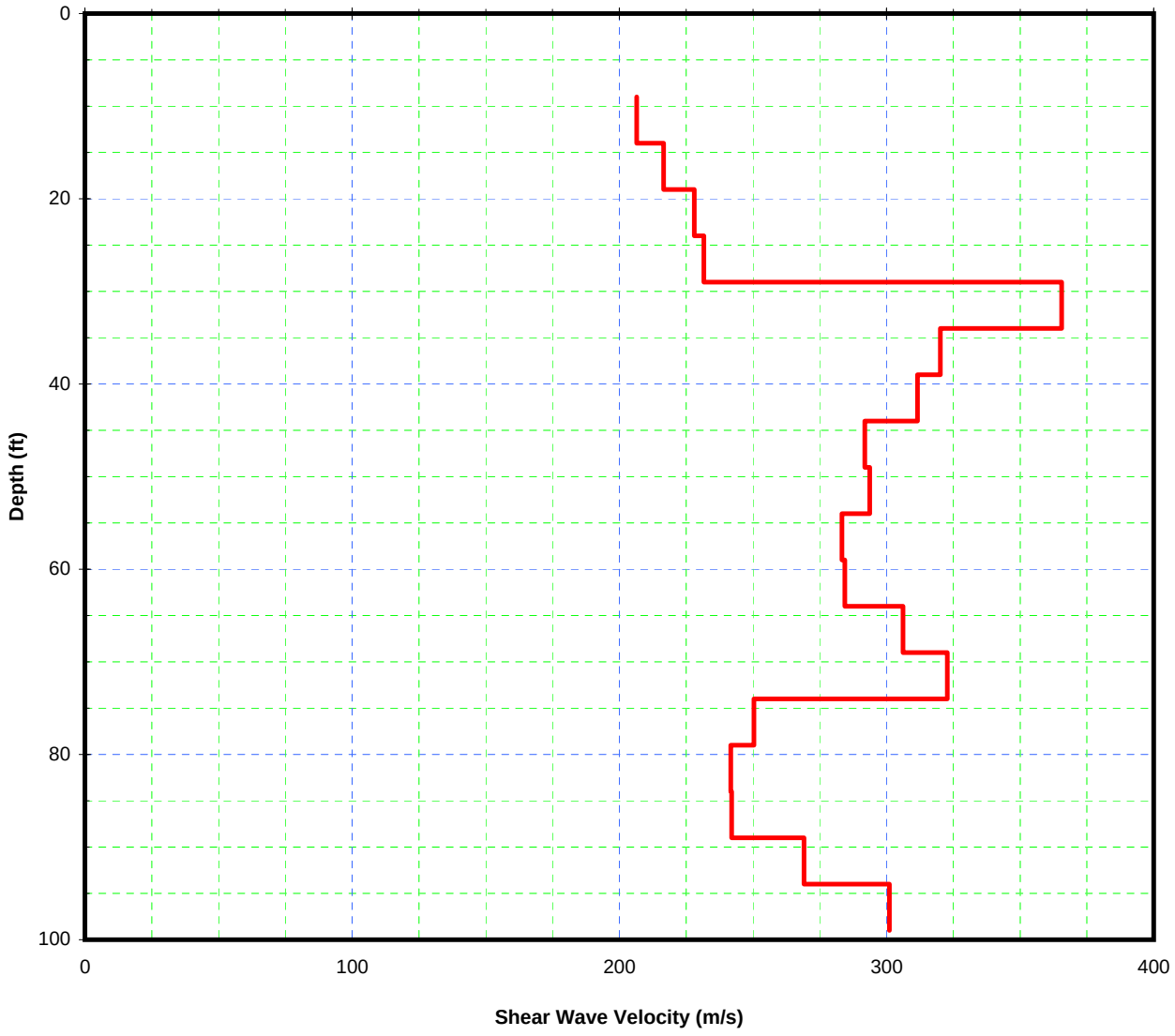
SURFACE EL: 15.0ft +/- (NGVD29)
COMPLETION DEPTH: 100.2ft
TESTDATE: 2/8/2011

EXPLORATION METHOD: CPT
PERFORMED BY: FUGRO
REVIEWED BY: B Wair
CONE AREA RATIO: 0.60

LOG OF CPT NO: CPT-02

NASA AMES SVS BOILER
Moffett Field, California

G:\jobdocs\04.71110005 NASA AMES SVS Boiler\Explorations\CPT\2011\Logs\2011_03_17_CPTLogs\MXD\CPT_Logs.mxd,03/31/2011,hlopez



SHEAR WAVE VELOCITY PROFILE
NASA Ames SVS Boiler Plant
Moffett Field, California

APPENDIX B
LABORATORY TESTING PROGRAM

APPENDIX B
LABORATORY TESTING PROGRAM

The laboratory-testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site.

The natural water content was determined on samples of the materials recovered from the borings in accordance with ASTM Test Designation D2216. These water contents are recorded on the boring logs at the appropriate depths.

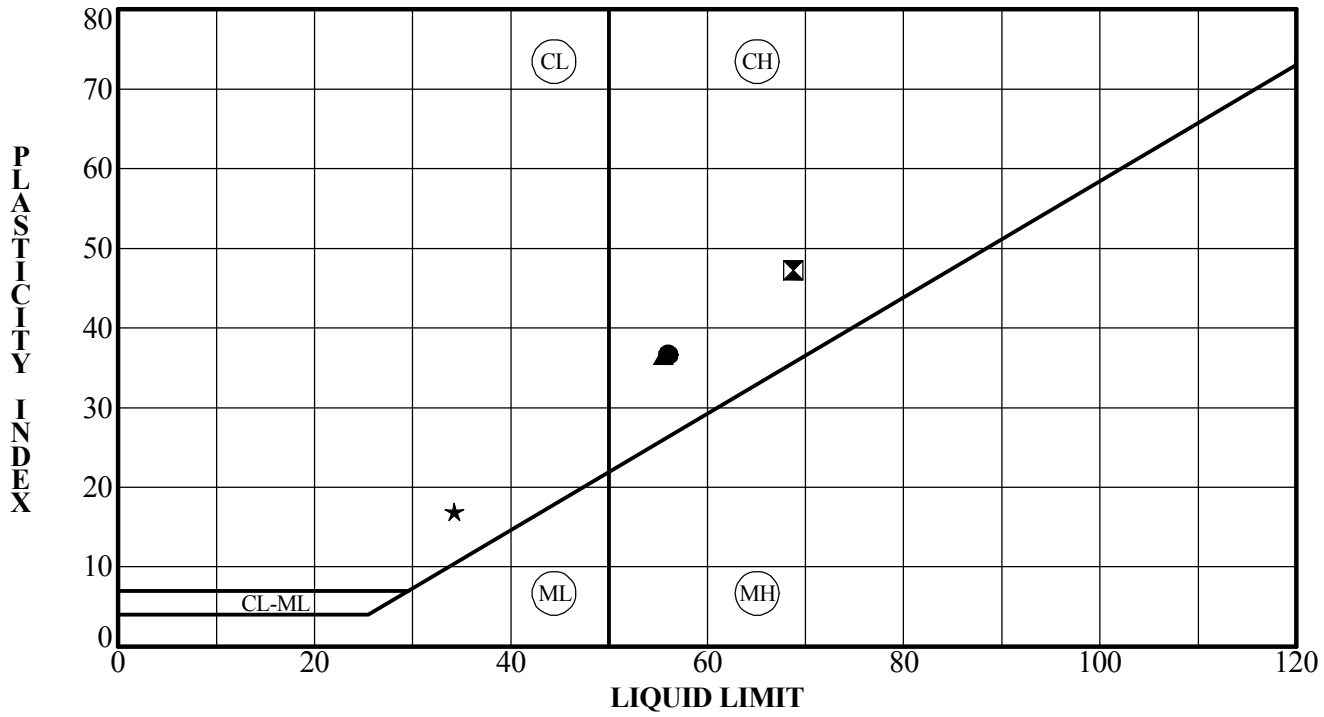
The dry density was measured for selected samples in accordance with ASTM Test Designation D2937. The results of these tests are shown on the boring logs at the appropriate sample depths.

Particle size (percent passing the #200 sieve) analysis was performed on selected samples to evaluate the fines content of the soil and aid in soil classification. The test was performed in accordance with ASTM Test Designation D1140. Test results are presented on the boring logs at the appropriate depths.

Atterberg Limits were performed on four samples of the subsurface soils to determine the range of water content over which these materials exhibit plasticity. The Atterberg Limits were determined in accordance with ASTM Test Designation D4318. These values are used to classify the soil in accordance with the Unified Soil Classification System and to estimate the soil's compressibility and expansion potential. The results of these tests are presented on Plate B-1 and on the boring logs at the appropriate samples.

Two consolidation tests were performed on a sample of the native clays to evaluate the compressibility and stress history. The consolidation tests were performed in accordance with ASTM Test Designation D2435. Test results are presented on Plate B-2 and B-3.

One Unconsolidated Undrained triaxial compression test was performed on a sample of the clay subsurface soils to evaluate the strength and compressibility characteristics of the soil. The triaxial test was performed in accordance with ASTM Test Designation D2850. Test results are presented on the boring logs at the appropriate sample depth. Plots of stress versus strain are shown on Plate B-4.



Key Symbol	Boring No.	Depth (Feet)	Liquid Limit	Plasticity Index	Liquidity Index	Water Content (%)	% Passing #200 Sieve	USCS
●	B-01	1.0	56	37	---	---		CH
⊠	B-01	6.2	69	47	0.158	29		CH
▲	B-02	2.0	56	36	0.332	31		CH
★	B-02	21.0	34	17	0.454	25		CL

FUGRO

PREP'D BY:
APP'D BY:
DATE: 3/21/11
DWG FILE:

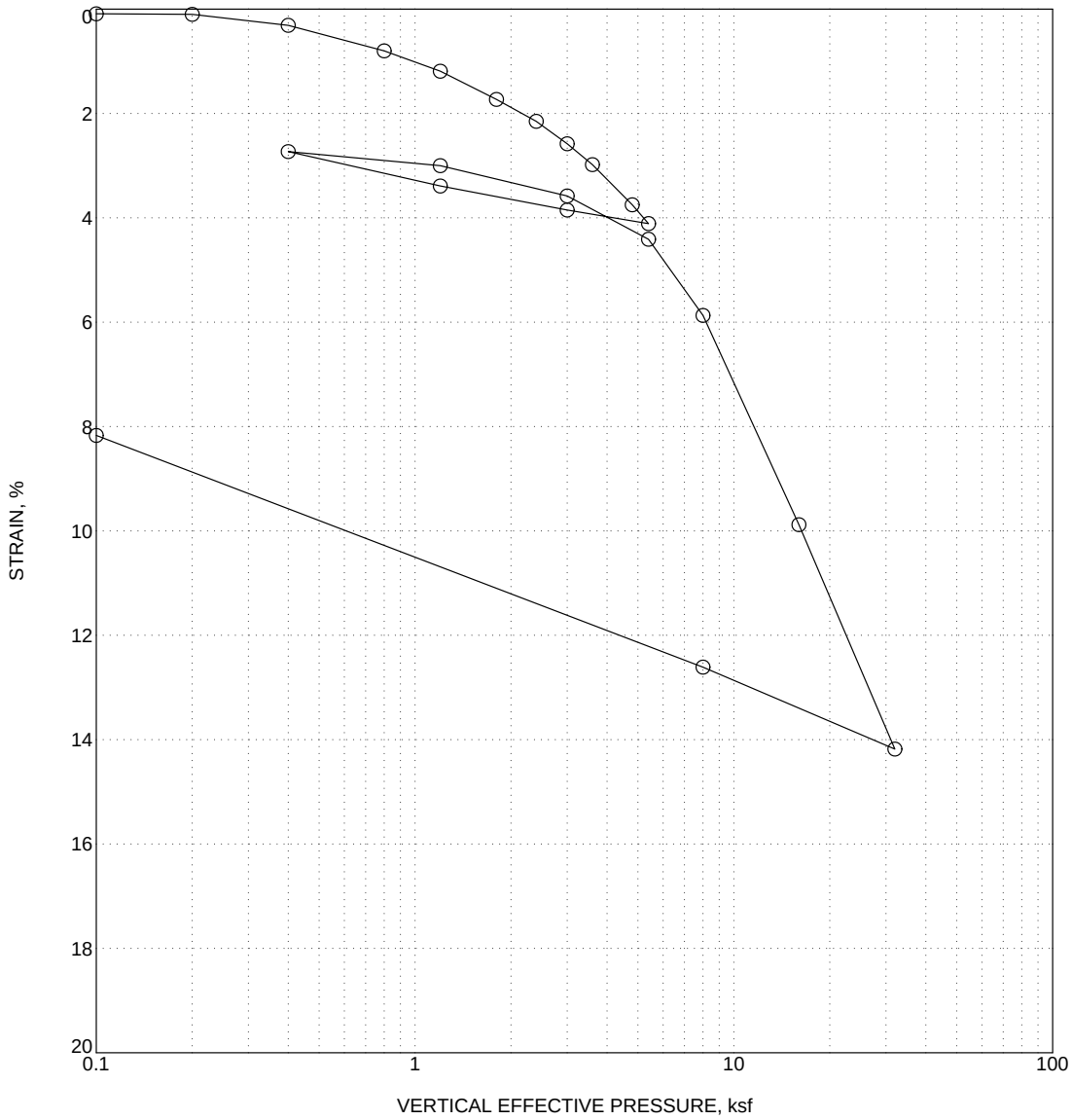
PLASTICITY CHART AND DATA

NASA AMES SVS BOILER PLANT
Moffett Field, California

FIGURE
B-1

PROJECT No.
04.71110005

ATTERBERG BORINGS 20110215.GPJ VERSION-012505.GDT 3/21/11

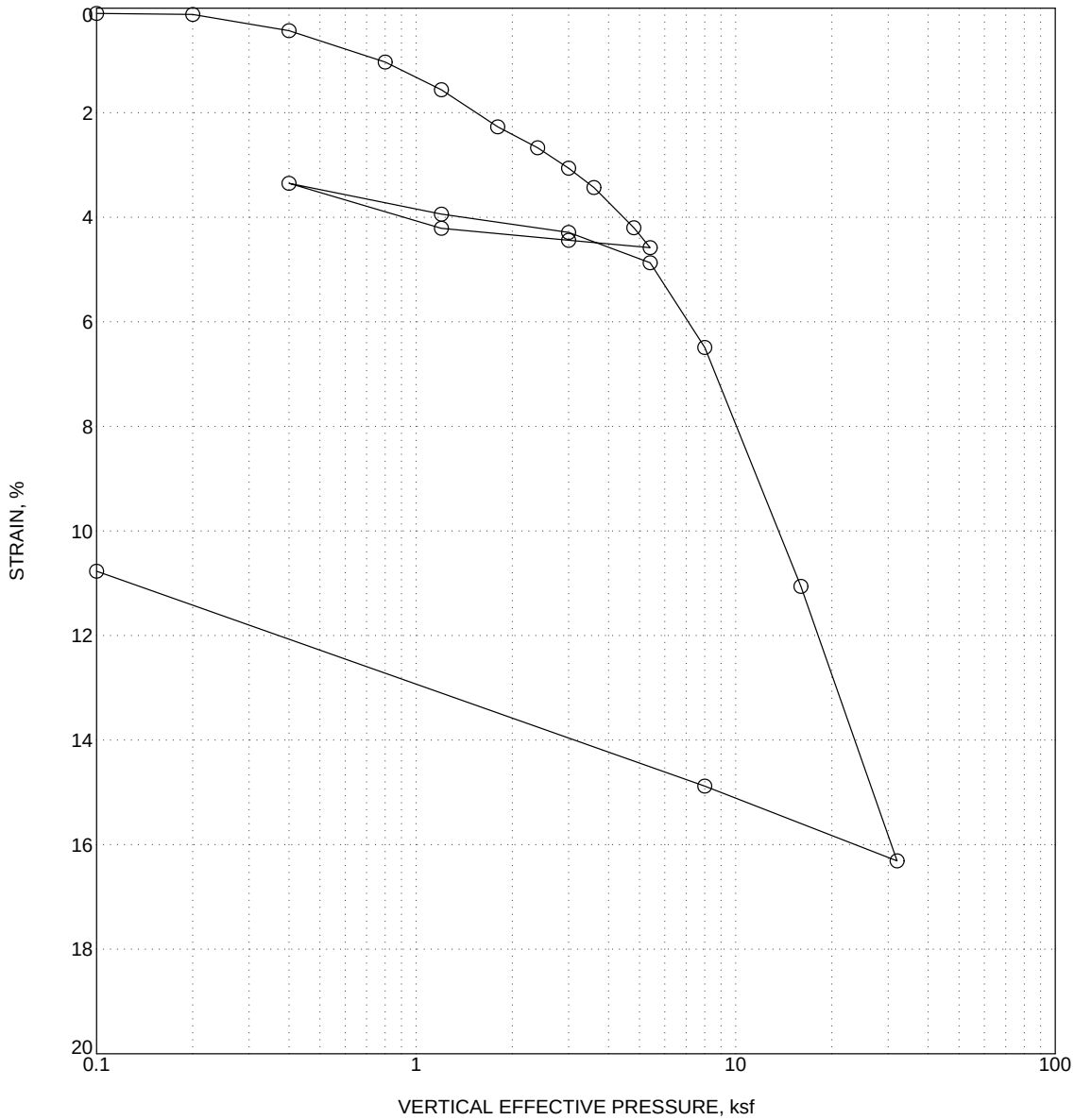


Boring No. B-1
Depth (feet) 6.2

	Initial	Final
Water Content (%)	29.4	27.2
Dry Density (pcf)	90.0	98.0
Void Ratio	0.89	0.74
Saturation (%)	89.7	100

Max Past Pressure (psf)	4,400
Compression Index (c'_c)	0.14
Recompression Index (c'_r)	0.015

CONSOLIDATION TEST RESULT
NASA Ames SVS Boiler Plant
Moffett Field, California

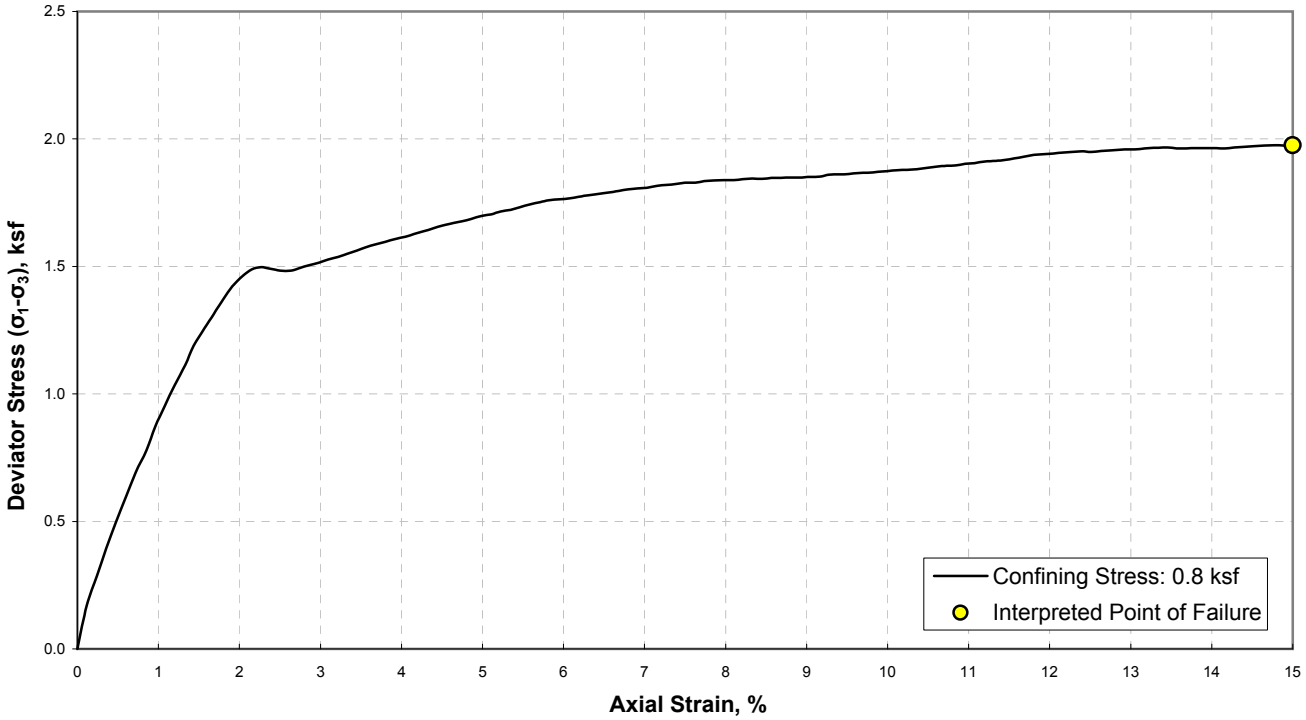


Boring No. B-2
Depth (feet) 21

	Initial	Final
Water Content (%)	24.6	21.1
Dry Density (pcf)	99.5	111.1
Void Ratio	0.75	0.56
Saturation (%)	91.6	100

Max Past Pressure (psf)	6,000
Compression Index (c'_c)	0.17
Recompression Index (c'_r)	0.015

CONSOLIDATION TEST RESULT
NASA Ames SVS Boiler Plant
Moffett Field, California



SAMPLE ID

Boring Number.:	B-01
Sample Number.:	4A
Sample Depth:	5.8 ft
USCS Classification:	Fat CLAY (CH): greenish black, moist

SAMPLE PROPERTIES

Water Content, %	33.1%
Dry Unit Weight, pcf	84.7
Saturation, %	90%
Void Ratio	0.99
Diameter, in	2.40
Height, in	4.92

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	---

Other Parameters	
Liquid Limit	69
Plastic Limit	22
Plasticity Index	47
Estimated Gs	2.70
S_u from T_v, ksf	0.9
S_u from PP, ksf	2

TEST SUMMARY

Maximum Deviator Stress, ksf	2.0
Undrained Shear Strength, ksf	1.0
Axial Strain at Failure, %	15.0
Strain Rate, %/min	0.7
Cell Pressure, ksf	0.8
Tested By:	JC
Date Tested:	3/1/11

REMARKS

Test Method: ASTM 2850

UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST

NASA Ames SVS Boiler Plant
Moffet Field, California

FIGURE B-4

APPENDIX C
ENVIRONMENTAL DATA REPORT

FUGRO WEST, INC.

1000 Broadway, Suite 440
Oakland, California 94607
Tel: (510) 268-0461
Fax: (510) 268-0545

April 11, 2011
Project No. 04.71110005

AECOM
NASA Ames Research Center
M/S 213-8, Building N213, Room 214
Moffett Field, California 94035-1000

Attention: Mr. Gregory Hite

Subject: Environmental Data Report ,
NASA Ames Boiler Plant Project, Moffett Field, California

Dear Mr. Hite:

With this letter, Fugro West Inc. (Fugro) presents the results of chemical analyses on soil samples collected from a boring located northeast of Vacuum Sphere #6 at the NASA Ames Research Center. The sampling was performed for the SVS Boiler Replacement project. We understand that the project will consist of replacing the existing SVS boiler located in Building N234A with a new boiler located north of Building N231. The new boiler will be supported on an approximately 140-foot by 75-foot concrete mat foundation. The purpose of this report is to evaluate the potential presence of chemicals in shallow soil prior to the demolition of Sphere #6.

SUMMARY OF PREVIOUS ENVIRONMENTAL ASSESSMENTS

Fugro has reviewed previous analytical results of shallow soil samples obtained by NASA's consultant ISSi in 2008 and 2009 at Sphere #5, formerly located immediately west of Sphere #6. The locations of ISSi's samples are shown on the Site Plan – Plate 1. In 2008, ISSi obtained two pre-demolition composite samples of the shallow soil beneath Sphere #5. Analytical results of the pre-demolition samples identified the presence of elevated concentrations of total petroleum hydrocarbons as motor oil (TPHmo); poly-chlorinated biphenyls (PCBs); and some metals including, lead, copper, mercury, and zinc, which exceeded the Environmental Screening Levels (ESLs) established by the Regional Water Quality Control Board (RWQCB) for a residential land use[1]. Additionally, analyses identified the presence of hexavalent chromium within the shallow soil at concentrations up to 0.05 milligrams per kilogram (mg/kg).

As part of demolition activities at Sphere 5, soil was excavated and stockpiled in a staging area east of Building N265. Analyses of a composite sample obtained from the stockpile detected similar elevated concentrations of the contaminants listed above.

[1] San Francisco Bay Regional Water Quality Control Board, Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Interim Final November 2007, Revised May 2008.

On March 10, 2009, ISSi obtained two sets of composite samples after the demolition of Sphere #5. These samples were presumably taken at the base of the excavation following demolition of Sphere #5 and removal of the surficial soil. The sample locations were not indicated in the ISSi report, and are therefore not shown on our Site Plan. Analytical results of the post-demolition composite samples identified low concentrations of TPHmo and metals within the shallow soil. However, the detected concentrations were below their respective ESLs for a residential land use. The laboratory analytical reports from the previous sampling events are attached.

ENVIRONMENTAL TESTING AND EVALUATION

To evaluate whether shallow soil near Sphere 6 had similar elevated concentrations of chemicals of concern (TPH, PCBs, and metals including hexavalent chromium) identified in soil prior to the demolition of Sphere 5, Fugro obtained soil samples from the upper four (4) feet of soil within Boring B-1 located northeast of Sphere 6. Fugro's work was conducted on February 9, 2011 concurrent with our geotechnical investigation at the Site.

Soil samples were collected in clean stainless steel liners, filled to avoid headspace, and capped with plastic end caps. All sampling was completed using standard industry practices for worker health and safety, equipment decontamination, sample collection and labeling, chain-of-custody documentation, and sample transport to a State-certified laboratory for analyses. The location of Boring B-1 is shown on Plate 1.

Fugro submitted a total of three soil samples to a State-certified laboratory for the following analysis:

- Total petroleum hydrocarbons as diesel (TPHd) and TPHmo using EPA Test Method 8015m with silica gel cleanup,
- PCBs using EPA Method 8082,
- 17 Title 22 metals using EPA Method 6010/7000 series, and
- Hexavalent Chromium using EPA Method 3060/7196.

Results of analyses for soil samples were compared to residential land use ESLs and Total Threshold Limit Concentrations (TTLC), one of the criteria used in the State of California to designate a waste as hazardous. Results of analyses for the soil samples are summarized on Table 1. The laboratory analytical report is attached.

Analyses detected TPHd and TPHmo in all samples analyzed at concentrations ranging up to 4.1 mg/kg and 22 mg/kg, respectively. PCBs were detected in the sample obtained from a depth of approximately 0.75 feet below ground surface (bgs) at a concentration of 12 micrograms per kilogram (µg/kg). All detections of TPHd, TPHmo, and PCBs were well below their respective ESLs for a residential land use. These concentrations are also below the ESLs that apply to Direct Exposure Soil Screening Levels for a Construction/Trench Worker Exposure Scenario.

Analyses detected various concentrations of heavy metals in all samples tested. With the exception of total antimony, the only detected metal exceeding respective ESL criteria was arsenic. Arsenic was detected in all samples at concentrations up to of 4.0 mg/kg, exceeding the residential ESL criteria of 0.39 mg/kg. However, naturally occurring arsenic concentrations within the San Francisco Bay Area are higher than the residential land use criteria and typically range from 10 mg/kg to 20 mg/kg. In Fugro's opinion, the detected arsenic concentrations are consistent with naturally occurring background values for the Bay Area.

Total antimony was detected in all three samples at concentrations ranging from 7.7 mg/kg to 13 mg/kg, exceeding the ESL of 6.3 mg/kg for a residential land use but below the ESL for Direct Exposure Soil Screening Levels for Construction/Trench Worker Exposure Scenario. All detected antimony concentrations were below the Total Threshold Limit Concentrations (TTLC) value of 500 mg/kg, one of the criteria used to classify a soil as hazardous waste in the State of California. No soluble testing has been completed on these samples.

CONCLUSIONS AND RECOMMENDATIONS

Based on our limited testing, no chemical concentrations were detected above the ESL criteria for a construction worker exposure scenario. On this basis, we conclude that the chemical results do not preclude re-use of the soil at the site as long as standard dust control methods and Best Management Practices are utilized. The data also suggests that if soils are to be disposed off-site, they will likely be considered non-hazardous and suitable for disposal at a Class II or Class III landfill. Depending on the landfill requirements, additional sampling and analyses may be required prior to arranging soil disposal at the selected landfill. We recommend that AECOM provide a copy of this report to the Contractor to assist with onsite management or offsite disposal of soil excavated from beneath Sphere #6.

If the soils are going to be removed from the site and reused elsewhere, additional testing may be required. If stained or obviously contaminated soil is encountered during site grading and construction, Fugro recommends that the Contractor notify AECOM and/or Fugro immediately, so that appropriate investigation or chemical testing is performed if necessary.

CLOSING STATMENT

We appreciate this opportunity to be of service to AECOM. We trust this provides the information required at this time. Please call either of the undersigned at (510) 268-0461 if you have any questions or need additional information.

Sincerely,

FUGRO WEST, INC.

Karen A. Emery, P.G.
Project Geologist

Stephen J. Osborne, P.E., G.E.
Principal Engineer

KAE/SJO:kae

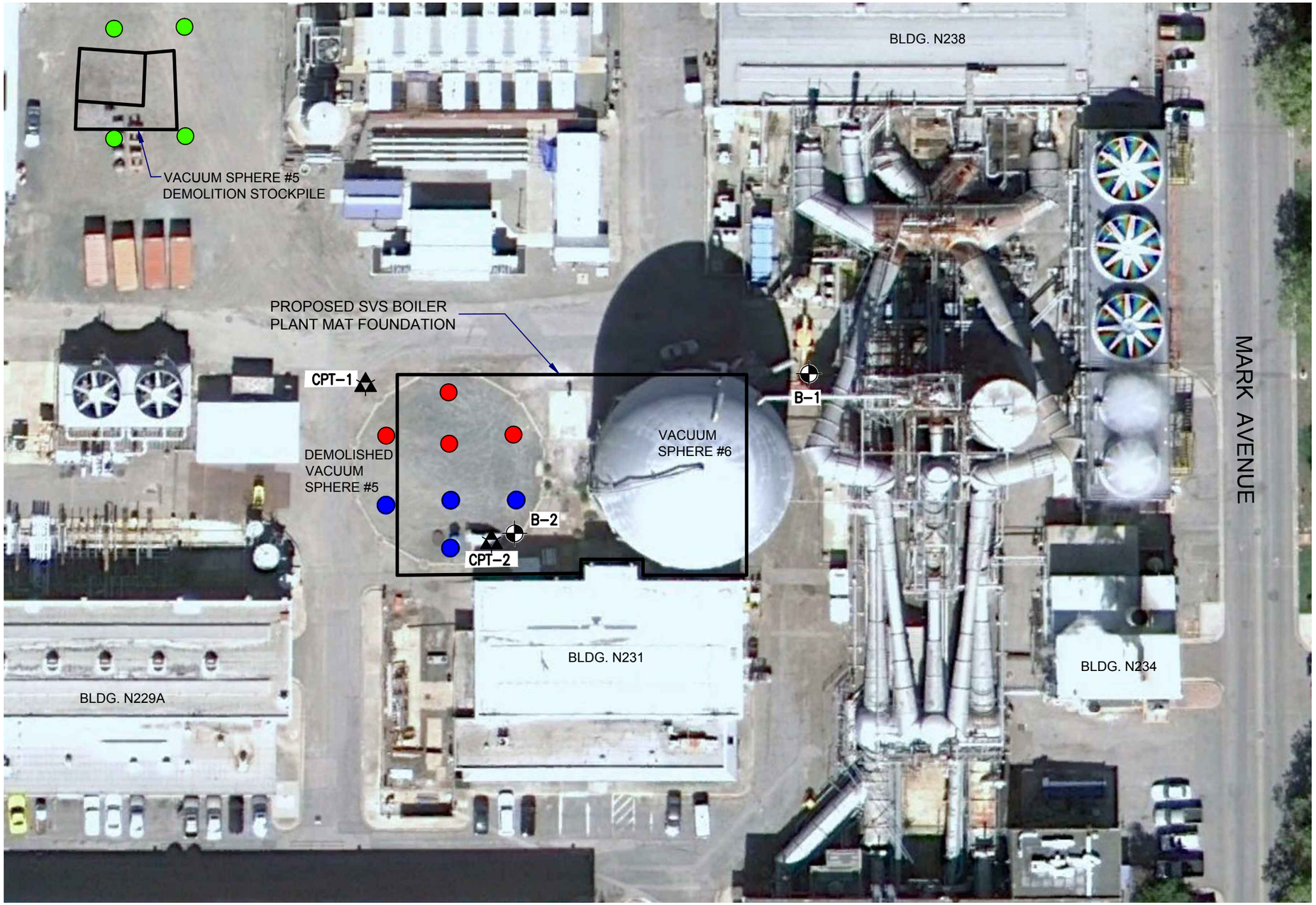
Attachments: Table 1. Summary of Analytical Data – Soil
Plate 1 – Site Plan
Analytical Laboratory Reports

Copies Submitted: (1) Addressee

Table 1
Summary of Analytical Data - Shallow Soil
NASA Ames SVS Boiler Plant Project
Moffet Field, California

		Sample ID			California Regulatory Limits	Screening Criteria	
	Units	B-1, 1A	B-1, 2A	B-1, 3A	TTLC	ESL	
						Residential Land Use	Construction Worker
Sample Depth	ft	0.75	1.5	3.0			
Hydrocarbons							
TPHd	mg/kg	**4.1** Y	**3.9** Y	**1.8** Y	NE	83	4,200
TPHmo	mg/kg	**14**	**22**	**14**	NE	370	12,000
Polychlorinated Biphenyls							
PCBs	µg/kg	**12**	ND	ND	50,000	220	6,700
Metals							
Antimony	mg/kg	**13**	**9.9**	**7.7**	500	6.3	310
Arsenic	mg/kg	**3.8**	**4.0**	**3.3**	500	0.39	15
Barium	mg/kg	**200**	**190**	**230**	10,000[b]	750	2,600
Beryllium	mg/kg	**0.65**	**0.52**	**0.58**	75	4.0	98
Cadmium	mg/kg	<0.25	<0.28	<0.26	100	1.7	39
Chromium	mg/kg	**57**	**57**	**45**	2,500	750[a]	1,200,000[a]
Hexavalent Chromium	mg/kg	<0.40	<0.40	<0.40	500	8.0	0.53
Cobalt	mg/kg	**11**	**9.0**	**8.5**	8,000	40	94
Copper	mg/kg	**43**	**29**	**28**	2,500	230	310,000
Lead	mg/kg	**11**	**13**	**4.7**	1,000	200	750
Mercury	mg/kg	**0.038**	**0.041**	**0.026**	20	1.3	58
Molybdenum	mg/kg	<0.25	<0.28	<0.26	3,500[c]	40	3,900
Nickel	mg/kg	**54**	**44**	**45**	2,000	150	260
Selenium	mg/kg	**2.7**	**3.0**	**4.1**	100	10	3,900
Silver	mg/kg	<0.25	<0.28	<0.26	500	20	3,900
Thallium	mg/kg	<0.5	<0.56	<0.52	700	1.3	62
Vanadium	mg/kg	**49**	**41**	**37**	2,400	16	770
Zinc	mg/kg	**75**	**71**	**45**	5,000	600	230,000

Notes:
TPHd= Total Petroleum Hydrocarbons as diesel
TPHmo= Total Petroleum Hydrocarbons as motor oil
Detected Concentrations shown in **Bold**
<0.5 = Not detected above laboratory detection limit
ND = Not Detected
mg/kg = Milligrams per kilogram
µg/kg = micrograms per kilogram
Y = Sample exhibits chromatographic pattern which does not resemble standard.
NE = Not Established
ESL = Environmental Screening Levels, RWQCB Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater
-- Interim Final November 2007, Revised May 2008. Table A, ESL for Residential Land Use, Table K-3 for Construction Worker Exposure
TTLC = Total Threshold Limit Criteria
[a] = Assumes Chromium III
[b] = TTLC does not include barium sulfate
[c] = TTLC does not inlcude molybdenum disulfide



BASE MAP SOURCE: Google Earth Pro, 2011.

LEGEND

B-1	EXPLORATORY BORING BY FUGRO (2011)
CPT-1	CONE PENETRATION TEST BY FUGRO (2011)
	ENVIRONMENTAL SAMPLE #1 BY ISSI (2008)
	ENVIRONMENTAL SAMPLE #2 BY ISSI (2008)
	ENVIRONMENTAL SAMPLE #3 BY ISSI (2009)

NORTH

0 40 80
FEET

SITE PLAN
NASA Ames SVS Boiler Plant
Moffett Field, California

G:\jobdocs\04.71110005 NASA AMES SVS Boiler\Drafting\B04.71110005-01_environ.dwg 4-11-11 11:08:50 AM oakCAD

ANALYTICAL LABORATORY REPORTS

Curtis & Tompkins, Ltd.
Analytical Laboratories, Since 1878

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 225895
ANALYTICAL REPORT

Fugro West Inc.	Project : 04.71110005
1000 Broadway	Location : NASA Ames SVS Boiler Plant
Oakland, CA 94607	Level : II

Sample ID	Lab ID
B-1,1A	225895-001
B-1,2A	225895-002
B-1,3A	225895-003

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: _____ Date: 02/17/2011
Project Manager

NELAP # 01107CA

Curtis & Tompkins, Ltd.

CASE NARRATIVE

Laboratory number:	**225895**
Client:	**Fugro West Inc.**
Project:	**04.71110005**
Location:	**NASA Ames SVS Boiler Plant**
Request Date:	**02/10/11**
Samples Received:	**02/10/11**

This data package contains sample and QC results for three soil samples, requested for the above referenced project on 02/10/11. The samples were received cold and intact.

TPH-Extractables by GC (EPA 8015B):
No analytical problems were encountered.

PCBs (EPA 8082):
All samples underwent sulfuric acid cleanup using EPA Method 3665A. All samples underwent sulfur cleanup using the copper option in EPA Method 3660B. No analytical problems were encountered.

Metals (EPA 6010B and EPA 7471A):
No analytical problems were encountered.

Hexavalent Chromium (EPA 7196A):
No analytical problems were encountered.

Hexavalent Chromium (EPA 3060/7196):
Low recovery was observed for hexavalent chromium in the matrix spike of B-1,3A (lab # 225895-003), due to matrix interference; the LCS was within limits. No other analytical problems were encountered.

225895

ES-F10 CHAIN OF CUSTODY

PROJECT NAME: Nasa Ames SVS Boiler Plant

PROJECT NO.: 04-7111 0005

LAB: CET

PROJECT CONTACT: Barney Wair

TURNAROUND: 5 days

SAMPLED BY: Alexa Sperske

LABORATORY I.D. NUMBER	FIELD SAMPLE I.D.	MATRIX: WATER	MATRIX: SOIL	MATRIX: AIR	CONTAINERS: VOA	CONTAINERS: LITER	CONTAINERS: PINT	CONTAINERS: TUBE	PRESERVATIVE: HCL	PRESERVATIVE: H_2SO_4	PRESERVATIVE: HNO_3	PRESERVATIVE: ICE	PRESERVATIVE: OTHER	PRESERVATIVE: NONE	SAMPLING DATE: MONTH	SAMPLING DATE: DAY	SAMPLING DATE: YEAR	SAMPLING DATE: TIME	Quantity	ANALYSIS REQUESTED: TPH d & mo 8015 w/ Si gel	ANALYSIS REQUESTED: Title 22 6010	ANALYSIS REQUESTED: PCBs 8082	ANALYSIS REQUESTED: Chrome VI 6010
	B-1, 1A		X					X				X			02	09	11	1305		X	X	X	X
	B-1, 2A		X					X				X			02	09	11	1310		X	X	X	X
	B-1, 3A		X					X				X			02	09	11	1315		X	X	X	X

CHAIN OF CUSTODY RECORD

RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)	DATE/TIME
[signature]	2/10/11 1134	[signature]	2/10/11 1134
[signature]	2/10/11 3:52	[signature]	2/10/11 1552

COMMENTS & NOTES:

FUGRO WEST, INC.
1000 Broadway, Suite 440
Oakland, California 94607
Tel: 510.268.0461 Fax: 510.268.0545

intact cold RG

COOLER RECEIPT CHECKLIST

Curtis & Tompkins, Ltd.

Login # 225895 Date Received 2/10/11 Number of coolers 1
Client Fugro Project NASA Ames

Date Opened 2/10/11 By (print) J. Gayette (sign)
Date Logged in 2/11/11 By (print) R. Pams (sign)

1. Did cooler come with a shipping slip (airbill, etc) _____ YES (NO)
   Shipping info _____

2A. Were custody seals present? ... ☐ YES (circle) on cooler on samples ☒ NO
   How many _____ Name _____ Date _____
2B. Were custody seals intact upon arrival? _____ YES NO (N/A)
3. Were custody papers dry and intact when received? _____ (YES) NO
4. Were custody papers filled out properly (ink, signed, etc)? _____ (YES) NO
5. Is the project identifiable from custody papers? (If so fill out top of form) ___ (YES) NO
6. Indicate the packing in cooler: (if other, describe) _____

☐ Bubble Wrap ☐ Foam blocks ☐ Bags ☐ None
☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. Temperature documentation:

Type of ice used: ☐ Wet ☐ Blue/Gel ☐ None Temp(°C) 2.3

☐ Samples Received on ice & cold without a temperature blank

☐ Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? _____ YES (NO)
   If YES, what time were they transferred to freezer? _____
9. Did all bottles arrive unbroken/unopened? _____ (YES) NO
10. Are samples in the appropriate containers for indicated tests? _____ (YES) NO
11. Are sample labels present, in good condition and complete? _____ (YES) NO
12. Do the sample labels agree with custody papers? _____ (YES) NO
13. Was sufficient amount of sample sent for tests requested? _____ (YES) NO
14. Are the samples appropriately preserved? _____ YES NO (N/A)
15. Are bubbles > 6mm absent in VOA samples? _____ YES NO (N/A)
16. Was the client contacted concerning this sample delivery? _____ YES (NO)
   If YES, Who was called? _____ By _____ Date: _____

COMMENTS

_____

Curtis & Tompkins, Ltd.

Total Extractable Hydrocarbons

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8015B
Matrix:	Soil	Sampled:	02/09/11
Units:	mg/Kg	Received:	02/10/11
Basis:	as received	Prepared:	02/14/11
Diln Fac:	1.000	Analyzed:	02/15/11
Batch#:	171813		

Field ID: B-1,1A Lab ID: 225895-001
Type: SAMPLE Cleanup Method: EPA 3630C

Analyte	Result	RL
Diesel C10-C24	4.1 Y	1.0
Motor Oil C24-C36	14	5.0

Surrogate	%REC	Limits
o-Terphenyl	57	52-130

Field ID: B-1,2A Lab ID: 225895-002
Type: SAMPLE Cleanup Method: EPA 3630C

Analyte	Result	RL
Diesel C10-C24	3.9 Y	1.0
Motor Oil C24-C36	22	5.0

Surrogate	%REC	Limits
o-Terphenyl	53	52-130

Field ID: B-1,3A Lab ID: 225895-003
Type: SAMPLE Cleanup Method: EPA 3630C

Analyte	Result	RL
Diesel C10-C24	1.8 Y	1.0
Motor Oil C24-C36	14	5.0

Surrogate	%REC	Limits
o-Terphenyl	77	52-130

Type: BLANK Cleanup Method: EPA 3630C
Lab ID: QC579928

Analyte	Result	RL
Diesel C10-C24	ND	1.0
Motor Oil C24-C36	ND	5.0

Surrogate	%REC	Limits
o-Terphenyl	76	52-130

Y= Sample exhibits chromatographic pattern which does not resemble standard
ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC579929	Batch#:	171813
Matrix:	Soil	Prepared:	02/14/11
Units:	mg/Kg	Analyzed:	02/15/11

Cleanup Method: EPA 3630C

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	49.97	30.96	62	44-151

Surrogate	%REC	Limits
o-Terphenyl	70	52-130

Curtis & Tompkins, Ltd.

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Batch#:	171813
MSS Lab ID:	225866-004	Sampled:	02/10/11
Matrix:	Soil	Received:	02/10/11
Units:	mg/Kg	Prepared:	02/14/11
Basis:	as received	Analyzed:	02/15/11
Diln Fac:	1.000		

Type: MS Cleanup Method: EPA 3630C
Lab ID: QC579930

Analyte	MSS Result	Spiked	Result	%REC	Limits
Diesel C10-C24	132.3	50.11	172.9	81	39-146

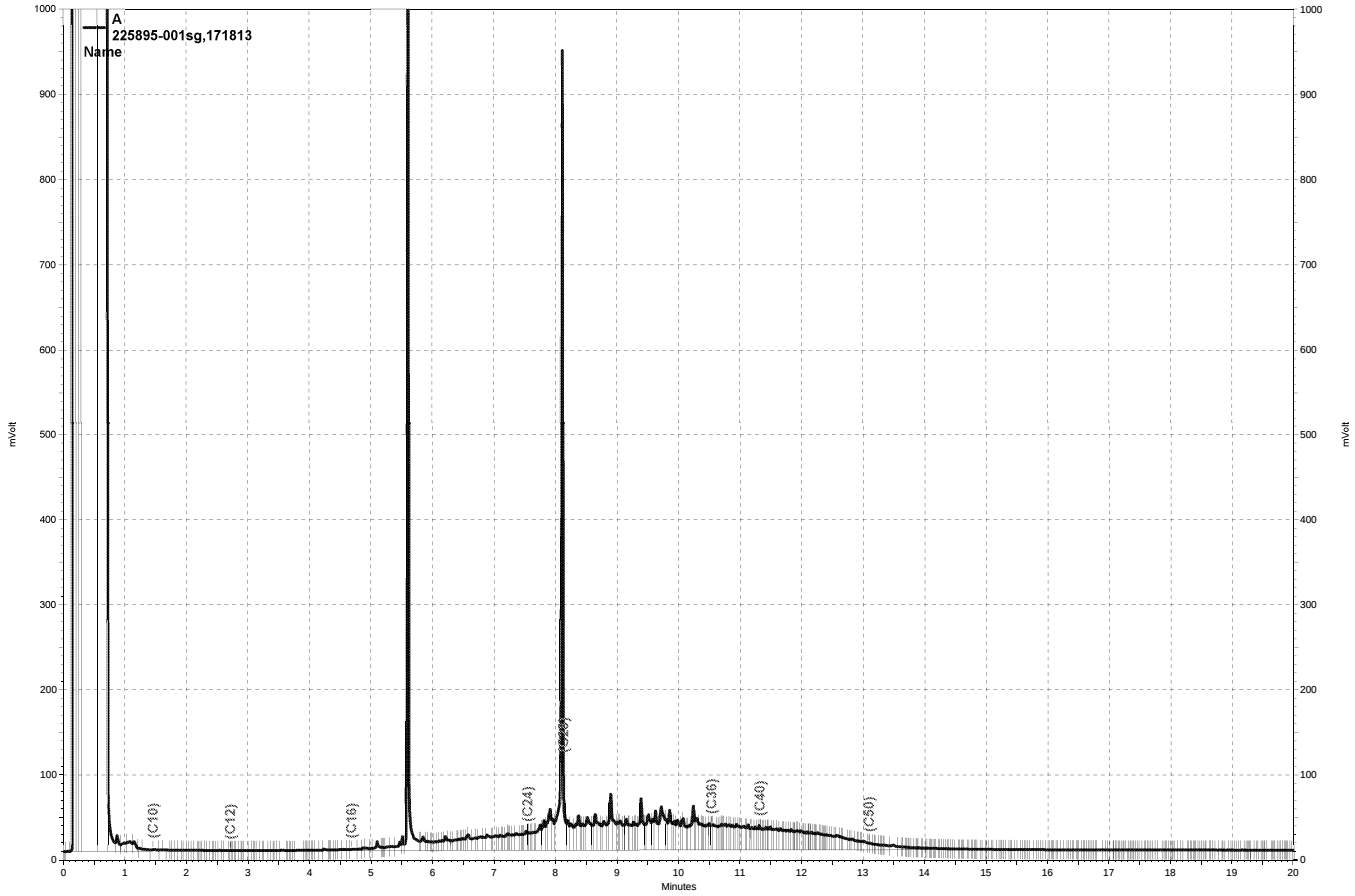
Surrogate	%REC	Limits
o-Terphenyl	84	52-130

Type: MSD Cleanup Method: EPA 3630C
Lab ID: QC579931

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	49.57	175.0	86	39-146	2	61

Surrogate	%REC	Limits
o-Terphenyl	85	52-130

RPD= Relative Percent Difference



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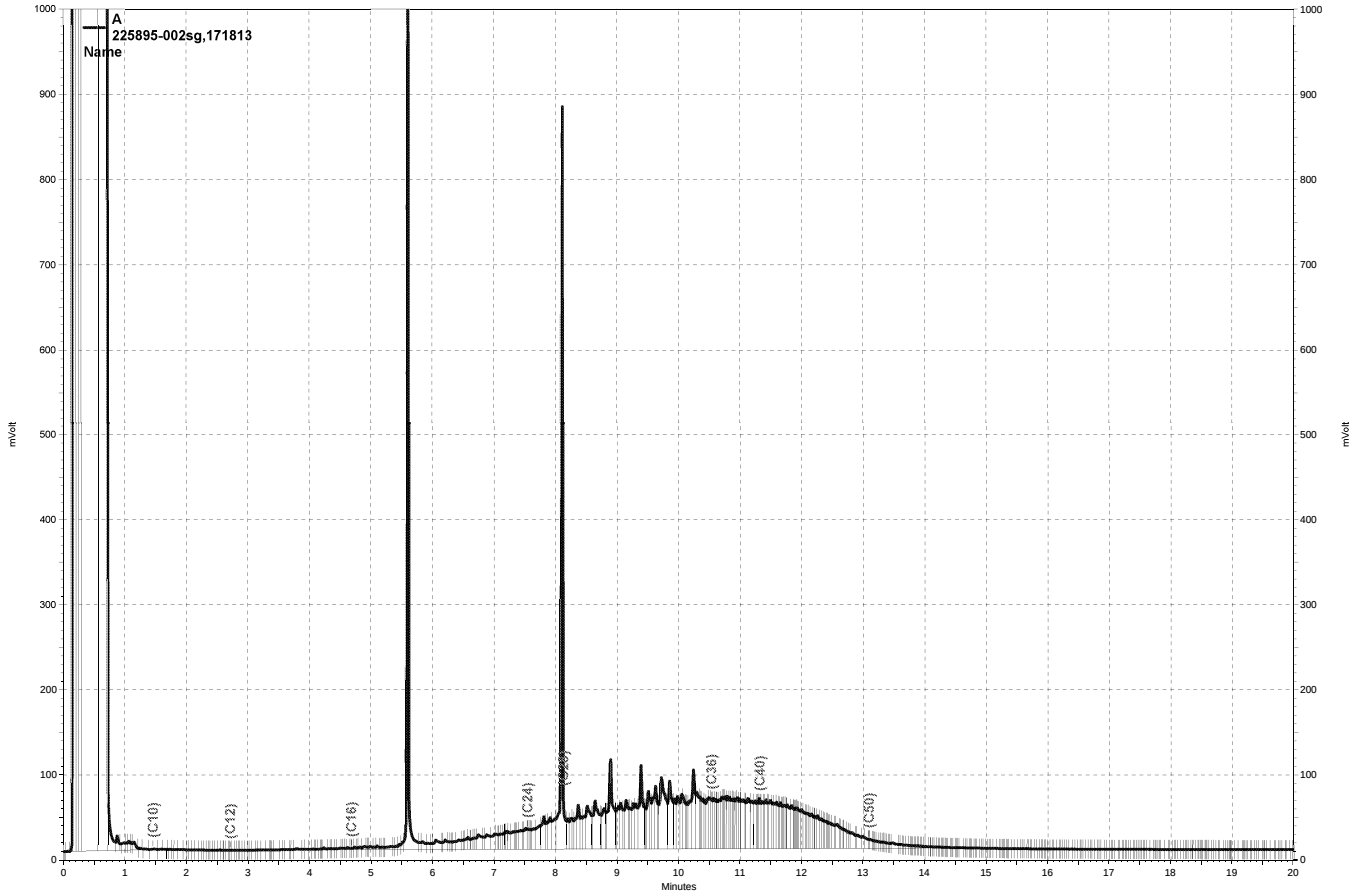

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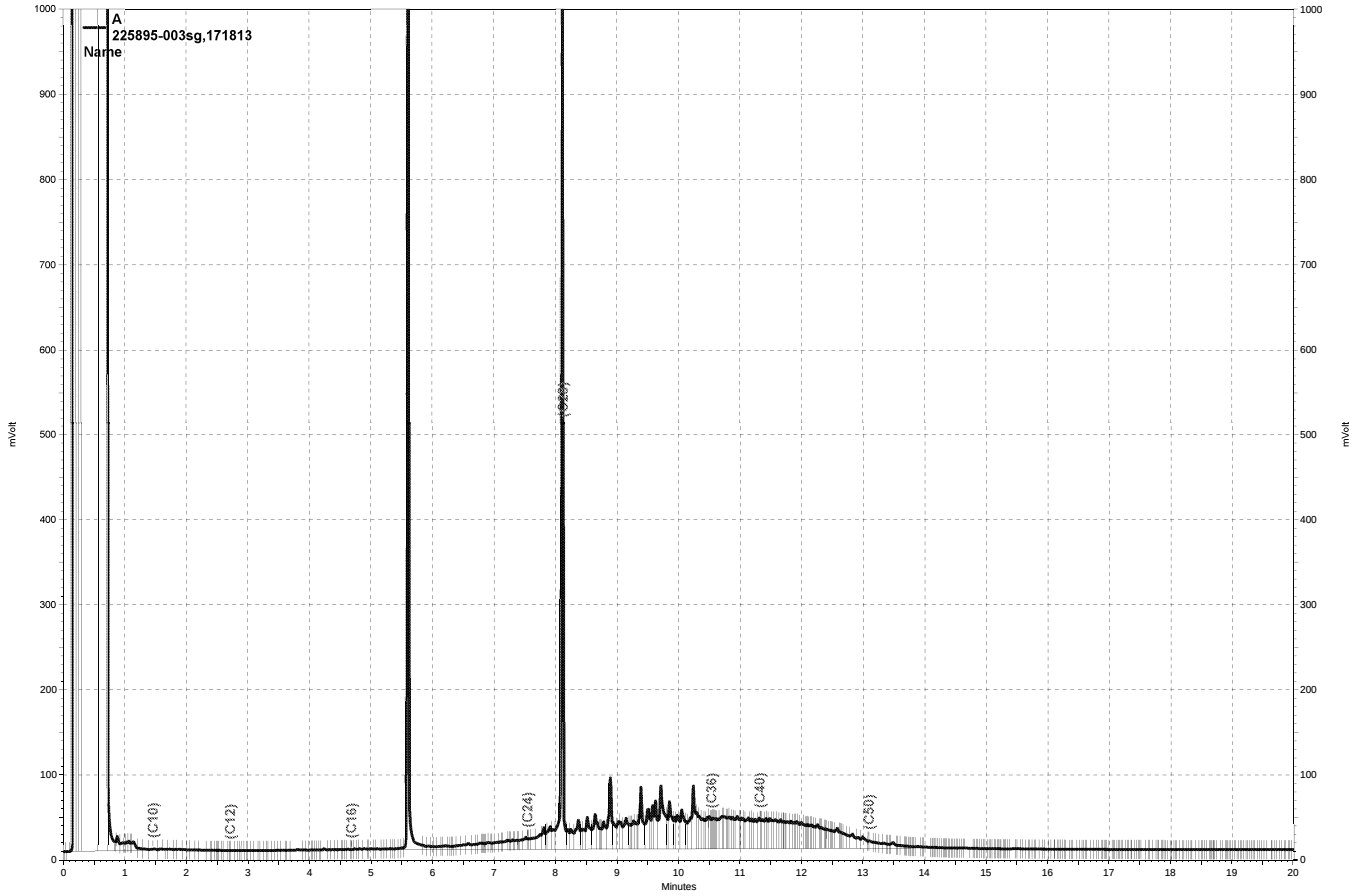

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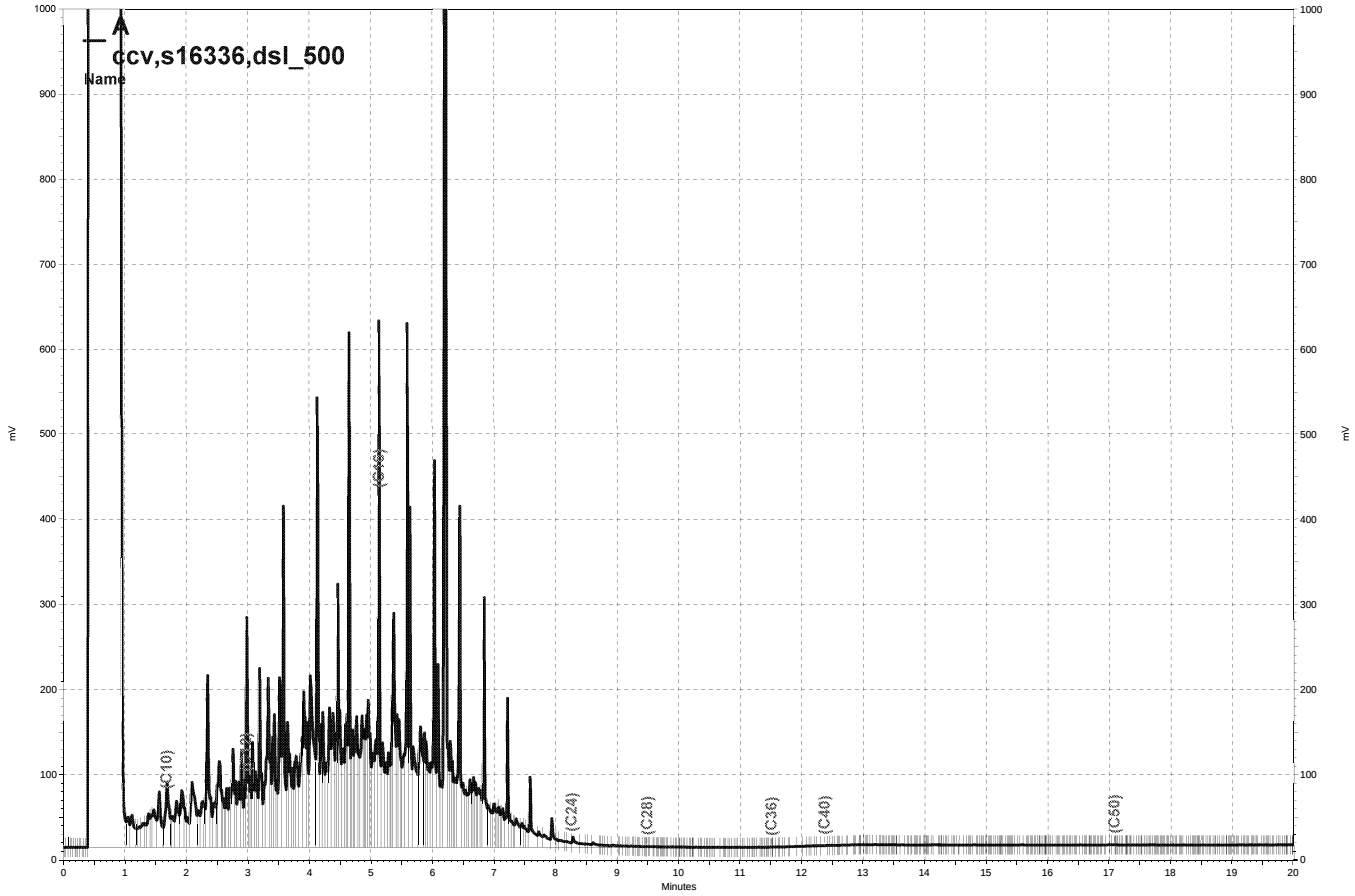

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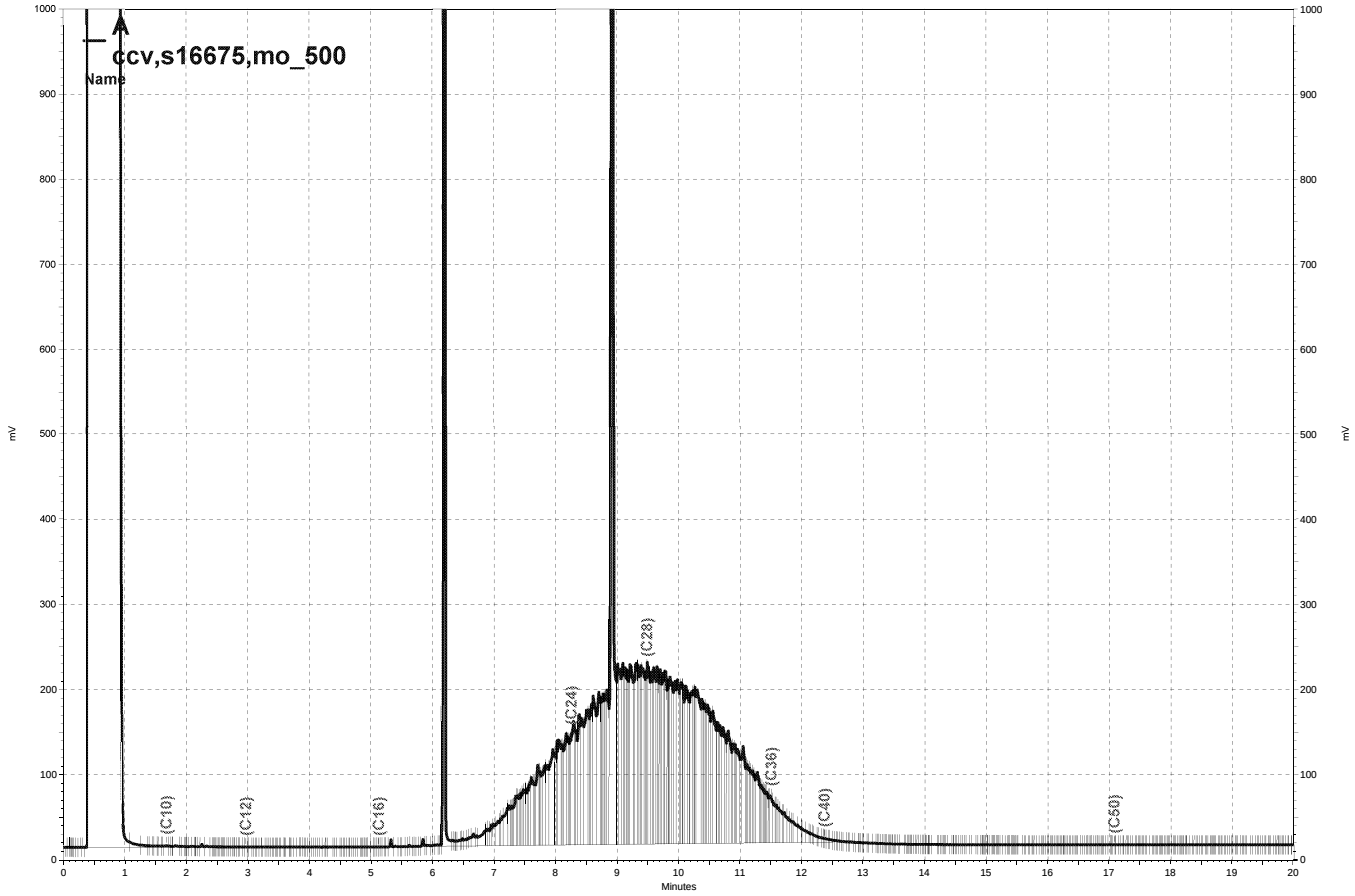

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Curtis & Tompkins, Ltd.

Polychlorinated Biphenyls (PCBs)

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8082
Matrix:	Soil	Batch#:	171754
Units:	ug/Kg	Sampled:	02/09/11
Basis:	as received	Received:	02/10/11
Diln Fac:	1.000	Prepared:	02/11/11

Field ID:	B-1,1A	Lab ID:	225895-001
Type:	SAMPLE	Analyzed:	02/12/11

Analyte	Result	RL
Aroclor-1016	ND	12
Aroclor-1221	ND	24
Aroclor-1232	ND	12
Aroclor-1242	ND	12
Aroclor-1248	ND	12
Aroclor-1254	ND	12
Aroclor-1260	12	12

Surrogate	%REC	Limits
TCMX	98	68-144
Decachlorobiphenyl	56	33-120

Field ID:	B-1,2A	Lab ID:	225895-002
Type:	SAMPLE	Analyzed:	02/12/11

Analyte	Result	RL
Aroclor-1016	ND	12
Aroclor-1221	ND	24
Aroclor-1232	ND	12
Aroclor-1242	ND	12
Aroclor-1248	ND	12
Aroclor-1254	ND	12
Aroclor-1260	ND	12

Surrogate	%REC	Limits
TCMX	100	68-144
Decachlorobiphenyl	59	33-120

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Polychlorinated Biphenyls (PCBs)

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8082
Matrix:	Soil	Batch#:	171754
Units:	ug/Kg	Sampled:	02/09/11
Basis:	as received	Received:	02/10/11
Diln Fac:	1.000	Prepared:	02/11/11

Field ID:	B-1,3A	Lab ID:	225895-003
Type:	SAMPLE	Analyzed:	02/12/11

Analyte	Result	RL
Aroclor-1016	ND	12
Aroclor-1221	ND	24
Aroclor-1232	ND	12
Aroclor-1242	ND	12
Aroclor-1248	ND	12
Aroclor-1254	ND	12
Aroclor-1260	ND	12

Surrogate	%REC	Limits
TCMX	100	68-144
Decachlorobiphenyl	59	33-120

Type:	BLANK	Analyzed:	02/11/11
Lab ID:	QC579684		

Analyte	Result	RL
Aroclor-1016	ND	12
Aroclor-1221	ND	24
Aroclor-1232	ND	12
Aroclor-1242	ND	12
Aroclor-1248	ND	12
Aroclor-1254	ND	12
Aroclor-1260	ND	12

Surrogate	%REC	Limits
TCMX	127	68-144
Decachlorobiphenyl	62	33-120

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Polychlorinated Biphenyls (PCBs)

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8082
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC579685	Batch#:	171754
Matrix:	Soil	Prepared:	02/11/11
Units:	ug/Kg	Analyzed:	02/11/11

Analyte	Spiked	Result	%REC	Limits
Aroclor-1016	165.9	177.4	107	73-150
Aroclor-1260	165.9	178.3	107	69-157

Surrogate	%REC	Limits
TCMX	99	68-144
Decachlorobiphenyl	57	33-120

Curtis & Tompkins, Ltd.

Batch QC Report

Polychlorinated Biphenyls (PCBs)

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3550B
Project#:	04.71110005	Analysis:	EPA 8082
Field ID:	ZZZZZZZZZZ	Batch#:	171754
MSS Lab ID:	225827-002	Sampled:	02/07/11
Matrix:	Soil	Received:	02/08/11
Units:	ug/Kg	Prepared:	02/11/11
Basis:	as received	Analyzed:	02/11/11
Diln Fac:	1.000		

Type: MS Lab ID: QC579686

Analyte	MSS Result	Spiked	Result	%REC	Limits
Aroclor-1016	<0.5884	165.6	194.0	117	60-159
Aroclor-1260	<0.4282	165.6	190.2	115	39-159

Surrogate	%REC	Limits
TCMX	108	68-144
Decachlorobiphenyl	55	33-120

Type: MSD Lab ID: QC579687

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Aroclor-1016	165.9	177.0	107	60-159	9	35
Aroclor-1260	165.9	174.3	105	39-159	9	39

Surrogate	%REC	Limits
TCMX	102	68-144
Decachlorobiphenyl	49	33-120

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

California Title 22 Metals

Lab #:	225895	Project#:	04.71110005
Client:	Fugro West Inc.	Location:	NASA Ames SVS Boiler Plant
Field ID:	B-1,1A	Diln Fac:	1.000
Lab ID:	225895-001	Sampled:	02/09/11
Matrix:	Soil	Received:	02/10/11
Units:	mg/Kg	Prepared:	02/15/11
Basis:	as received		

Analyte	Result	RL	Batch#	Analyzed	Prep	Analysis
Antimony	13	0.50	171869	02/16/11	EPA 3050B	EPA 6010B
Arsenic	3.8	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Barium	200	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Beryllium	0.65	0.10	171869	02/16/11	EPA 3050B	EPA 6010B
Cadmium	ND	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Chromium	57	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Cobalt	11	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Copper	43	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Lead	11	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Mercury	0.038	0.020	171842	02/15/11	METHOD	EPA 7471A
Molybdenum	ND	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Nickel	54	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Selenium	2.7	0.50	171869	02/16/11	EPA 3050B	EPA 6010B
Silver	ND	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Thallium	ND	0.50	171869	02/16/11	EPA 3050B	EPA 6010B
Vanadium	49	0.25	171869	02/16/11	EPA 3050B	EPA 6010B
Zinc	75	1.0	171869	02/16/11	EPA 3050B	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

California Title 22 Metals

Lab #:	225895	Project#:	04.71110005
Client:	Fugro West Inc.	Location:	NASA Ames SVS Boiler Plant
Field ID:	B-1,2A	Diln Fac:	1.000
Lab ID:	225895-002	Sampled:	02/09/11
Matrix:	Soil	Received:	02/10/11
Units:	mg/Kg	Prepared:	02/15/11
Basis:	as received		

Analyte	Result	RL	Batch#	Analyzed	Prep	Analysis
Antimony	9.9	0.56	171869	02/16/11	EPA 3050B	EPA 6010B
Arsenic	4.0	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Barium	190	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Beryllium	0.52	0.11	171869	02/16/11	EPA 3050B	EPA 6010B
Cadmium	ND	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Chromium	57	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Cobalt	9.0	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Copper	29	0.29	171869	02/16/11	EPA 3050B	EPA 6010B
Lead	13	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Mercury	0.041	0.020	171842	02/15/11	METHOD	EPA 7471A
Molybdenum	ND	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Nickel	44	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Selenium	3.0	0.56	171869	02/16/11	EPA 3050B	EPA 6010B
Silver	ND	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Thallium	ND	0.56	171869	02/16/11	EPA 3050B	EPA 6010B
Vanadium	41	0.28	171869	02/16/11	EPA 3050B	EPA 6010B
Zinc	71	1.1	171869	02/16/11	EPA 3050B	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

California Title 22 Metals

Lab #:	225895	Project#:	04.71110005
Client:	Fugro West Inc.	Location:	NASA Ames SVS Boiler Plant
Field ID:	B-1,3A	Diln Fac:	1.000
Lab ID:	225895-003	Sampled:	02/09/11
Matrix:	Soil	Received:	02/10/11
Units:	mg/Kg	Prepared:	02/15/11
Basis:	as received		

Analyte	Result	RL	Batch#	Analyzed	Prep	Analysis
Antimony	7.7	0.52	171869	02/16/11	EPA 3050B	EPA 6010B
Arsenic	3.3	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Barium	230	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Beryllium	0.58	0.10	171869	02/16/11	EPA 3050B	EPA 6010B
Cadmium	ND	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Chromium	45	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Cobalt	8.5	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Copper	28	0.27	171869	02/16/11	EPA 3050B	EPA 6010B
Lead	4.7	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Mercury	0.026	0.020	171842	02/15/11	METHOD	EPA 7471A
Molybdenum	ND	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Nickel	45	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Selenium	4.1	0.52	171869	02/16/11	EPA 3050B	EPA 6010B
Silver	ND	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Thallium	ND	0.52	171869	02/16/11	EPA 3050B	EPA 6010B
Vanadium	37	0.26	171869	02/16/11	EPA 3050B	EPA 6010B
Zinc	45	1.0	171869	02/16/11	EPA 3050B	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	METHOD
Project#:	04.71110005	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	171842
Lab ID:	QC580042	Prepared:	02/15/11
Matrix:	Soil	Analyzed:	02/15/11
Units:	mg/Kg		

Result	RL
ND	0.020

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	METHOD
Project#:	04.71110005	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Type:	LCS	Batch#:	171842
Lab ID:	QC580043	Prepared:	02/15/11
Matrix:	Soil	Analyzed:	02/15/11
Units:	mg/Kg		

Spiked	Result	%REC	Limits
0.2500	0.2650	106	80-120

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	METHOD
Project#:	04.71110005	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Field ID:	ZZZZZZZZZZ	Batch#:	171842
MSS Lab ID:	225521-002	Sampled:	01/24/11
Matrix:	Soil	Received:	01/24/11
Units:	mg/Kg	Prepared:	02/15/11
Basis:	as received	Analyzed:	02/15/11

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC580044	1.820	0.2551	2.061	>LR 95 NM	72-124		
MSD	QC580045		0.2551	2.592	>LR 303 NM	72-124	NC	31

NC= Not Calculated
NM= Not Meaningful: Sample concentration > 4X spike concentration
>LR= Response exceeds instrument's linear range
RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	METHOD
Project#:	04.71110005	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Field ID:	ZZZZZZZZZZ	Batch#:	171842
MSS Lab ID:	225827-001	Sampled:	02/07/11
Matrix:	Soil	Received:	02/08/11
Units:	mg/Kg	Prepared:	02/15/11
Basis:	as received	Analyzed:	02/15/11

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC580046	0.05670	0.2500	0.2830	91	72-124		
MSD	QC580047		0.2404	0.2875	96	72-124	5	31

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3050B
Project#:	04.71110005	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC580148	Batch#:	171869
Matrix:	Soil	Prepared:	02/15/11
Units:	mg/Kg	Analyzed:	02/16/11

Analyte	Result	RL
Antimony	ND	0.50
Arsenic	ND	0.25
Barium	ND	0.25
Beryllium	ND	0.10
Cadmium	ND	0.25
Chromium	ND	0.25
Cobalt	ND	0.25
Copper	ND	0.26
Lead	ND	0.25
Molybdenum	ND	0.25
Nickel	ND	0.25
Selenium	ND	0.50
Silver	ND	0.25
Thallium	ND	0.50
Vanadium	ND	0.25
Zinc	ND	1.0

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3050B
Project#:	04.71110005	Analysis:	EPA 6010B
Matrix:	Soil	Batch#:	171869
Units:	mg/Kg	Prepared:	02/15/11
Diln Fac:	1.000	Analyzed:	02/16/11

Type: BS Lab ID: QC580149

Analyte	Spiked	Result	%REC	Limits
Antimony	100.0	108.0	108	80-120
Arsenic	50.00	54.73	109	80-120
Barium	100.0	101.7	102	80-120
Beryllium	2.500	2.712	108	80-120
Cadmium	10.00	10.85	108	80-120
Chromium	100.0	103.1	103	80-120
Cobalt	25.00	25.17	101	80-120
Copper	12.50	13.02	104	78-120
Lead	100.0	101.0	101	80-120
Molybdenum	20.00	21.33	107	80-120
Nickel	25.00	25.55	102	80-120
Selenium	50.00	51.08	102	80-120
Silver	10.00	10.23	102	80-120
Thallium	50.00	50.96	102	80-120
Vanadium	25.00	25.92	104	80-120
Zinc	25.00	26.13	105	80-120

Type: BSD Lab ID: QC580150

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	107.5	107	80-120	0	20
Arsenic	50.00	54.42	109	80-120	1	20
Barium	100.0	100.5	100	80-120	1	20
Beryllium	2.500	2.684	107	80-120	1	20
Cadmium	10.00	10.70	107	80-120	1	20
Chromium	100.0	101.0	101	80-120	2	20
Cobalt	25.00	24.99	100	80-120	1	20
Copper	12.50	13.08	105	78-120	0	20
Lead	100.0	99.48	99	80-120	2	20
Molybdenum	20.00	21.15	106	80-120	1	20
Nickel	25.00	25.30	101	80-120	1	20
Selenium	50.00	50.88	102	80-120	0	20
Silver	10.00	10.02	100	80-120	2	20
Thallium	50.00	50.20	100	80-120	1	20
Vanadium	25.00	25.54	102	80-120	1	20
Zinc	25.00	25.74	103	80-120	1	20

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

California Title 22 Metals

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3050B
Project#:	04.71110005	Analysis:	EPA 6010B
Field ID:	ZZZZZZZZZZ	Batch#:	171869
MSS Lab ID:	225939-001	Sampled:	02/09/11
Matrix:	Soil	Received:	02/10/11
Units:	mg/Kg	Prepared:	02/15/11
Basis:	as received	Analyzed:	02/16/11
Diln Fac:	1.000		

Type: MS Lab ID: QC580151

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	29.67	100.0	54.52	25	7-120
Arsenic	31.35	50.00	85.90	109	66-122
Barium	76.47	100.0	180.4	104	51-135
Beryllium	0.4595	2.500	2.992	101	73-120
Cadmium	0.9238	10.00	10.70	98	64-120
Chromium	55.37	100.0	144.7	89	57-122
Cobalt	8.259	25.00	30.84	90	53-122
Copper	390.2	12.50	316.1	-593 NM	33-157
Lead	71.85	100.0	173.8	102	52-123
Molybdenum	1.946	20.00	18.75	84	66-120
Nickel	49.05	25.00	69.45	82	42-137
Selenium	8.308	50.00	52.24	88	64-120
Silver	<0.07475	10.00	9.494	95	65-120
Thallium	0.4870	50.00	45.64	90	55-120
Vanadium	58.11	25.00	79.41	85	49-139
Zinc	4,691	25.00	3,747 >LR	-3778 NM	32-155

Type: MSD Lab ID: QC580152

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	97.09	53.91	25	7-120	1	44
Arsenic	48.54	73.57	87	66-122	14	35
Barium	97.09	173.1	100	51-135	2	42
Beryllium	2.427	2.967	103	73-120	2	22
Cadmium	9.709	10.37	97	64-120	1	36
Chromium	97.09	147.2	95	57-122	4	34
Cobalt	24.27	29.97	89	53-122	1	32
Copper	12.14	279.4	-913 NM	33-157	12	41
Lead	97.09	169.6	101	52-123	1	41
Molybdenum	19.42	18.17	84	66-120	0	20
Nickel	24.27	63.96	61	42-137	7	36
Selenium	48.54	53.26	93	64-120	4	28
Silver	9.709	9.334	96	65-120	1	27
Thallium	48.54	44.45	91	55-120	0	27
Vanadium	24.27	78.61	84	49-139	0	32
Zinc	24.27	3,047 >LR	-6774 NM	32-155	NC	45

NC= Not Calculated
NM= Not Meaningful: Sample concentration > 4X spike concentration
>LR= Response exceeds instrument's linear range
RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Hexavalent Chromium

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3060
Project#:	04.71110005	Analysis:	EPA 3060/7196
Analyte:	Hexavalent Chromium	Batch#:	171893
Matrix:	Soil	Sampled:	02/09/11
Units:	mg/Kg	Received:	02/10/11
Basis:	as received	Analyzed:	02/16/11
Diln Fac:	1.000		

Field ID	Type	Lab ID	Result	RL
B-1,1A	SAMPLE	225895-001	ND	0.40
B-1,2A	SAMPLE	225895-002	ND	0.40
B-1,3A	SAMPLE	225895-003	ND	0.40
	BLANK	QC580252	ND	0.40

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Hexavalent Chromium

Lab #:	225895	Location:	NASA Ames SVS Boiler Plant
Client:	Fugro West Inc.	Prep:	EPA 3060
Project#:	04.71110005	Analysis:	EPA 3060/7196
Analyte:	Hexavalent Chromium	Diln Fac:	1.000
Field ID:	B-1,3A	Batch#:	171893
MSS Lab ID:	225895-003	Sampled:	02/09/11
Matrix:	Soil	Received:	02/10/11
Units:	mg/Kg	Analyzed:	02/16/11
Basis:	as received		

Type	Lab ID	MSS Result	Spiked	Result	RL	%REC	Limits	RPD	Lim
LCS	QC580253		40.00	39.72		99	80-120		
SDUP	QC580254	<0.4000		<0.4000	0.4000			NC	30
SSPIKE	QC580255	<0.4000	39.68	27.28		69 *	75-125		

*= Value outside of QC limits; see narrative
NC= Not Calculated
RL= Reporting Limit
RPD= Relative Percent Difference

CALIFORNIA LABORATORY SERVICES

3249 Fitzgerald Road Rancho Cordova, CA 95742

September 30, 2008

CLS Work Order #: CRI0892
COC #: 95002

Brian Reddig
ISSI/NASA Ames MS221-10
NASA Ames MS T20-G
Moffet Field, CA 94035-1000

Project Name: Sphere 5 Demo

Enclosed are the results of analyses for samples received by the laboratory on 09/23/08 17:30. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that the results are in compliance both technically and for completeness.

Analytical results are attached to this letter. Please call if we can provide additional assistance.

Sincerely,

James Liang, Ph.D.
Laboratory Director

CA DOHS ELAP Accreditation/Registration number 1233

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

CLS - Labs CHAIN OF CUSTODY CLS ID No.; CRI 0892 LOG NO. 95002

REPORT TO:
NAME AND ADDRESS: ISSI NASA Ames Moffett Field, CA
PROJECT MANAGER: Brian Reddig PHONE#: 650-604-1315
PROJECT NAME: Sphere 5 Demo
SAMPLED BY: BR
JOB DESCRIPTION: Pre-demo baseline soil sampling
SITE LOCATION:

CLIENT JOB NUMBER: N140-200
DESTINATION LABORATORY: [X] CLS (916) 638-7301, 3249 FITZGERALD RD. RANCHO CORDOVA, CA. 95742 [ ] OTHER

GEOTRACKER: EDF REPORT [ ] YES [ ] NO
GLOBAL ID:
COMPOSITE:
FIELD CONDITIONS:

DATE	TIME	SAMPLE IDENTIFICATION	MATRIX	CONTAINER NO.	CONTAINER TYPE	PRESERVATIVES	Priority Pollutant Metals	Chromium VI	TPH-D, SP415/S, MO	PCBs (include 1268)				1 DAY	2 DAY	5 DAY	10 DAY	ALT. ID:
9-22-08	340	SPHERE 5 - N	SOIL	1	8 oz JAR	3	X	X	X	X						X		
	345	SPHERE 5 - S		1		3	X	X	X	X						X		
	350	SPHERE 5 - STAGE		1		3	X	X	X	X						X		

TURN AROUND TIME: 1 DAY, 2 DAY, 5 DAY, 10 DAY
SPECIAL INSTRUCTIONS: OR ALT. ID:
INVOICE TO:
P.O. #
QUOTE #
SUSPECTED CONSTITUENTS
PRESERVATIVES: (1) HCL (2) HNO_3 (3) = COLD (4) = NaOH (5) = H_2SO_4 (6) = $Na_2S_2O_3$ (7) =

RELINQUISHED BY (SIGN)	PRINT NAME / COMPANY	DATE / TIME	RECEIVED BY (SIGN)	PRINT NAME / COMPANY
Brian Reddig	Brian Reddig / ISSI	9/23/08 @ 1200 hr		CJ / CLS
	CLS	9/23/08 @ 1730 hr		

REC'D AT LAB BY: JonR DATE / TIME: 9-23-8 1730 CONDITIONS / COMMENTS: 7°C
SHIPPED BY: [ ] FED X [ ] UPS [X] OTHER CLS AIR BILL #

LAB

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Conventional Chemistry Parameters by APHA/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-N (CRI0892-01) Soil Sampled: 09/22/08 15:40 Received: 09/23/08 17:30									
Hexavalent Chromium	**50**	10	µg/kg	1	CR08025	09/25/08	09/25/08	EPA 7199	
Sphere 5-S (CRI0892-02) Soil Sampled: 09/22/08 15:45 Received: 09/23/08 17:30									
Hexavalent Chromium	**28**	10	µg/kg	1	CR08025	09/25/08	09/25/08	EPA 7199	
Sphere 5-Stage (CRI0892-03) Soil Sampled: 09/22/08 15:50 Received: 09/23/08 17:30									
Hexavalent Chromium	**11**	10	µg/kg	1	CR08025	09/25/08	09/25/08	EPA 7199	

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Extractable Petroleum Hydrocarbons by EPA Method 8015M

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-N (CRI0892-01) Soil Sampled: 09/22/08 15:40 Received: 09/23/08 17:30									**EXT-3**
Diesel	ND	20	mg/kg	20	CR07987	09/24/08	09/24/08	EPA 8015M	
Motor Oil	**1300**	20	"	"	"	"	"	"	
JP-5/JP-8	ND	20	"	"	"	"	"	"	
Sphere 5-S (CRI0892-02) Soil Sampled: 09/22/08 15:45 Received: 09/23/08 17:30									**EXT-3**
Diesel	ND	20	mg/kg	20	CR07987	09/24/08	09/24/08	EPA 8015M	
Motor Oil	**1900**	20	"	"	"	"	"	"	
JP-5/JP-8	ND	20	"	"	"	"	"	"	
Sphere 5-Stage (CRI0892-03) Soil Sampled: 09/22/08 15:50 Received: 09/23/08 17:30									**EXT-3**
Diesel	ND	1.0	mg/kg	1	CR07987	09/24/08	09/24/08	EPA 8015M	
Motor Oil	**110**	1.0	"	"	"	"	"	"	
JP-5/JP-8	ND	1.0	"	"	"	"	"	"	

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Metals by EPA 6000/7000 Series Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-N (CRI0892-01) Soil Sampled: 09/22/08 15:40 Received: 09/23/08 17:30									
Mercury	**0.12**	0.10	mg/kg	1	CR08094	09/26/08	09/30/08	EPA 7471A	
Antimony	ND	2.5	"	"	CR08048	09/25/08	09/25/08	EPA 6010B	
Beryllium	ND	0.25	"	"	"	"	"	"	
Cadmium	**26**	0.50	"	"	"	"	"	"	
Chromium	**130**	1.0	"	"	"	"	"	"	
Copper	**500**	1.0	"	"	"	"	"	"	
Lead	**160**	2.5	"	"	"	"	"	"	
Nickel	**57**	1.0	"	"	"	"	"	"	
Silver	**11**	0.50	"	"	"	"	"	"	
Zinc	**360**	1.0	"	"	"	"	"	"	
Arsenic	**3.4**	2.5	"	10	CR08047	09/25/08	09/25/08	EPA 7000	
Selenium	ND	2.5	"	"	"	"	"	"	
Thallium	ND	2.5	"	"	"	"	"	"	
Sphere 5-S (CRI0892-02) Soil Sampled: 09/22/08 15:45 Received: 09/23/08 17:30									
Mercury	**6.4**	1.0	mg/kg	10	CR08094	09/26/08	09/30/08	EPA 7471A	
Antimony	**2.5**	2.5	"	1	CR08048	09/25/08	09/25/08	EPA 6010B	
Beryllium	ND	0.25	"	"	"	"	"	"	
Cadmium	**7.2**	0.50	"	"	"	"	"	"	
Chromium	**120**	1.0	"	"	"	"	"	"	
Copper	**130**	1.0	"	"	"	"	"	"	
Lead	**140**	2.5	"	"	"	"	"	"	
Nickel	**64**	1.0	"	"	"	"	"	"	
Silver	**3.8**	0.50	"	"	"	"	"	"	
Zinc	**880**	1.0	"	"	"	"	"	"	
Arsenic	**4.5**	2.5	"	10	CR08047	09/25/08	09/25/08	EPA 7000	
Selenium	ND	2.5	"	"	"	"	"	"	
Thallium	ND	2.5	"	"	"	"	"	"	

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Metals by EPA 6000/7000 Series Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-Stage (CRI0892-03) Soil Sampled: 09/22/08 15:50 Received: 09/23/08 17:30									
Mercury	ND	0.10	mg/kg	1	CR08094	09/26/08	09/30/08	EPA 7471A	
Antimony	ND	2.5	"	"	CR08048	09/25/08	09/25/08	EPA 6010B	
Beryllium	ND	0.25	"	"	"	"	"	"	
Cadmium	**0.68**	0.50	"	"	"	"	"	"	
Chromium	**81**	1.0	"	"	"	"	"	"	
Copper	**38**	1.0	"	"	"	"	"	"	
Lead	**24**	2.5	"	"	"	"	"	"	
Nickel	**61**	1.0	"	"	"	"	"	"	
Silver	**1.2**	0.50	"	"	"	"	"	"	
Zinc	**120**	1.0	"	"	"	"	"	"	
Arsenic	**3.3**	2.5	"	10	CR08047	09/25/08	09/25/08	EPA 7000	
Selenium	ND	2.5	"	"	"	"	"	"	
Thallium	ND	2.5	"	"	"	"	"	"	

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Polychlorinated Biphenyls by EPA Method 8082A

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-N (CRI0892-01) Soil Sampled: 09/22/08 15:40 Received: 09/23/08 17:30									
Aroclor 1016	ND	40	µg/kg	2	CR08010	09/24/08	09/26/08	EPA 8082A	
Aroclor 1221	ND	40	"	"	"	"	"	"	
Aroclor 1232	ND	40	"	"	"	"	"	"	
Aroclor 1242	ND	40	"	"	"	"	"	"	
Aroclor 1248	ND	40	"	"	"	"	"	"	
Aroclor 1254	ND	40	"	"	"	"	"	"	
Aroclor 1260	**200**	40	"	"	"	"	"	"	
Aroclor 1268	ND	40	"	"	"	"	"	"	
Surrogate: Decachlorobiphenyl		*89 %*	*50-150*		"	"	"	"	
Sphere 5-S (CRI0892-02) Soil Sampled: 09/22/08 15:45 Received: 09/23/08 17:30									
Aroclor 1016	ND	400	µg/kg	20	CR08010	09/24/08	09/26/08	EPA 8082A	
Aroclor 1221	ND	400	"	"	"	"	"	"	
Aroclor 1232	ND	400	"	"	"	"	"	"	
Aroclor 1242	ND	400	"	"	"	"	"	"	
Aroclor 1248	ND	400	"	"	"	"	"	"	
Aroclor 1254	ND	400	"	"	"	"	"	"	
Aroclor 1260	**1400**	400	"	"	"	"	"	"	
Aroclor 1268	ND	400	"	"	"	"	"	"	
Surrogate: Decachlorobiphenyl		*56 %*	*50-150*		"	"	"	"	
Sphere 5-Stage (CRI0892-03) Soil Sampled: 09/22/08 15:50 Received: 09/23/08 17:30									
Aroclor 1016	ND	40	µg/kg	2	CR08010	09/24/08	09/26/08	EPA 8082A	
Aroclor 1221	ND	40	"	"	"	"	"	"	
Aroclor 1232	ND	40	"	"	"	"	"	"	
Aroclor 1242	ND	40	"	"	"	"	"	"	
Aroclor 1248	ND	40	"	"	"	"	"	"	
Aroclor 1254	ND	40	"	"	"	"	"	"	
Aroclor 1260	**130**	40	"	"	"	"	"	"	

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Polychlorinated Biphenyls by EPA Method 8082A

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-Stage (CRI0892-03) Soil Sampled: 09/22/08 15:50 Received: 09/23/08 17:30									
Aroclor 1268	ND	40	µg/kg	2	CR08010	"	09/26/08	EPA 8082A	
Surrogate: Decachlorobiphenyl		*63 %*		*50-150*	"	"	"	"	

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR08025 - General Prep										
Blank (CR08025-BLK1)				Prepared & Analyzed: 09/25/08						
Hexavalent Chromium	ND	10	µg/kg							
LCS (CR08025-BS1)				Prepared & Analyzed: 09/25/08						
Hexavalent Chromium	53.2	10	µg/kg	50.0		106	80-120			
LCS Dup (CR08025-BSD1)				Prepared & Analyzed: 09/25/08						
Hexavalent Chromium	48.8	10	µg/kg	50.0		98	80-120	9	20	
Matrix Spike (CR08025-MS1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Hexavalent Chromium	99.9	10	µg/kg	50.0	50.3	99	75-125			
Matrix Spike Dup (CR08025-MSD1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Hexavalent Chromium	107	10	µg/kg	50.0	50.3	113	75-125	7	25	

CALIFORNIA LABORATORY SERVICES

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Extractable Petroleum Hydrocarbons by EPA Method 8015M - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR07987 - LUFT-DHS GCNV										
Blank (CR07987-BLK1)				Prepared & Analyzed: 09/24/08						
Diesel	ND	1.0	mg/kg							
Motor Oil	ND	1.0	"							
Hydraulic Oil	ND	1.0	"							
Mineral Oil	ND	1.0	"							
Kerosene	ND	1.0	"							
JP-5/JP-8	ND	1.0	"							
LCS (CR07987-BS1)				Prepared & Analyzed: 09/24/08						
Diesel	53.7	1.0	mg/kg	50.0		107	65-135			
LCS Dup (CR07987-BSD1)				Prepared & Analyzed: 09/24/08						
Diesel	53.4	1.0	mg/kg	50.0		107	65-135	0.6	30	
Matrix Spike (CR07987-MS1)		**Source: CRI0854-01**		Prepared & Analyzed: 09/24/08						
Diesel	48.3	1.0	mg/kg	50.0	ND	97	59-138			
Matrix Spike Dup (CR07987-MSD1)		**Source: CRI0854-01**		Prepared & Analyzed: 09/24/08						
Diesel	51.1	1.0	mg/kg	50.0	ND	102	59-138	6	37	

CALIFORNIA LABORATORY SERVICES

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR08047 - EPA 3050B										
Blank (CR08047-BLK1)				Prepared & Analyzed: 09/25/08						
Arsenic	ND	0.25	mg/kg							
Selenium	ND	0.25	"							
Thallium	ND	0.25	"							
LCS (CR08047-BS1)				Prepared & Analyzed: 09/25/08						
Arsenic	4.20	0.25	mg/kg	5.00		84	75-125			
Selenium	3.99	0.25	"	5.00		80	75-125			
Thallium	5.05	0.25	"	5.00		101	75-125			
LCS Dup (CR08047-BSD1)				Prepared & Analyzed: 09/25/08						
Arsenic	4.20	0.25	mg/kg	5.00		84	75-125	0.1	25	
Selenium	3.83	0.25	"	5.00		77	75-125	4	25	
Thallium	5.14	0.25	"	5.00		103	75-125	2	25	
Matrix Spike (CR08047-MS1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Arsenic	7.46	2.5	mg/kg	5.00	3.35	82	75-125			
Selenium	3.15	2.5	"	5.00	ND	63	75-125			QM-5
Thallium	5.52	2.5	"	5.00	ND	110	75-125			
Matrix Spike Dup (CR08047-MSD1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Arsenic	7.35	2.5	mg/kg	5.00	3.35	80	75-125	2	30	
Selenium	2.78	2.5	"	5.00	ND	56	75-125	13	30	QM-5
Thallium	5.43	2.5	"	5.00	ND	109	75-125	2	30	
Batch CR08048 - EPA 3050B										
Blank (CR08048-BLK1)				Prepared & Analyzed: 09/25/08						
Antimony	ND	2.5	mg/kg							
Beryllium	ND	0.25	"							
Cadmium	ND	0.50	"							
Chromium	ND	1.0	"							
Copper	ND	1.0	"							
Lead	ND	2.5	"							
Nickel	ND	1.0	"							

CALIFORNIA LABORATORY SERVICES

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR08048 - EPA 3050B										
Blank (CR08048-BLK1)				Prepared & Analyzed: 09/25/08						
Silver	ND	0.50	mg/kg							
Zinc	ND	1.0	"							
LCS (CR08048-BS1)				Prepared & Analyzed: 09/25/08						
Antimony	26.6	2.5	mg/kg	25.0		107	75-125			
Beryllium	2.36	0.25	"	2.50		95	75-125			
Cadmium	2.64	0.50	"	2.50		106	75-125			
Chromium	10.4	1.0	"	10.0		104	75-125			
Copper	12.2	1.0	"	12.5		98	75-125			
Lead	25.1	2.5	"	25.0		100	75-125			
Nickel	25.4	1.0	"	25.0		102	75-125			
Silver	2.69	0.50	"	2.50		107	75-125			
Zinc	24.6	1.0	"	25.0		99	75-125			
LCS Dup (CR08048-BSD1)				Prepared & Analyzed: 09/25/08						
Antimony	26.4	2.5	mg/kg	25.0		106	75-125	0.8	25	
Beryllium	2.34	0.25	"	2.50		94	75-125	0.9	25	
Cadmium	2.74	0.50	"	2.50		109	75-125	4	25	
Chromium	10.6	1.0	"	10.0		106	75-125	2	25	
Copper	12.2	1.0	"	12.5		98	75-125	0.04	25	
Lead	24.9	2.5	"	25.0		99	75-125	0.9	25	
Nickel	24.9	1.0	"	25.0		100	75-125	2	25	
Silver	2.68	0.50	"	2.50		107	75-125	0.2	25	
Zinc	24.3	1.0	"	25.0		97	75-125	1	25	
Matrix Spike (CR08048-MS1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Antimony	7.18	2.5	mg/kg	25.0	ND	29	75-125			QM-5
Beryllium	2.15	0.25	"	2.50	ND	86	75-125			
Cadmium	27.9	0.50	"	2.50	26.2	67	75-125			QM-5
Chromium	126	1.0	"	10.0	133	NR	75-125			QM-5
Copper	122	1.0	"	12.5	498	NR	75-125			QM-5
Lead	152	2.5	"	25.0	157	NR	75-125			QM-5

CALIFORNIA LABORATORY SERVICES

 09/30/08 16:26

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR08048 - EPA 3050B										
Matrix Spike (CR08048-MS1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Nickel	78.2	1.0	mg/kg	25.0	56.7	86	75-125			
Silver	9.01	0.50	"	2.50	11.1	NR	75-125			QM-5
Zinc	341	1.0	"	25.0	360	NR	75-125			QM-5
Matrix Spike Dup (CR08048-MSD1)		**Source: CRI0892-01**		Prepared & Analyzed: 09/25/08						
Antimony	8.53	2.5	mg/kg	25.0	ND	34	75-125	17	30	QM-5
Beryllium	2.19	0.25	"	2.50	ND	88	75-125	2	30	
Cadmium	22.5	0.50	"	2.50	26.2	NR	75-125	21	30	QM-5
Chromium	107	1.0	"	10.0	133	NR	75-125	16	30	QM-5
Copper	107	1.0	"	12.5	498	NR	75-125	13	30	QM-5
Lead	156	2.5	"	25.0	157	NR	75-125	3	30	QM-5
Nickel	69.4	1.0	"	25.0	56.7	51	75-125	12	30	QM-5
Silver	8.15	0.50	"	2.50	11.1	NR	75-125	10	30	QM-5
Zinc	304	1.0	"	25.0	360	NR	75-125	12	30	QM-5
Batch CR08094 - EPA 7471A										
Blank (CR08094-BLK1)				Prepared: 09/26/08		Analyzed: 09/30/08				
Mercury	ND	0.10	mg/kg							
LCS (CR08094-BS1)				Prepared: 09/26/08		Analyzed: 09/30/08				
Mercury	0.519	0.10	mg/kg	0.625		83	75-125			
LCS Dup (CR08094-BSD1)				Prepared: 09/26/08		Analyzed: 09/30/08				
Mercury	0.495	0.10	mg/kg	0.625		79	75-125	5	25	
Matrix Spike (CR08094-MS1)		**Source: CRI0892-01**		Prepared: 09/26/08		Analyzed: 09/30/08				
Mercury	0.729	0.10	mg/kg	0.625	0.118	98	75-125			

CALIFORNIA LABORATORY SERVICES

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR08094 - EPA 7471A										
Matrix Spike Dup (CR08094-MSD1)		**Source: CRI0892-01**		Prepared: 09/26/08	Analyzed: 09/30/08					
Mercury	0.615	0.10	mg/kg	0.625	0.118	79	75-125	17	25	

CALIFORNIA LABORATORY SERVICES

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

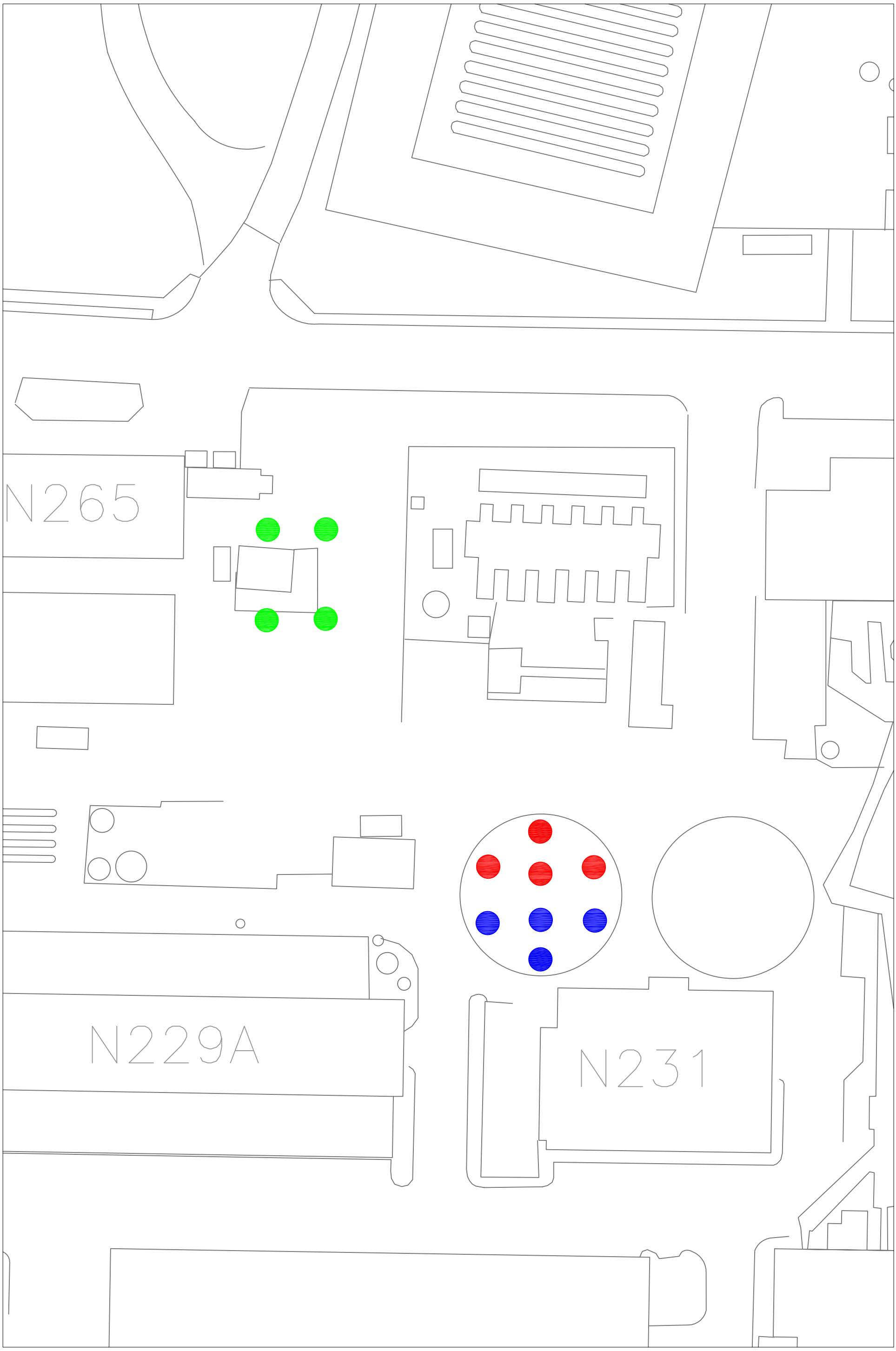
Polychlorinated Biphenyls by EPA Method 8082A - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CR08010 - CA LUFT - orb shaker										
Blank (CR08010-BLK1)				Prepared: 09/24/08		Analyzed: 09/26/08				
Aroclor 1016	ND	20	µg/kg							
Aroclor 1221	ND	20	"							
Aroclor 1232	ND	20	"							
Aroclor 1242	ND	20	"							
Aroclor 1248	ND	20	"							
Aroclor 1254	ND	20	"							
Aroclor 1260	ND	20	"							
Aroclor 1268	ND	20	"							
Surrogate: Decachlorobiphenyl	*8.93*		*"*	*8.33*		*107*	*50-150*			
LCS (CR08010-BS1)				Prepared: 09/24/08		Analyzed: 09/26/08				
Aroclor 1260	98.6	20	µg/kg	83.3		118	29-131			
Surrogate: Decachlorobiphenyl	*9.12*		*"*	*8.33*		*109*	*50-150*			
LCS Dup (CR08010-BSD1)				Prepared: 09/24/08		Analyzed: 09/26/08				
Aroclor 1260	103	20	µg/kg	83.3		124	29-131	5	30	
Surrogate: Decachlorobiphenyl	*9.45*		*"*	*8.33*		*113*	*50-150*			
Matrix Spike (CR08010-MS1)		**Source: CRI0892-03**		Prepared: 09/24/08		Analyzed: 09/26/08				
Aroclor 1260	212	40	µg/kg	83.3	130	98	29-131			
Surrogate: Decachlorobiphenyl	*5.53*		*"*	*8.33*		*66*	*50-150*			
Matrix Spike Dup (CR08010-MSD1)		**Source: CRI0892-03**		Prepared: 09/24/08		Analyzed: 09/26/08				
Aroclor 1260	209	40	µg/kg	83.3	130	95	29-131	1	30	
Surrogate: Decachlorobiphenyl	*5.47*		*"*	*8.33*		*66*	*50-150*			

ISSI/NASA Ames MS221-10	Project: Sphere 5 Demo	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CRI0892**
Moffet Field, CA 94035-1000	Project Manager: Brian Reddig	COC #: 95002

Notes and Definitions

QM-5	The spike recovery was outside acceptance limits for the MS and/or MSD due to matrix interference. The LCS and/or LCSD were within acceptance limits showing that the laboratory is in control and the data is acceptable.
EXT-3	The sample extract has undergone silica-gel clean-up, EPA Method 3630, which is specific to polar compound contamination.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference



Ames Research Center
Moffett Field, California 94035

TITLE:	DWN:	DES.:	PROJECT NO.:
	CHKD:	APPD:	FIGURE NO.:
	DATE:	REV.:	

CALIFORNIA LABORATORY SERVICES

3249 Fitzgerald Road Rancho Cordova, CA 95742

March 10, 2009

CLS Work Order #: CSC0342
COC #: 95031

Luke Metz
ISSI/NASA Ames MS221-10
NASA Ames MS T20-G
Moffet Field, CA 94035-1000

Project Name: Sphere 5 Soil Removal

Enclosed are the results of analyses for samples received by the laboratory on 03/09/09 16:00. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that the results are in compliance both technically and for completeness.

Analytical results are attached to this letter. Please call if we can provide additional assistance.

Sincerely,

James Liang, Ph.D.
Laboratory Director

CA DOHS ELAP Accreditation/Registration number 1233

CALIFORNIA LABORATORY SERVICES

 03/10/09 16:07

ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

CLS - Labs CHAIN OF CUSTODY CLS ID No.; CSC0342 LOG NO. 95031

REPORT TO:
NAME AND ADDRESS: ISSI, NASA Ames, Moffett Field, CA
PROJECT MANAGER: Luke Metz PHONE#: 650-604-2753
PROJECT NAME: SPHERE 5 SOIL REMOVAL
SAMPLED BY: LM
JOB DESCRIPTION: 21' DEPTH SAMPLES POST-DEMO
SITE LOCATION:

CLIENT JOB NUMBER: N140-200
DESTINATION LABORATORY: [X] CLS (916) 638-7301, 3249 FITZGERALD RD., RANCHO CORDOVA, CA. 95742 [ ] OTHER

GEOTRACKER: EDF REPORT [ ] YES [X] NO
GLOBAL ID:
COMPOSITE:
FIELD CONDITIONS:

DATE	TIME	SAMPLE IDENTIFICATION	MATRIX	CONTAINER NO.	CONTAINER TYPE	PRESERVATIVES	PP METALS	CHROMIUM VI	TPH-D, JP4/5/8, MO	PCBs (INCLUDE 1268)	1 DAY	2 DAY	5 DAY	10 DAY
3-9-2009	1015	SPHERE5-PD-N	SOIL	1	8oz	3	X	X	X	X	X			
3-9-2009	1025	SPHERE5-PD-S	SOIL	1	8oz	3	X	X	X	X	X			

SPECIAL INSTRUCTIONS OR ALT. ID:
SEND RESULTS AS THEY ARE COMPLETED TO LUKE.T.METZ@NASA.GOV. "PLEASE RUSH" — SENDING ANALYSIS IN SECTIONS WHEN READY OK. THX LM

INVOICE TO:
P.O. #:
QUOTE #:
SUSPECTED CONSTITUENTS:

PRESERVATIVES: (1) HCL (2) HNO_3 (3) = COLD (4) = NaOH (5) = H_2SO_4 (6) = $Na_2S_2O_3$ (7) =

RELINQUISHED BY (SIGN)	PRINT NAME / COMPANY	DATE / TIME	RECEIVED BY (SIGN)	PRINT NAME / COMPANY
Luke T. Metz	Luke T Metz / ISSI/SAIC	3-9-09/ 1100		
		1124		
	CLS	3/9/09 1600		CONRAD JR/CLS

RECD AT LAB BY: JonR DATE / TIME: 3-9-9 1600 CONDITIONS / COMMENTS: 12-4°C

SHIPPED BY: [ ] FED X [ ] UPS [X] OTHER CLS COURIER AIR BILL #

LAB

CALIFORNIA LABORATORY SERVICES

 03/10/09 16:07

ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Conventional Chemistry Parameters by APHA/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-PD-N (CSC0342-01) Soil Sampled: 03/09/09 10:15 Received: 03/09/09 16:00									
Hexavalent Chromium	ND	10	µg/kg	1	CS01786	03/10/09	03/10/09	EPA 7199	
Sphere 5-PD-S (CSC0342-02) Soil Sampled: 03/09/09 10:25 Received: 03/09/09 16:00									
Hexavalent Chromium	ND	10	µg/kg	1	CS01786	03/10/09	03/10/09	EPA 7199	

CALIFORNIA LABORATORY SERVICES

 03/10/09 16:07

ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Extractable Petroleum Hydrocarbons by EPA Method 8015M

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-PD-N (CSC0342-01) Soil Sampled: 03/09/09 10:15 Received: 03/09/09 16:00									
Diesel	ND	1.0	mg/kg	1	CS01742	03/10/09	03/10/09	EPA 8015M	
Motor Oil	**5.1**	1.0	"	"	"	"	"	"	
JP-5/JP-8	ND	1.0	"	"	"	"	"	"	
Surrogate: o-Terphenyl		*82 %*	*65-135*		*"*	*"*	*"*	*"*	
Sphere 5-PD-S (CSC0342-02) Soil Sampled: 03/09/09 10:25 Received: 03/09/09 16:00									
Diesel	ND	1.0	mg/kg	1	CS01742	03/10/09	03/10/09	EPA 8015M	
Motor Oil	**3.5**	1.0	"	"	"	"	"	"	
JP-5/JP-8	ND	1.0	"	"	"	"	"	"	
Surrogate: o-Terphenyl		*79 %*	*65-135*		*"*	*"*	*"*	*"*	

CALIFORNIA LABORATORY SERVICES

 03/10/09 16:07

ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Metals by EPA 6000/7000 Series Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-PD-N (CSC0342-01) Soil Sampled: 03/09/09 10:15 Received: 03/09/09 16:00									
Mercury	ND	0.040	mg/kg	1	CS01781	03/09/09	03/10/09	EPA 7471A	
Antimony	ND	13	"	5	CS01795	03/10/09	03/10/09	EPA 6010B	
Beryllium	ND	1.3	"	"	"	"	"	"	
Cadmium	ND	2.5	"	"	"	"	"	"	
Chromium	**43**	5.0	"	"	"	"	"	"	
Copper	**30**	5.0	"	"	"	"	"	"	
Lead	ND	13	"	"	"	"	"	"	
Nickel	**37**	5.0	"	"	"	"	"	"	
Silver	ND	2.5	"	"	"	"	"	"	
Zinc	**40**	5.0	"	"	"	"	"	"	
Arsenic	ND	2.5	"	10	CS01794	03/10/09	03/10/09	EPA 7000	
Selenium	ND	2.5	"	"	"	"	"	"	
Thallium	ND	2.5	"	"	"	"	"	"	
Sphere 5-PD-S (CSC0342-02) Soil Sampled: 03/09/09 10:25 Received: 03/09/09 16:00									
Mercury	**0.070**	0.040	mg/kg	1	CS01781	03/09/09	03/10/09	EPA 7471A	
Antimony	ND	2.5	"	"	CS01795	03/10/09	03/10/09	EPA 6010B	
Beryllium	**0.28**	0.25	"	"	"	"	"	"	
Cadmium	ND	0.50	"	"	"	"	"	"	
Chromium	**35**	1.0	"	"	"	"	"	"	
Copper	**19**	1.0	"	"	"	"	"	"	
Lead	**8.7**	2.5	"	"	"	"	"	"	
Nickel	**33**	1.0	"	"	"	"	"	"	
Silver	**0.58**	0.50	"	"	"	"	"	"	
Zinc	**32**	1.0	"	"	"	"	"	"	
Arsenic	**3.2**	2.5	"	10	CS01794	03/10/09	"	EPA 7000	
Selenium	ND	2.5	"	"	"	"	"	"	
Thallium	ND	2.5	"	"	"	"	"	"	

CALIFORNIA LABORATORY SERVICES

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Polychlorinated Biphenyls by EPA Method 8082A

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-PD-N (CSC0342-01) Soil Sampled: 03/09/09 10:15 Received: 03/09/09 16:00									
Aroclor 1016	ND	20	µg/kg	1	CS01791	03/10/09	03/10/09	EPA 8082A	
Aroclor 1221	ND	20	"	"	"	"	"	"	
Aroclor 1232	ND	20	"	"	"	"	"	"	
Aroclor 1242	ND	20	"	"	"	"	"	"	
Aroclor 1248	ND	20	"	"	"	"	"	"	
Aroclor 1254	ND	20	"	"	"	"	"	"	
Aroclor 1260	ND	20	"	"	"	"	"	"	
Aroclor 1268	ND	20	"	"	"	"	"	"	
Surrogate: Decachlorobiphenyl		*106 %*	*50-150*		"	"	"	"	
Sphere 5-PD-S (CSC0342-02) Soil Sampled: 03/09/09 10:25 Received: 03/09/09 16:00									
Aroclor 1016	ND	20	µg/kg	1	CS01791	03/10/09	03/10/09	EPA 8082A	
Aroclor 1221	ND	20	"	"	"	"	"	"	
Aroclor 1232	ND	20	"	"	"	"	"	"	
Aroclor 1242	ND	20	"	"	"	"	"	"	
Aroclor 1248	ND	20	"	"	"	"	"	"	
Aroclor 1254	ND	20	"	"	"	"	"	"	
Aroclor 1260	ND	20	"	"	"	"	"	"	
Aroclor 1268	ND	20	"	"	"	"	"	"	
Surrogate: Decachlorobiphenyl		*107 %*	*50-150*		"	"	"	"	

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

TPH-Gasoline by GC FID

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Sphere 5-PD-N (CSC0342-01) Soil Sampled: 03/09/09 10:15 Received: 03/09/09 16:00									
JP-4	ND	1.0	mg/kg	1	CS01743	03/10/09	03/10/09	EPA 8015M	
Surrogate: o-Chlorotoluene (Gas)		*105 %*	*65-135*		"	"	"	"	
Sphere 5-PD-S (CSC0342-02) Soil Sampled: 03/09/09 10:25 Received: 03/09/09 16:00									
JP-4	ND	1.0	mg/kg	1	CS01743	03/10/09	03/10/09	EPA 8015M	
Surrogate: o-Chlorotoluene (Gas)		*109 %*	*65-135*		"	"	"	"	

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01786 - General Prep										
Blank (CS01786-BLK1)				Prepared & Analyzed: 03/10/09						
Hexavalent Chromium	ND	10	µg/kg							
LCS (CS01786-BS1)				Prepared & Analyzed: 03/10/09						
Hexavalent Chromium	45.0	10	µg/kg	50.0		90	80-120			
LCS Dup (CS01786-BSD1)				Prepared & Analyzed: 03/10/09						
Hexavalent Chromium	47.3	10	µg/kg	50.0		95	80-120	5	20	
Matrix Spike (CS01786-MS1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Hexavalent Chromium	52.6	10	µg/kg	50.0	ND	105	75-125			
Matrix Spike Dup (CS01786-MSD1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Hexavalent Chromium	47.4	10	µg/kg	50.0	ND	95	75-125	10	25	

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Extractable Petroleum Hydrocarbons by EPA Method 8015M - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01742 - LUFT-DHS GCNV										
Blank (CS01742-BLK1)				Prepared & Analyzed: 03/10/09						
Diesel	ND	1.0	mg/kg							
Motor Oil	ND	1.0	"							
Hydraulic Oil	ND	1.0	"							
Mineral Oil	ND	1.0	"							
Kerosene	ND	1.0	"							
JP-5/JP-8	ND	1.0	"							
Surrogate: o-Terphenyl	*0.376*		*"*	*0.500*		*75*	*65-135*			
LCS (CS01742-BS1)				Prepared & Analyzed: 03/10/09						
Diesel	46.9	1.0	mg/kg	50.0		94	65-135			
Surrogate: o-Terphenyl	*0.394*		*"*	*0.500*		*79*	*65-135*			
LCS Dup (CS01742-BSD1)				Prepared & Analyzed: 03/10/09						
Diesel	49.2	1.0	mg/kg	50.0		98	65-135	5	30	
Surrogate: o-Terphenyl	*0.404*		*"*	*0.500*		*81*	*65-135*			
Matrix Spike (CS01742-MS1)		**Source: CSB1005-03**		Prepared & Analyzed: 03/10/09						
Diesel	ND	1.0	mg/kg	50.0	ND		59-138			
Surrogate: o-Terphenyl	*0.00*		*"*	*0.500*			*65-135*			
Matrix Spike Dup (CS01742-MSD1)		**Source: CSB1005-03**		Prepared & Analyzed: 03/10/09						
Diesel	ND	1.0	mg/kg	50.0	ND		59-138		37	
Surrogate: o-Terphenyl	*0.00*		*"*	*0.500*			*65-135*			

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01781 - EPA 7471A										
Blank (CS01781-BLK1)				Prepared: 03/09/09	Analyzed: 03/10/09					
Mercury	ND	0.040	mg/kg							
LCS (CS01781-BS1)				Prepared: 03/09/09	Analyzed: 03/10/09					
Mercury	0.256	0.040	mg/kg	0.250		102	75-125			
LCS Dup (CS01781-BSD1)				Prepared: 03/09/09	Analyzed: 03/10/09					
Mercury	0.254	0.040	mg/kg	0.250		102	75-125	0.8	25	
Matrix Spike (CS01781-MS1)		**Source: CSC0330-01**		Prepared: 03/09/09	Analyzed: 03/10/09					
Mercury	0.290	0.040	mg/kg	0.250	0.0600	92	75-125			
Matrix Spike Dup (CS01781-MSD1)		**Source: CSC0330-01**		Prepared: 03/09/09	Analyzed: 03/10/09					
Mercury	0.304	0.040	mg/kg	0.250	0.0600	98	75-125	5	25	
Batch CS01794 - EPA 3050B										
Blank (CS01794-BLK1)				Prepared & Analyzed: 03/10/09						
Arsenic	ND	0.25	mg/kg							
Selenium	ND	0.25	"							
Thallium	ND	0.25	"							
LCS (CS01794-BS1)				Prepared & Analyzed: 03/10/09						
Arsenic	4.22	0.25	mg/kg	5.00		84	75-125			
Selenium	4.03	0.25	"	5.00		81	75-125			
Thallium	4.90	0.25	"	5.00		98	75-125			
LCS Dup (CS01794-BSD1)				Prepared & Analyzed: 03/10/09						
Arsenic	4.13	0.25	mg/kg	5.00		83	75-125	2	25	
Selenium	3.91	0.25	"	5.00		78	75-125	3	25	
Thallium	4.93	0.25	"	5.00		99	75-125	0.5	25	

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01794 - EPA 3050B										
Matrix Spike (CS01794-MS1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Arsenic	5.90	2.5	mg/kg	5.00	2.00	78	75-125			
Selenium	3.99	2.5	"	5.00	ND	80	75-125			
Thallium	5.07	2.5	"	5.00	ND	101	75-125			
Matrix Spike Dup (CS01794-MSD1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Arsenic	6.36	2.5	mg/kg	5.00	2.00	87	75-125	8	30	
Selenium	4.02	2.5	"	5.00	ND	80	75-125	0.9	30	
Thallium	5.61	2.5	"	5.00	ND	112	75-125	10	30	
Batch CS01795 - EPA 3050B										
Blank (CS01795-BLK1)				Prepared & Analyzed: 03/10/09						
Antimony	ND	2.5	mg/kg							
Beryllium	ND	0.25	"							
Cadmium	ND	0.50	"							
Chromium	ND	1.0	"							
Copper	ND	1.0	"							
Lead	ND	2.5	"							
Nickel	ND	1.0	"							
Silver	ND	0.50	"							
Zinc	ND	1.0	"							
LCS (CS01795-BS1)				Prepared & Analyzed: 03/10/09						
Antimony	23.7	2.5	mg/kg	25.0		95	75-125			
Beryllium	2.16	0.25	"	2.50		86	75-125			
Cadmium	2.25	0.50	"	2.50		90	75-125			
Chromium	9.47	1.0	"	10.0		95	75-125			
Copper	10.9	1.0	"	12.5		87	75-125			
Lead	22.3	2.5	"	25.0		89	75-125			
Nickel	22.0	1.0	"	25.0		88	75-125			
Silver	2.40	0.50	"	2.50		96	75-125			
Zinc	21.3	1.0	"	25.0		85	75-125			

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Metals by EPA 6000/7000 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01795 - EPA 3050B										
LCS Dup (CS01795-BSD1)				Prepared & Analyzed: 03/10/09						
Antimony	22.8	2.5	mg/kg	25.0		91	75-125	4	25	
Beryllium	2.13	0.25	"	2.50		85	75-125	1	25	
Cadmium	2.04	0.50	"	2.50		81	75-125	10	25	
Chromium	9.38	1.0	"	10.0		94	75-125	1	25	
Copper	10.8	1.0	"	12.5		86	75-125	1	25	
Lead	22.3	2.5	"	25.0		89	75-125	0.1	25	
Nickel	21.7	1.0	"	25.0		87	75-125	1	25	
Silver	2.42	0.50	"	2.50		97	75-125	1	25	
Zinc	21.1	1.0	"	25.0		84	75-125	1	25	
Matrix Spike (CS01795-MS1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Antimony	5.45	2.5	mg/kg	25.0	ND	22	75-125			QM-5
Beryllium	2.14	0.25	"	2.50	0.278	74	75-125			QM-5
Cadmium	2.33	0.50	"	2.50	ND	93	75-125			
Chromium	49.4	1.0	"	10.0	43.0	64	75-125			QM-5
Copper	39.8	1.0	"	12.5	29.9	79	75-125			
Lead	29.1	2.5	"	25.0	8.75	81	75-125			
Nickel	52.7	1.0	"	25.0	37.1	62	75-125			QM-5
Silver	2.78	0.50	"	2.50	1.63	46	75-125			QM-5
Zinc	55.8	1.0	"	25.0	40.4	62	75-125			QM-5
Matrix Spike Dup (CS01795-MSD1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Antimony	ND	13	mg/kg	25.0	ND		75-125		30	QM-5
Beryllium	2.58	1.3	"	2.50	0.278	92	75-125	19	30	
Cadmium	2.58	2.5	"	2.50	ND	103	75-125	10	30	
Chromium	62.1	5.0	"	10.0	43.0	192	75-125	23	30	QM-5
Copper	47.9	5.0	"	12.5	29.9	144	75-125	19	30	QM-5
Lead	32.3	13	"	25.0	8.75	94	75-125	10	30	
Nickel	64.7	5.0	"	25.0	37.1	110	75-125	21	30	
Silver	3.28	2.5	"	2.50	1.63	66	75-125	17	30	QM-5
Zinc	68.7	5.0	"	25.0	40.4	113	75-125	21	30	

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Polychlorinated Biphenyls by EPA Method 8082A - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01791 - LUFT-DHS GCNV										
Blank (CS01791-BLK1)				Prepared & Analyzed: 03/10/09						
Aroclor 1016	ND	20	µg/kg							
Aroclor 1221	ND	20	"							
Aroclor 1232	ND	20	"							
Aroclor 1242	ND	20	"							
Aroclor 1248	ND	20	"							
Aroclor 1254	ND	20	"							
Aroclor 1260	ND	20	"							
Aroclor 1268	ND	20	"							
Surrogate: Decachlorobiphenyl	*9.07*		*"*	*8.33*		*109*	*50-150*			
LCS (CS01791-BS1)				Prepared & Analyzed: 03/10/09						
Aroclor 1260	85.7	20	µg/kg	83.3		103	29-131			
Surrogate: Decachlorobiphenyl	*9.03*		*"*	*8.33*		*108*	*50-150*			
LCS Dup (CS01791-BSD1)				Prepared & Analyzed: 03/10/09						
Aroclor 1260	86.0	20	µg/kg	83.3		103	29-131	0.4	30	
Surrogate: Decachlorobiphenyl	*9.13*		*"*	*8.33*		*110*	*50-150*			
Matrix Spike (CS01791-MS1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Aroclor 1260	83.8	20	µg/kg	83.3	ND	101	29-131			
Surrogate: Decachlorobiphenyl	*8.55*		*"*	*8.33*		*103*	*50-150*			
Matrix Spike Dup (CS01791-MSD1)		**Source: CSC0342-01**		Prepared & Analyzed: 03/10/09						
Aroclor 1260	85.1	20	µg/kg	83.3	ND	102	29-131	1	30	
Surrogate: Decachlorobiphenyl	*17.0*		*"*	*8.33*		*204*	*50-150*			*QS-4*

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ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

TPH-Gasoline by GC FID - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CS01743 - EPA 5030 Soil GC										
Blank (CS01743-BLK1)				Prepared & Analyzed: 03/10/09						
JP-4	ND	1.0	mg/kg							
Gasoline	ND	1.0	"							
Surrogate: o-Chlorotoluene (Gas)	*0.101*		*"*	*0.100*		*101*	*65-135*			
LCS (CS01743-BS1)				Prepared & Analyzed: 03/10/09						
Gasoline	2.77	1.0	mg/kg	2.50		111	65-135			
Surrogate: o-Chlorotoluene (Gas)	*0.111*		*"*	*0.100*		*111*	*65-135*			
LCS Dup (CS01743-BSD1)				Prepared & Analyzed: 03/10/09						
Gasoline	2.31	1.0	mg/kg	2.50		93	65-135	18	30	
Surrogate: o-Chlorotoluene (Gas)	*0.107*		*"*	*0.100*		*107*	*65-135*			
Matrix Spike (CS01743-MS1)		**Source: CSC0330-01**		Prepared & Analyzed: 03/10/09						
Gasoline	2.79	1.0	mg/kg	2.50	0.291	100	63-124			
Surrogate: o-Chlorotoluene (Gas)	*0.117*		*"*	*0.100*		*117*	*65-135*			
Matrix Spike Dup (CS01743-MSD1)		**Source: CSC0330-01**		Prepared & Analyzed: 03/10/09						
Gasoline	2.61	1.0	mg/kg	2.50	0.291	93	63-124	7	35	
Surrogate: o-Chlorotoluene (Gas)	*0.116*		*"*	*0.100*		*116*	*65-135*			

ISSI/NASA Ames MS221-10	Project: Sphere 5 Soil Removal	
NASA Ames MS T20-G	Project Number: N140-200	**CLS Work Order #: CSC0342**
Moffet Field, CA 94035-1000	Project Manager: Luke Metz	COC #: 95031

Notes and Definitions

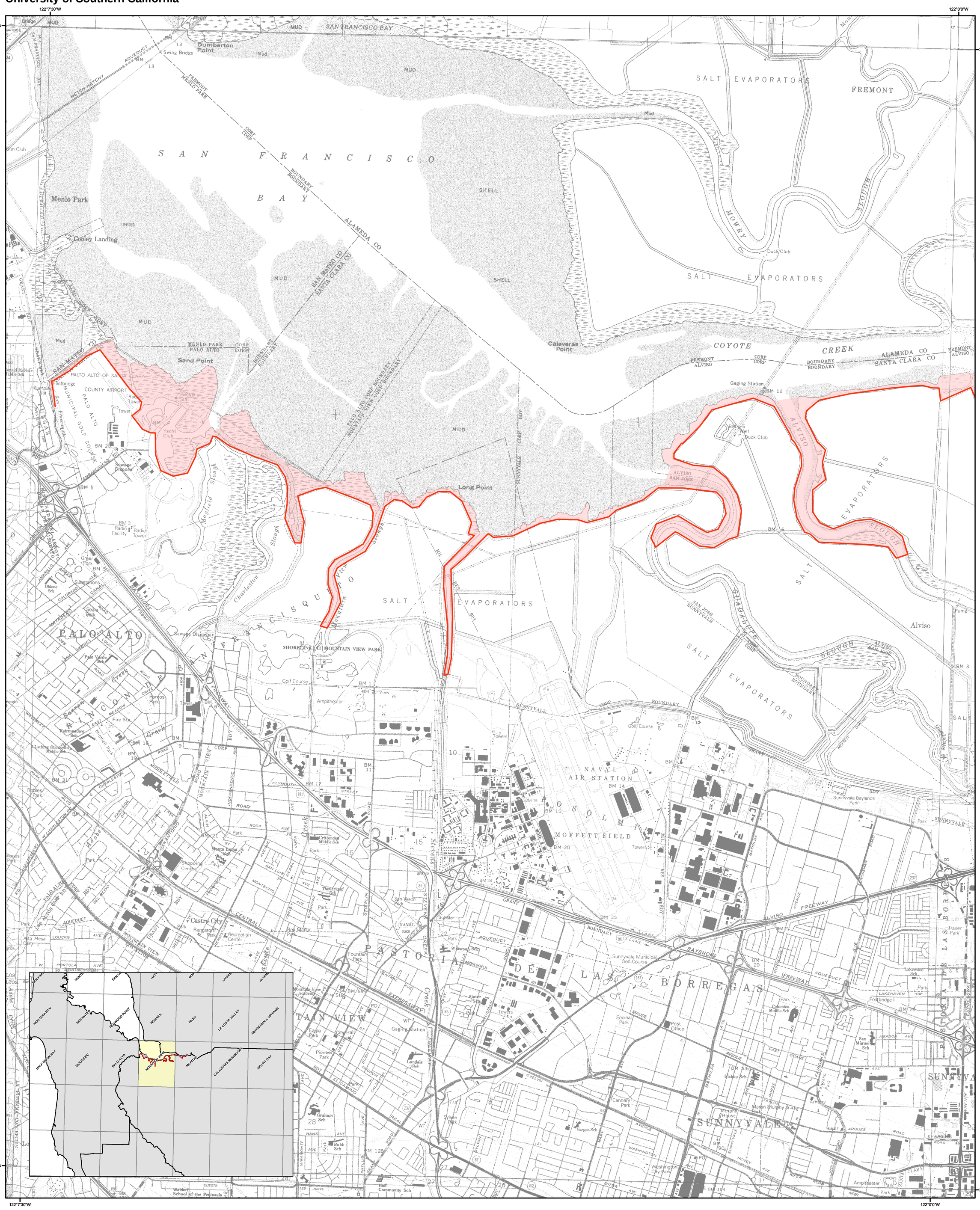
QS-4	The surrogate recovery for this sample is outside of established control limits due to a sample matrix effect.
QM-5	The spike recovery was outside acceptance limits for the MS and/or MSD due to matrix interference. The LCS and/or LCSD were within acceptance limits showing that the laboratory is in control and the data is acceptable.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

APPENDIX D
TSUNAMI INUNDATION MAP

California Emergency Management Agency
California Geological Survey
University of Southern California

Tsunami Inundation Map for Emergency Planning
Mountain View Quadrangle

State of California
County of Santa Clara



METHOD OF PREPARATION

Initial tsunami modeling was performed by the University of Southern California (USC) Tsunami Research Center funded through the California Emergency Management Agency (CalEMA) by the National Tsunami Hazard Mitigation Program. The tsunami modeling process utilized the MOST (Method of Splitting Tsunamis) computational program (Version 0), which allows for wave evolution over a variable bathymetry and topography used for the inundation mapping (Titov and Gonzalez, 1997; Titov and Synolakis, 1998).

The bathymetric/topographic data that were used in the tsunami models consist of a series of nested grids. Near-shore grids with a 3 arc-second (75- to 90-meters) resolution or higher, were adjusted to "Mean High Water" sea-level conditions, representing a conservative sea level for the intended use of the tsunami modeling and mapping.

A suite of tsunami source events was selected for modeling, representing realistic local and distant earthquakes and hypothetical extreme undersea, near-shore landslides (Table 1). Local tsunami sources that were considered include offshore reverse-thrust faults, restraining bends on strike-slip fault zones and large submarine landslides capable of significant seafloor displacement and tsunami generation. Distant tsunami sources that were considered include great subduction zone events that are known to have occurred historically (1960 Chile and 1964 Alaska earthquakes) and others which can occur around the Pacific Ocean "Ring of Fire."

In order to enhance the result from the 75- to 90-meter inundation grid data, a method was developed utilizing higher-resolution digital topographic data (3- to 10-meters resolution) that better defines the location of the maximum inundation line (U.S. Geological Survey, 1993; Intermap, 2003; NOAA, 2004). The location of the enhanced inundation line was determined by using digital imagery and terrain data on a GIS platform with consideration given to historic inundation information (Lander, et al., 1993). This information was verified, where possible, by field work coordinated with local county personnel.

The accuracy of the inundation line shown on these maps is subject to limitations in the accuracy and completeness of available terrain and tsunami source information, and the current understanding of tsunami generation and propagation phenomena as expressed in the models. Thus, although an attempt has been made to identify a credible upper bound to inundation at any location along the coastline, it remains possible that actual inundation could be greater in a major tsunami event.

This map does not represent inundation from a single scenario event. It was created by combining inundation results for an ensemble of source events affecting a given region (Table 1). For this reason, all of the inundation region in a particular area will not likely be inundated during a single tsunami event.

References:

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TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING

State of California ~ County of Santa Clara
MOUNTAIN VIEW QUADRANGLE

July 31, 2009

SCALE 1:24,000

0.5 0.25 0 0.5 1 Miles

1,000 500 0 1,000 2,000 3,000 4,000 5,000 Feet

0.5 0.25 0 0.5 1 Kilometers

Table 1: Tsunami sources modeled for the Santa Clara County coastline.

Sources (M = moment magnitude used in modeled event)		Area of Inundation Map Coverage and Sources Used
		San Francisco Bay
Local sources	Point Reyes Thrust Fault	X
	Rodgers Creek-Hayward Faults	X
	San Gregorio Fault	X
Distant Sources	Cascadia Subduction Zone-full rupture (M9.0)	X
	Central Aleutians Subduction Zone #1 (M8.9)	X
	Central Aleutians Subduction Zone #2 (M8.9)	X
	Central Aleutians Subduction Zone #3 (M9.2)	X
	Chile North Subduction Zone (M9.4)	X
	1960 Chile Earthquake (M9.3)	X
	1964 Alaska Earthquake (M9.2)	X
	Japan Subduction Zone #2 (M8.8)	X
	Kuril Islands Subduction Zone #2 (M8.8)	X
	Kuril Islands Subduction Zone #3 (M8.8)	X
	Kuril Islands Subduction Zone #4 (M8.8)	X
	Marianas Subduction Zone (M8.6)	X

MAP EXPLANATION

Tsunami Inundation Line

Tsunami Inundation Area

PURPOSE OF THIS MAP

This tsunami inundation map was prepared to assist cities and counties in identifying their tsunami hazard. It is intended for local jurisdictional, coastal evacuation planning uses only. This map, and the information presented herein, is not a legal document and does not meet disclosure requirements for real estate transactions nor for any other regulatory purpose.

The inundation map has been compiled with best currently available scientific information. The inundation line represents the maximum considered tsunami runup from a number of extreme, yet realistic, tsunami sources. Tsunamis are rare events; due to a lack of known occurrences in the historical record, this map includes no information about the probability of any tsunami affecting any area within a specific period of time.

Please refer to the following websites for additional information on the construction and/or intended use of the tsunami inundation map:

State of California Emergency Management Agency, Earthquake and Tsunami Program:
http://www.oes.ca.gov/WebPage/oeswebsite.nsf/Content/B1EC51BA215931768825741F005E8D80?OpenDocument

University of Southern California – Tsunami Research Center:
http://www.usc.edu/dept/tsunamis/2005/index.php

State of California Geological Survey Tsunami Information:
http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/index.htm

National Oceanic and Atmospheric Agency Center for Tsunami Research (MOST model):
http://nctr.pmel.noaa.gov/time/background/models.html

MAP BASE

Topographic base maps prepared by U.S. Geological Survey as part of the 7.5-minute Quadrangle Map Series (originally 1:24,000 scale). Tsunami inundation line boundaries may reflect updated digital orthophotographic and topographic data that can differ significantly from contours shown on the base map.

DISCLAIMER

The California Emergency Management Agency (CalEMA), the University of Southern California (USC), and the California Geological Survey (CGS) make no representation or warranties regarding the accuracy of this inundation map nor the data from which the map was derived. Neither the State of California nor USC shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

APPENDIX E
SITE-SPECIFIC SEISMIC HAZARD ANALYSIS

INTRODUCTION

This Appendix presents the pertinent details of the site-specific seismic hazard analysis which we previously performed for the N234a SVS Deaerator Tank / Feedwater Tank replacement project in accordance with ASCE 7-*05 Chapter 21* (Fugro, 2010). The Deaerator Tank project is located approximately 150 feet to the southeast of the proposed Boiler Plant. The subsurface conditions at the Deaerator tank are consistent with those encountered at the proposed Boiler Plant (i.e. deep, stiff alluvial soils). The measured V_{S30} at each location was 265 m/s. Due to the site proximity and the similar soil conditions, the results of our previous site-specific study may be used for design of the SVS Boiler Plant.

Our site-specific seismic hazard analysis consisted of the following components:

- Characterization the subsurface conditions;
- Identification potential seismic sources and fault parameters;
- Probabilistic seismic hazard analysis (PSHA) and deterministic seismic hazard analysis (DSHA) to determine the site-specific MCE response spectra; and
- Development of site-specific design response spectrum and seismic design parameters.

SUBSURFACE CONDITIONS

The site is located at the northern end of the Santa Clara Valley. The Santa Clara Valley is a sediment-filled trough at the southern end of the San Francisco Bay. Valley sediments are comprised of unconsolidated, alluvial deposits that slope gently to the north, toward the San Francisco Bay. Our borings and CPTs encountered alluvial soils consisting stiff to very stiff clays with interbedded sand layers to a depth of 100 feet, the maximum depth explored. Based on the alluvium thickness map of the Santa Clara Valley by Bishop and Williams (1974), the site is underlain by approximately 500 feet of alluvium.

Our seismic cone penetration tests (SCPTs) indicate that the upper 30 meters of the soil profile have an average shear wave velocity of 265 m/s, which is consistent with a Site Class D soil profile.

POTENTIAL SEISMOGENIC SOURCES

Significant seismogenic sources within 100 km of the site were identified and characterized with respect to geometric, geologic, and seismic conditions. The key characteristics include:

- Style of Faulting (e.g. strike-slip, reverse, normal);
- Closest source-to-site distance;
- Total fault length and rupture length;
- Rupture width;
- Slip rate; and
- Maximum magnitude (M_{max}).

Table E-1 lists the key fault parameters for the sources found within a 30 km radius of the site. These parameters were subsequently used in the seismic hazard analyses and were adapted from the Working Group on California Earthquake Probabilities (Field, et al., 2008).

Table E-1: Significant Seismogenic Sources within 30 km of the Project Site

Potential Seismogenic Source	Type [1], [2]	Closest Distance in km (miles)	Total Length (km)	Down Dip Width [3] (km)	Slip Rate (mm/yr)	M_{max} [4]
Monte Vista – Shannon	R (45 E)	9.7 (6.0)	41	9	0.4	6.5
San Andreas	RL-SS	14.0 (8.64)	472	11 - 15	17 – 24	8.05
Hayward-Rodgers Creek	RL-SS	16.8 (10.4)	150	12	9	7.3
Calaveras	RL-SS	22.3 (13.7)	104	11 - 13	6 - 15	7.0
San Gregorio	RL-SS	32.0 (20.0)	190	12	3 - 7	7.5

Notes:
1. Fault parameters were adapted from the Field, et al. (2008).
2. SS = Strike Slip Fault, RL = Right Lateral, R = Reverse (Dip in degrees), O = Oblique
3. Down-dip width = (rupture bottom minus rupture top) divided by sine of dip angle.
4. M_{max} adapted from USGS (2008).

PROBABILISTIC SEISMIC HAZARD ANALYSES

ASCE 7-05 Section 21.2.1 defines the *probabilistic Maximum Considered Earthquake (MCE)* spectral response acceleration as the spectral response accelerations represented by a 5 percent damped acceleration response spectrum having a 2 percent probability of

exceedance in a 50 year period, which corresponds to a 2,475 year return period ground motion.

We performed a PSHA out using the computer program EZ-Frisk (version 7.35). The program employs the analytical procedure to compute seismic hazard originally developed by Cornell (1968). The activity of the seismic sources was modeled using the Youngs and Coppersmith (1985) composite model to simulate the relative distribution of magnitudes for each fault.

The seismic hazard analysis was conducted using the recently developed Next Generation of Attenuation (NGAs) relationships (Abrahamson and Silva, 2008, Boore and Atkinson, 2008, Chiou and Youngs, 2008, Campbell and Bozorgnia, 2008).

The *probabilistic MCE* spectrum is presented in tabular form in Table E-2 and graphically in Plate E-1. Deaggregation indicates that the greatest contribution to the hazard is due to magnitude 7.5 and 8.0 events at a distance of 10 and 15 km, which are associated with events on the San Andreas Fault located to the southwest of the site.

Table E-2: Probabilistic MCE Spectrum

Period (seconds)	Spectral Acceleration (g)
0	0.68
0.05	0.85
0.10	1.21
0.12	1.32
0.20	1.51
0.30	1.52
0.40	1.43
0.50	1.35
0.60	1.26
0.75	1.15
1.0	0.98
2.0	0.67
3.0	0.52
4.0	0.42
5.0	0.36

DETERMINISTIC HAZARD ANALYSIS

ASCE 7-05 Section 21.2.2 defines the *deterministic MCE* spectrum as 150 percent of the largest median 5 percent damped spectral response acceleration for characteristic earthquakes on all known active faults with the region. Section 21.2.2 also stipulates that the deterministic MCE shall not be taken lower then the *deterministic lower limit* defined in Figure 21.2-1. The *deterministic MCE* at each period is calculated as the greater of:

1. 150% of the largest median ground motion from all known active faults; or
2. The deterministic lower limit defined by Figure 21.2-1.

The largest median ground motion at the site was calculated for a M_W 8.05 earthquake on the San Andreas Fault at a distance of 14.0 km from the site. Derivation of the deterministic MCE is presented in Table E-3 and graphically on Plate E-2.

Table E-3: Deterministic MCE Spectrum

Period (seconds)	Largest Median Response Spectrum (g's)	150% of Median Response Spectrum (g's)	Deterministic Lower Limit (g's)	Deterministic MCE (g's)
0	0.31	0.46	1.5	1.5
0.05	0.35	0.53	1.5	1.5
0.10	0.47	0.70	1.50	1.50
0.12	0.51	0.77	1.50	1.50
0.20	0.60	0.91	1.50	1.50
0.30	0.64	0.96	1.50	1.50
0.40	0.62	0.92	1.50	1.50
0.50	0.59	0.88	1.50	1.50
0.60	0.55	0.82	1.50	1.50
0.75	0.51	0.76	1.20	1.20
1.0	0.43	0.64	0.90	0.90
1.5	0.35	0.53	0.60	0.60
2.0	0.26	0.39	0.45	0.45
2.5	0.22	0.33	0.36	0.36
3.0	0.18	0.28	0.30	0.30
4.0	0.13	0.20	0.23	0.23
5.0	0.10	0.15	0.18	0.18

SITE-SPECIFIC SPECTRA AND ACCELERATION PARAMETERS

ASCE 7-05 Section 21.2.3 defines the *site-specific MCE* as the lesser of the *probabilistic MCE* and the *deterministic MCE*. Development of the *site-specific MCE* is shown graphically on Plate E-3. The spectral ordinates of the *site-specific MCE* are presented in the second column of Table E-4.

ASCE 7-05 Section 21.3.1 defines the *site-specific design response spectrum (DRS)* as two-thirds of the *site-specific MCE*, with the restriction that it may not be less than 80% of the *code-based DRS* determined in accordance with Section 11.4.5. Development of the *site-specific DRS* is shown graphically on Plate E-4. The spectral ordinates of the *site-specific DRS* are presented in the third column of Table E-4.

Table E-4: Site-Specific Response Spectra Ordinates

Period (seconds)	Maximum Considered Earthquake (g)	Design Response Spectrum (g)
0	0.69	0.46
0.05	0.85	0.57
0.10	1.21	0.81
0.12	1.32	0.88
0.20	1.50	1.00
0.30	1.50	1.00
0.40	1.43	0.95
0.50	1.35	0.90
0.60	1.26	0.84
0.75	1.15	0.77
1.0	0.90	0.60
1.5	0.60	0.40
2.0	0.45	0.30
2.5	0.36	0.24
3.0	0.30	0.20
4.0	0.23	0.15
5.0	0.18	0.12

Per ASCE 7-05 Section 21.4, the acceleration parameters S_{DS} and S_{D1} can be obtained from the site-specific design spectrum. The S_{DS} value is calculated as the larger of: (1) spectral acceleration at 0.2 second and (2) 90 percent of the largest spectral acceleration for any period greater than 0.2 second. The S_{D1} value is calculated as the larger of: (1) spectral acceleration at 1 second and (2) two times the spectral acceleration at 2 seconds. Based on these criteria, the design parameters for the project are: S_{DS} = 1.00 and S_{D1} = 0.60.

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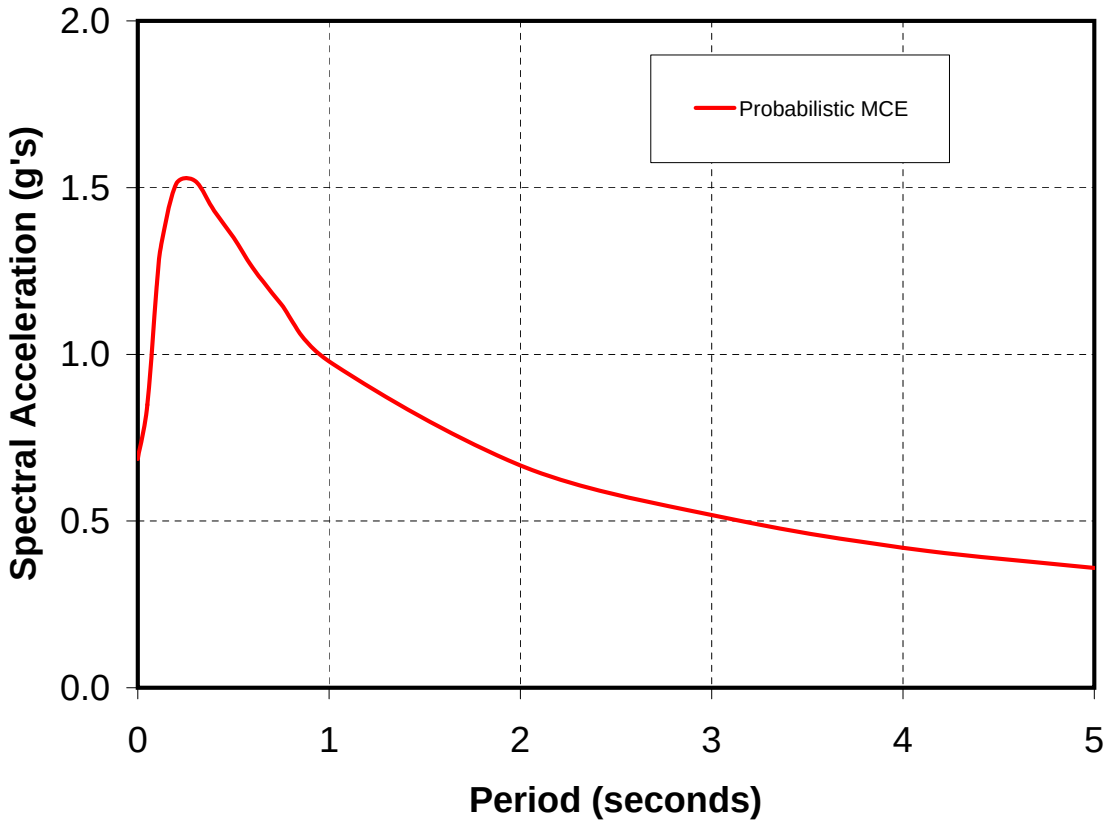
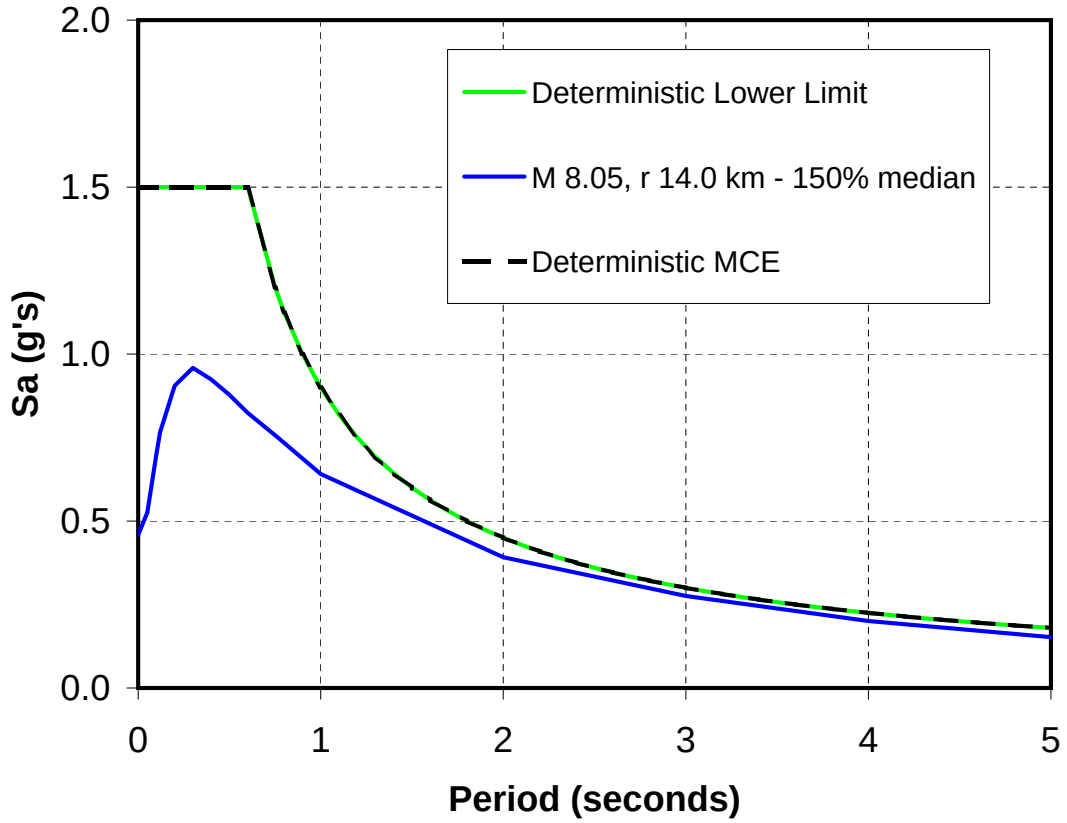


The Probabilistic Maximum Considered Earthquake (MCE) is calculated for a 2% probability of exceedance in 50 years.

Probabilistic Maximum Considered Earthquake Spectrum
NASA Ames N234A SVS Deaerator / Feedwater
Tank Replacement Project
Moffett Field, California

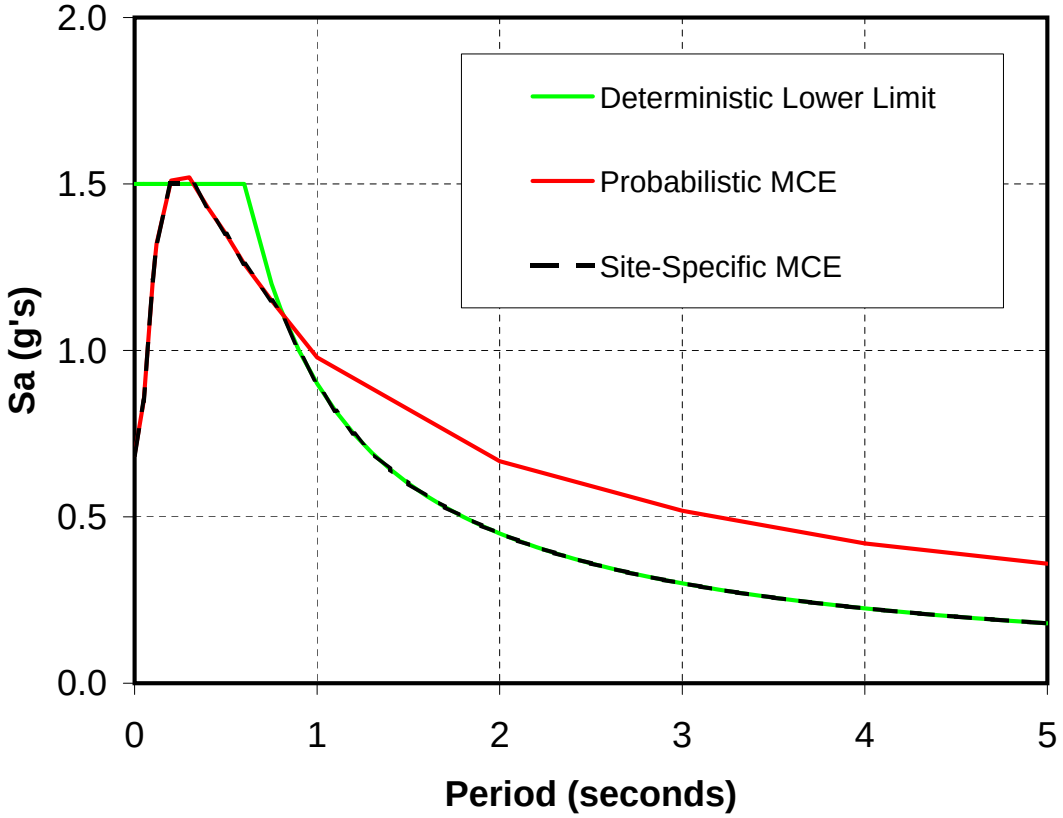


The Deterministic MCE response spectrum is calculated as the greater of:

- Site-Specific Deterministic response spectrum, defined as 150% of the median ground motion for a M 8.05 earthquake at a distance of 14.0 km, or

- Deterministic Lower Limit per ASCE 7-05 Section 21.2.2.

Deterministic Maximum Considered Earthquake Spectrum
NASA Ames N234A SVS Deaerator / Feedwater
Tank Replacement Project
Moffett Field, California

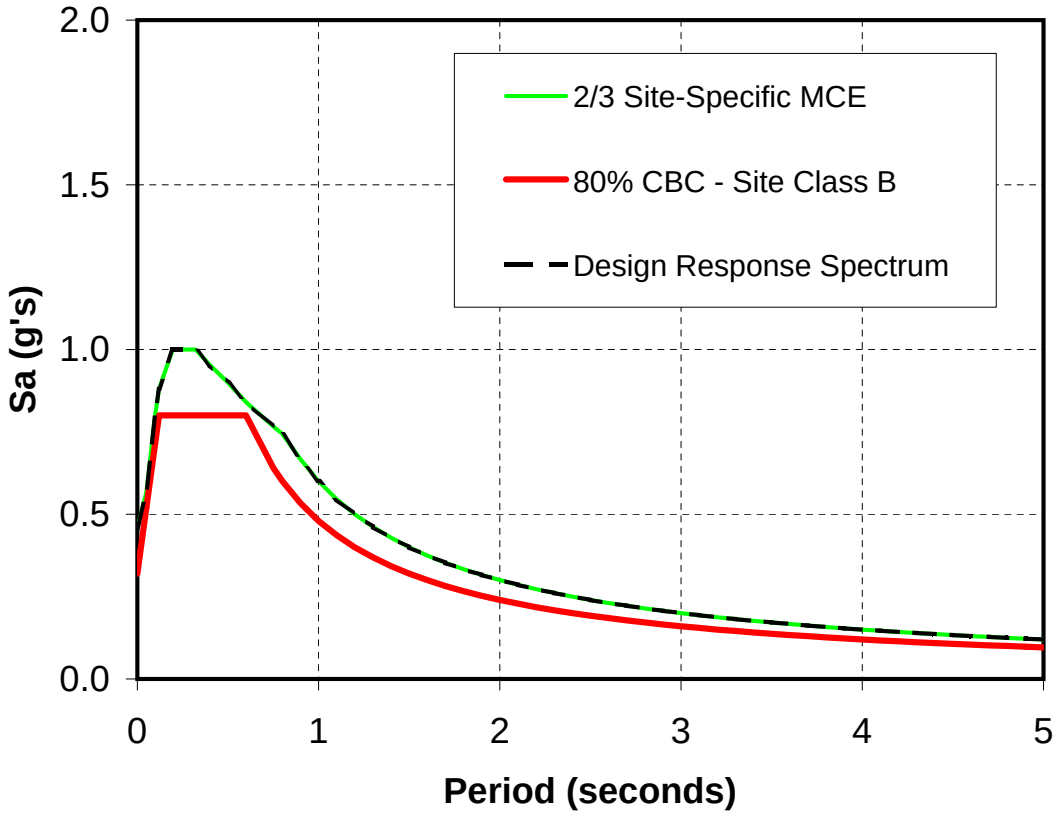


The Site-Specific MCE response spectrum is considered to be the less of:

- Probabilistic MCE, or

- Deterministic MCE.

Site-Specific Maximum Considered Earthquake Spectrum
NASA Ames N234A SVS Deaerator / Feedwater
Tank Replacement Project
Moffett Field, California



The Site-Specific design response spectrum is considered to be the greater of:

- 2/3 the Site-Specific MCE, or

- 80% of the California Building Code general spectrum.

Site-Specific Design Response Spectrum
NASA Ames N234A SVS Deaerator / Feedwater
Tank Replacement Project
Moffett Field, California