

Table 2.9-3
Summary of Duplicate (QC) Sampling Program
TNT Strips #5

| EPA Test Method | Total Number of Samples | | | | Total Number of Duplicate Samples | | | |
|--|-------------------------|-------------|----------|---------------|-----------------------------------|-------------|----------|---------------|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water |
| Field TNT Soil Test | 22 | | | | 2 | | | |
| SW8330 Explosives | | | | | | | | |
| SW8330 Nitroglycerin & PETN | | | | | | | | |
| SW8310 PAHs | | | | | | | | |
| Metals ^(a) SW601B/SW87470A, SW7471A | | | | | | | | |
| LUFT Mod. SW8015 TEPH-D/MO | | | | | | | | |
| LUFT Mod. SW8015 TEPH-K | | | | | | | | |
| SW8260B VOCs | | | | | | | | |
| E300.0 Nitrate/Nitrite | | | | | | | | |
| E365.2 Total Phosphorous | | | | | | | | |
| SW8290 Dioxins/Furans | | | | | | | | |
| Groundwater Chemistry ^(b) | | | | | | | | |

Total No. Boring/Sample Locations: 7 borings

Notes: ^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.

^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 306.0, total phosphorous by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 160.1, and total suspended solids (TSS) by EPA Method 160.2; and (2) Field parameters - temperature by EPA Method 170.1, pH by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 180.1.

■ Environmental Protection Agency

■ leaking underground fuel tank

■ polyaromatic hydrocarbons

■ total extractable petroleum hydrocarbons as diesel and motor oil

■ total extractable petroleum hydrocarbons as kerosene

■ volatile organic compounds

■ pentaerythritol tetranitrate

Due to a combination of composting and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site #1, or the wetlands surface water/sediment.

Table 2.9-4
 Summary of Duplicate (QC) Sampling Program
 Former Howitzer Test Facility

| EPA Test Method | Total Number of Samples | | | | | Total Number of Duplicate Samples | | | | |
|--|-------------------------|-------------|----------|---------------|------|-----------------------------------|----------|---------------|--|--|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water | | |
| Field TNT Soil Test | | | | | | | | | | |
| SW8330 Explosives | 30 | | | | 3 | | | | | |
| SW8330 Nitroglycerin & PETN | 30 | | | | 3 | | | | | |
| SW8310 PAHs | 30 | | | | 3 | | | | | |
| Metals ^(a) SW601B/SW87470A, SW7471A | 30 | | | | 3 | | | | | |
| LUFT Mod. SW8015 TEPH-D/MO | 30 | | | | 3 | | | | | |
| LUFT Mod. SW8015 TEPH-K | 30 | | | | 3 | | | | | |
| SW8260B VOCs | 30 | | | | 3 | | | | | |
| E300.0 Nitrate/Nitrite | 30 | | | | 3 | | | | | |
| E365.2 Total Phosphorous | | | | | | | | | | |
| SW8290 Dioxins/Furans | | | | | | | | | | |
| Groundwater Chemistry ^(b) | | | | | | | | | | |

Total No. Boring/Sample Locations: 6 (3 borings/3 wells)

Notes: ^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.

^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 300.0, total phosphorous by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 160.1, and total suspended solids (TSS) by EPA Method 160.2; and (2) Field parameters - temperature by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 160.1.

EPA = Environmental Protection Agency

LUFT = leaking underground fuel tank

PAHs = polycyclic aromatic hydrocarbons

TEPH-D/MO = total extractable petroleum hydrocarbons as diesel and motor oil

TEPH-K = total extractable petroleum hydrocarbons as kerosene

VOCs = volatile organic compounds

PETN = pentaerythritol tetranitrate

Due to a combination of compositing and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site #1, or the wetlands surface water/sediment.

Table 2.9-5
 Summary of Duplicate (QC) Sampling Program
 Former Ammunition Renovation Area/Primer Destruction Site

| EPA Test Method | Total Number of Samples | | | | Total Number of Duplicate Samples | | | |
|--|-------------------------|-------------|----------|---------------|-----------------------------------|-------------|----------|---------------|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water |
| Field TNT Soil Test | | | | | | | | |
| SW8330 Explosives | 30 | | | | 3 | | | |
| SW8330 Nitroglycerin & PETN | 30 | | | | 3 | | | |
| SW8310 PAHs | 30 | | | | 3 | | | |
| Metals ^(a) SW601B/SW87470A, SW7471A | 30 | | | | 3 | | | |
| LUFT Mod. SW8015 TEPH-D/MO | 30 | | | | 3 | | | |
| LUFT Mod. SW8015 TEPH-K | 30 | | | | 3 | | | |
| SW8260B VOCs | 30 | | | | 3 | | | |
| E300.0 Nitrate/Nitrite | 30 | | | | 3 | | | |
| E365.2 Total Phosphorous | | | | | | | | |
| SW8290 Dioxins/Furans | | | | | | | | |
| Groundwater Chemistry ^(b) | | | | | | | | |

Total No. Borings/Sample Locations: 6 (4 borings/2 wells)

Notes:

^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.

^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 300.0, total phosphorous by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 180.1, and total suspended solids (TSS) by EPA Method 160.2; and (2) Field parameters - temperature by EPA Method 170.1, pH by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 180.1.

- EPA = Environmental Protection Agency
- LUFT = leaking underground fuel tank
- PAHs = polycyclic aromatic hydrocarbons
- TEPH-D/MO = total extractable petroleum hydrocarbons as diesel and motor oil
- TEPH-K = total extractable petroleum hydrocarbons as kerosene
- VOCs = volatile organic compounds
- PETN = pentaerythritol tetranitrate

Due to a combination of composing and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site #1, or the wetlands surface water/sediment.

Table 2.9-6
 Summary of Duplicate (QC) Sampling Program
 North Valley Groundwater

| EPA Test Method | Total Number of Samples | | | | | Total Number of Duplicate Samples | | | | |
|--|-------------------------|-------------|----------|---------------|------|-----------------------------------|----------|---------------|--|--|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water | | |
| Field TNT Soil Test | | | | | | | | | | |
| SW8330 Explosives | | 9 | | | | 1 | | | | |
| SW8330 Nitrolycerin & PETN | | 9 | | | | 1 | | | | |
| SW8310 PAHs | | 9 | | | | 1 | | | | |
| Metals ^(a) SW601B/SW87470A, SW7471A | | 9 | | | | 1 | | | | |
| LUFT Mod. SW8015 TEPH-D/MO | | 9 | | | | 1 | | | | |
| LUFT Mod. SW8015 TEPH-K | | 9 | | | | 1 | | | | |
| SW8260B VOCs | | 9 | | | | 1 | | | | |
| E300.0 Nitrate/Nitrite | | | | | | 1 | | | | |
| E365.2 Total Phosphorous | | | | | | | | | | |
| SW8290 Dioxins/Furans | | | | | | | | | | |
| Groundwater Chemistry ^(b) | | 9 | | | | 1 | | | | |

Total No. Boring/Sample Locations: 9 wells

Notes: ^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.

^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 300.0, total phosphorous by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 160.1, and total suspended solids (TSS) by EPA Method 160.2, and (2) Field parameters - temperature by EPA Method 170.1, pH by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 180.1.

- EPA
 - LUFT
 - PAHs
 - TEPH-D/MO
 - TEPH-K
 - VOCs
 - PETN
- = Environmental Protection Agency
 - = leaking underground fuel tank
 - = polyaromatic hydrocarbons
 - = total extractable petroleum hydrocarbons as diesel and motor oil
 - = total extractable petroleum hydrocarbons as kerosene
 - = volatile organic compounds
 - = pentachloritol tetranitrate

Due to a combination of compaction and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site #1, or the wetlands surface water/sediment.

Table 2.9-7
Summary of Duplicate (QC) Sampling Program
Flare Area

| EPA Test Method | Total Number of Samples | | | | | Total Number of Duplicate Samples | | | | |
|--|-------------------------|-------------|----------|---------------|------|-----------------------------------|----------|---------------|--|--|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water | | |
| Field TNT Soil Test | | | | | | | | | | |
| SW8330 Explosives | 1 | | | | - | | | | | |
| SW8330 Nitroglycerin & PETN | 1 | | | | - | | | | | |
| SW8310 PAHs | 1 | | | | - | | | | | |
| Metals ^(a) SW801B/SW87470A, SW7471A | 14 | | | | 2 | | | | | |
| LUFT Mod. SW8015 TEPH-D/MO | | | | | | | | | | |
| LUFT Mod. SW8015 TEPH-K | | | | | | | | | | |
| SW8260B VOCs | | | | | | | | | | |
| E300.0 Nitrate/Nitrite | 1 | | | | - | | | | | |
| E365.2 Total Phosphorous | 14 | | | | 2 | | | | | |
| SW8280 Dioxins/Furans | 1 | | | | - | | | | | |
| Groundwater Chemistry ^(b) | | | | | | | | | | |

Total No. Boring/Sample Locations: 3 borings

Notes:

^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.

^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 300.0, total phosphorous by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 180.1, and total suspended solids (TSS) by EPA Method 180.2; and (2) Field parameters - temperature by EPA Method 170.1, pH by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 180.1.

- = Environmental Protection Agency
- = leaking underground fuel tank
- = polyaromatic hydrocarbons
- = total extractable petroleum hydrocarbons as diesel and motor oil
- = total extractable petroleum hydrocarbons as kerosene
- = volatile organic compounds
- = pentaerythritol tetranitrate

Due to a combination of competing and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site #1, or the wetlands surface water/sediment.

Table 2.9-8
 Summary of Duplicate (QC) Sampling Program
 Demolition Sites

| EPA Test Method | Total Number of Samples | | | | Total Number of Duplicate Samples | | | |
|--|-------------------------|-------------|----------|---------------|-----------------------------------|-------------|----------|---------------|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water |
| Field TNT Soil Test | | | | | | | | |
| SW8330 Explosives | 16 | | | | 2 | | | |
| SW8330 Nitroglycerin & PETN | 2 | | | | - | | | |
| SW8310 PAHs | 16 | | | | 2 | | | |
| Metals ^(a) SW801B/SW87470A, SW7471A | 16 | | | | 2 | | | |
| LUFT Mod. SW8015 TEPH-D/MO | | | | | | | | |
| LUFT Mod. SW8015 TEPH-K | | | | | | | | |
| SW8260B VOCs | | | | | | | | |
| E300.0 Nitrate/Nitrite | 2 | | | | - | | | |
| E365.2 Total Phosphorus | | | | | | | | |
| SW6290 Dioxins/Furans | | | | | | | | |
| Groundwater Chemistry ^(b) | | | | | | | | |

Total No. Boring/Sample Locations: 4 borings

Notes:

^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.

^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 300.0, total phosphorus by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 180.1, and total suspended solids (TSS) by EPA Method 180.2; and (2) Field parameters - temperature by EPA Method 170.1, pH by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 180.1.

- = Environmental Protection Agency
- = leaking underground fuel tank
- = polyaromatic hydrocarbons
- = total extractable petroleum hydrocarbons as diesel and motor oil
- = total extractable petroleum hydrocarbons as kerosene
- = volatile organic compounds
- = pentacythritol tetranitrate

Due to a combination of composting and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site # 1, or the wetlands surface water/sediment.

Table 2.9-9
 Summary of Duplicate (QC) Sampling Program
 South Valley Wetlands, Sediment and Surface Water, Groundwater, and Seeps/Springs

| EPA Test Method | Total Number of Samples | | | | Total Number of Duplicate Samples | | | |
|--|-------------------------|-------------|----------|---------------|-----------------------------------|-------------|----------|---------------|
| | Soil | Groundwater | Sediment | Surface Water | Soil | Groundwater | Sediment | Surface Water |
| Field TNT Soil Test | | | | | | | | |
| SW8330 Explosives | | 3 | 2 | 2 | | 1 | - | - |
| SW8330 Nitroglycerin & PETN | | 3 | 2 | 2 | | 1 | - | - |
| SW8310 PAHs | | 3 | 2 | 2 | | 1 | - | - |
| Metals ^(a) SW601B/SW87470A, SW7471A | | 3 | 2 | 2 | | 1 | - | - |
| LUFT Mod. SW8015 TEPH-D/MO | | | | | | | | |
| LUFT Mod. SW8015 TEPH-K | | | | | | | | |
| SW8260B VOCs | | 3 | | | | 1 | | |
| E300.0 Nitrate/Nitrite | | | 2 | | | | | |
| E365.2 Total Phosphorous | | | 2 | | | | | |
| SW8290 Dioxins/Furans | | | 1 | | | | | |
| Groundwater Chemistry ^(b) | | 3 | | 2 | | 1 | | |

Total No. Boring/Sample Locations: 10 (3 wells, 3 seep/springs, 2 surface water, 2 sediment)

Notes:

- ^(a) California Assessment Manual (CAM) 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, potassium, and sodium.
- ^(b) General water chemistry includes (1) chloride, nitrate/nitrite, sulphate, and orthophosphate by EPA Method 300.0, total phosphorous by EPA Method 365.2, total organic carbon by EPA Method 415.1, total dissolved solids (TDS) by EPA Method 160.1, and total suspended solids (TSS) by EPA Method 160.2; and (2) Field parameters - temperature by EPA Method 170.1, pH by EPA Method 150.1, electrical conductivity by EPA Method 120.1, and turbidity by EPA Method 180.1.

= Environmental Protection Agency

= leaking underground fuel tank

= polyaromatic hydrocarbons

TEPH-D/MO = total extractable petroleum hydrocarbons as diesel and motor oil

TEPH-K = total extractable petroleum hydrocarbons as kerosene

VOCs = volatile organic compounds

PETN = pentaerythritol tetranitrate

Due to a combination of compositing and/or number of samples being collected, no duplicate samples will be collected from the stockpiles, Demolition Site #1, or the wetlands surface water/sediment.

Table 2.10-1. Recommended Sample Container, Preservation, and Holding Times for Selected Analytical Test Methods
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| Parameter | Aqueous Sample Container ^(e) | Field Filter ^(e) | Volume Required | | Preservation ^(b) | | Maximum Holding Times ^{(c)**} |
|---|---|-----------------------------|-----------------|---------------|---|---|---|
| | | | Water (ml)* | Soil (g) | Water | Soil | |
| Metals (SW6010B) | P, G, T | X | 1,000 | 250 | HNO ₃ to pH <2 | Soil 4°C | 6 months |
| Mercury (SW7470A/SW7471A) | P, G, T | X | 1,000 | 10 | HNO ₃ to pH <2 | 4°C | 28 days |
| Total Petroleum Hydrocarbons: TEPH Diesel Kerosene and Motor Oil (Mod SW8015 LUFT) | G, amber, T | | 1,000 | 250 | Cool 4°C | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Volatile Organics (SW8260B) Preparation by SW5030 or SW5035 | G, Teflon™ lined septum, T | | 3 x 40 | 25 for SW5035 | Cool 4°C HCl to pH <2 (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C; and Na ₂ SO ₄ or Methanol for SW5035 | 14 days (7 days for waters if not pH adjusted); 48 hours for soils by SW5035 Encore™ sampler method if unpreserved |
| Polyaromatic Hydrocarbons (SW8310) | G, Teflon™ screw cap, T | | 1,000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Dioxins/Furans (SW8290) | G, Teflon™ screw cap | | 1,000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) store in dark | 4°C | 7 days until extraction, 40 days after extraction |
| Nitroaromatics & Nitroamines and Nitroglycerin/PETN (SW8330) Collect Separate Containers for Nitroglycerin/PETN | G, Teflon™ screw cap | | 1,000 | 50 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soils) until extraction, 40 days after extraction |
| Residue, Filterable (160.1) (TDS) | P, G | | 100 | NA | Cool 4°C | NA | 7 days |
| Residue, Non-Filterable (160.2) (TSS) | P, G | | 100 | NA | Cool 4°C | NA | 7 days |
| Chloride, Sulfate (300.0) | P | | 100 | 50 | Cool 4°C | 4°C | 28 days |
| Nitrate-N, Nitrite-N, Orthophosphate-P (300.0) | P, G | | 100 | 50 | Cool 4°C | 4°C | 48 hours |

Table 2.10-1. Recommended Sample Container, Preservation, and Holding Times for Selected Analytical Test Methods

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| Parameter | Aqueous Sample Container ^(a) | Field Filter ^(b) | Volume Required | | Preservation ^(b) | | Maximum Holding Times ^{(c)**} |
|--|---|-----------------------------|-----------------|----------|---|------|--|
| | | | Water (ml)* | Soil (g) | Water | Soil | |
| Orthophosphate-P (365.2) | P | X | 50 | 50 | Cool 4°C | Soil | 48 hours |
| Total Organic Carbon (415.1, SW9060) | P, G | | 1,000 | 150 | Cool 4°C; H ₂ SO ₄ or HCl to pH <-2 | 4°C | 28 days |
| Electrical Conductivity (120.1)(field) | P, G | | 100 | NA | None Required | NA | Analyze immediately |
| Hydrogen ion (pH) (150.1) (field) | P, G | | 50 | NA | None Required | NA | Analyze immediately |
| Temperature (170.1) (field) | P, G | | 1,000 | NA | None Required | NA | Analyze immediately |
| Turbidity (180.1) (field) | P, G | | 100 | NA | None Required | NA | Analyze immediately |

Notes: * Do not pre-wash bottle with samples.
 ** Extraction holding times are from date of sample collection; analysis times are from date of extraction.
 (a) Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T). Soil samples may be collected in either glass jars or stainless steel liners with both ends sealed with Teflon™ paper and plastic caps.
 (b) Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed.
 (c) Samples should be analyzed as soon as possible after collection. The times listed are maximum times (in calendar days) that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the monitoring laboratory has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period given in the table. The monitoring laboratory is obligated to hold the sample for a shorter period if knowledge exists to show this is necessary to maintain sample stability.
 (d) Should be used only in the presence of residual chlorine.
 (e) For dissolved metals and orthophosphate, the sample shall be filtered in the field through a 0.45-micron filter immediately (within 15 minutes) after sample collection and before sample preservation.

| | | | | |
|---------------------------------------|---|---------------------------------|------|---------------------------------|
| CAM = California Assessment Manual | HNO ₃ | = nitric acid | PAHs | = polyaromatic hydrocarbons |
| C = Celcius | LUFT | = leaking underground fuel tank | PETN | = pentaerythritol tetranitrate |
| EPA = Environmental Protection Agency | ml | = milliliter | TDS | = total dissolved solids |
| ft = feet below ground surface | Na ₂ S ₂ O ₃ | = sodium thiosulfate | TEPH | = total extractable hydrocarbon |
| g = gram | Na ₂ SO ₄ | = sodium sulfate | TNT | = trinitrotoluene |
| HCl = hydrochloric acid | NA | = not applicable | TSS | = total suspended solids |

REFERENCE: This table includes the requirements of the U.S. Environmental Protection Agency, as published in the Code of Federal Regulations, Volume 49, Number 209, 40 CFR Part 136, dated October 26, 1984, page 43260.

Table 2.13-1. Recommended Sample Container, Preservation, and Holding Times for Selected Analytical Test Methods

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| Parameter | Aqueous Sample Container ^(a) | Field Filter ^(e) | Volume Required | | Preservation ^(b) | | Maximum Holding Times ^{(c)**} |
|---|---|-----------------------------|-----------------|---------------|---|--|---|
| | | | Water (ml)* | Soil (g) | Water | Soil | |
| Metals (SW6010B) | P, G, T | X | 1,000 | 250 | HNO ₃ to pH <2 | Soil 4°C | 6 months |
| Mercury (SW7470A/SW7471A) | P, G, T | X | 1,000 | 10 | HNO ₃ to pH <2 | 4°C | 28 days |
| Total Petroleum Hydrocarbons: TEPH Diesel Kerosene and Motor Oil (Mod SW8015 LUFT) | G, amber, T | | 1,000 | 250 | Cool 4°C | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Volatile Organics (SW8260B) Preparation by SW5030 or SW5035 | G, Teflon™ lined septum, T | | 3 x 40 | 25 for SW5035 | Cool 4°C HCl to pH<2 (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C; and Na ₂ SO ₄ or Methanol for SW5035 | 14 days (7 days for waters if not pH adjusted); 48 hours for soils by SW5035 Encore™ sampler method if unreserved |
| Polyaromatic Hydrocarbons (SW8310) | G, Teflon™ screw cap, T | | 1,000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Dioxins/Furans (SW8290) | G, Teflon™ screw cap | | 1,000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) store in dark | 4°C | 7 days until extraction, 40 days after extraction |
| Nitroaromatics & Nitroamines and Nitroglycerin/PETN (SW8330) Collect Separate Containers for Nitroglycerin/PETN | G, Teflon™ screw cap | | 1,000 | 50 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soils) until extraction, 40 days after extraction |
| Residue, Filterable (160.1) (TDS) | P, G | | 100 | NA | Cool 4°C | NA | 7 days |
| Residue, Non-Filterable (160.2) (TSS) | P, G | | 100 | NA | Cool 4°C | NA | 7 days |
| Chloride, Sulfate (300.0) | P | | 100 | 50 | Cool 4°C | 4°C | 28 days |
| Nitrate-N, Nitrite-N, Orthophosphate-P (300.0) | P, G | | 100 | 50 | Cool 4°C | 4°C | 48 hours |

Table 2.13-1. Recommended Sample Container, Preservation, and Holding Times for Selected Analytical Test Methods
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| Parameter | Aqueous Sample Container ^(a) | Field Filter ^(b) | Volume Required | | Preservation ^(b) | | Maximum Holding Times ^{(c)**} |
|--|---|-----------------------------|-----------------|----------|--|------|--|
| | | | Water (ml)* | Soil (g) | Water | Soil | |
| Orthophosphate-P (365.2) | P | X | 50 | 50 | Cool 4°C | Soil | 48 hours |
| Total Organic Carbon (415.1, SW9060) | P, G | | 1,000 | 150 | Cool 4°C; H ₂ SO ₄ or HCl to pH <2 | 4°C | 28 days |
| Electrical Conductivity (120.1)(field) | P, G | | 100 | NA | None Required | NA | Analyze immediately |
| Hydrogen ion (pH) (150.1) (field) | P, G | | 50 | NA | None Required | NA | Analyze immediately |
| Temperature (170.1) (field) | P, G | | 1,000 | NA | None Required | NA | Analyze immediately |
| Turbidity (180.1) (field) | P, G | | 100 | NA | None Required | NA | Analyze immediately |

- Notes:**
- Do not pre-wash bottle with samples.
 - ** Extraction holding times are from date of sample collection; analysis times are from date of extraction.
 - (a) Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T). Soil samples may be collected in either glass jars or stainless steel liners with both ends sealed with Teflon™ paper and plastic caps.
 - (b) Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed.
 - (c) Samples should be analyzed as soon as possible after collection. The times listed are maximum times (in calendar days) that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the monitoring laboratory has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period given in the table. The monitoring laboratory is obligated to hold the sample for a shorter period if knowledge exists to show this is necessary to maintain sample stability.
 - (d) Should be used only in the presence of residual chlorine.
 - (e) For dissolved metals and orthophosphate, the sample shall be filtered in the field through a 0.45-micron filter immediately (within 15 minutes) after sample collection and before sample preservation.
- | | | | | | | | | |
|--------|---|---------------------------------|---|---|-------------------------------|------|---|-------------------------------|
| CAM | = | California Assessment Manual | HNO ₃ | = | nitric acid | PAHs | = | polyaromatic hydrocarbons |
| C | = | Celsius | LUFT | = | leaking underground fuel tank | PETN | = | pentaerythritol tetranitrate |
| EPA | = | Environmental Protection Agency | ml | = | milliliter | TDS | = | total dissolved solids |
| ft bgs | = | feet below ground surface | Na ₂ S ₂ O ₃ | = | sodium thiosulfate | TEPH | = | total extractable hydrocarbon |
| g | = | gram | Na ₂ SO ₄ | = | sodium sulfate | TNT | = | trinitrotoluene |
| HCl | = | hydrochloric acid | NA | = | not applicable | TSS | = | total suspended solids |

REFERENCE: This table includes the requirements of the U.S. Environmental Protection Agency, as published in the Code of Federal Regulations, Volume 49, Number 209, 40 CFR Part 136, dated October 26, 1984, page 43260.

Table 2-14.1. Typical Field Parameters and Measuring Equipment

| Parameter | Equipment (or equivalent) |
|----------------------------------|--|
| Water Conductivity | Cambridge Scientific Hydac pH/EC Meter |
| Water pH | Cambridge Scientific Hydac pH/EC Meter |
| Water Temperature | Thermometer (°C) |
| Water Turbidity | HF Scientific DRT-15C Turbidimeter, or LaMotte Chemical Model 2008 Turbidity Meter |
| Depth to Water | Electric Tape (Sounder) |
| Volume of Discharged Groundwater | Calibrated 5-gallon bucket or flow meter |

EC = electrical conductivity

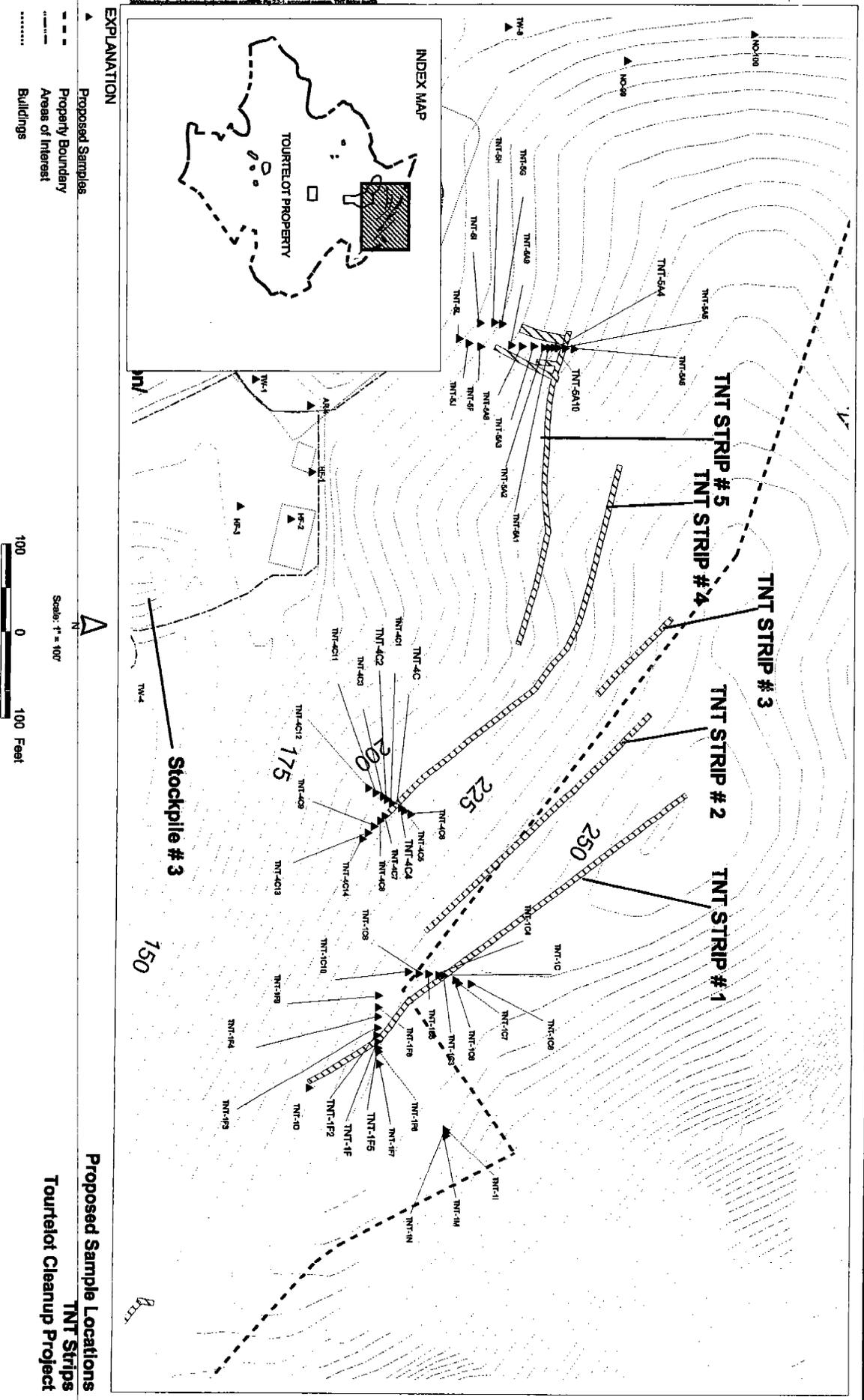
Table 2.14-2. Calibration Check Frequency For Field Test Equipment

| Equipment | Calibration Frequency |
|--------------------------------------|--|
| pH/Conductivity Meter | Calibration check prior to use and at end of day. |
| Thermometer | No field calibration, annual calibration and certification required. |
| Turbidity Meter | Standardization check prior to use and at the end of each day. |
| Electric Tape | No field calibration |
| Container for Measuring Water Volume | Visual inspection before use |

Table 2-14-3. Summary of Field Quality Control Procedures

| Method | Parameter | QC Performed | Frequency ^(a) | Acceptance Criteria | Corrective Action |
|-----------|-----------------------|--------------------|--------------------------|---------------------|---|
| 120.1 | Conductance (aqueous) | Duplicate analysis | 10% | RPD <5% | 1) Obtain third value 2) Recalibrate |
| 150.1 | pH (aqueous) | Duplicate analysis | 10% | ±0.1 pH | 1) Obtain third value 2) Recalibrate |
| 170.1 | Temperature (aqueous) | Duplicate analysis | 10% | ±1.0°C | 1) Obtain third value 2) Use different thermometer |
| 180.1 | Turbidity (aqueous) | Duplicate analysis | 10% | RPD <15% | 1) Obtain third value 2) Recalibrate |
| ASTM D422 | Grain size (soil) | Duplicate analysis | 10% | RPD <10% | 1) Obtain third value |

Note: (a) Frequencies for duplicate samples and field blanks are computed based on the number of samples taken and the number of analyses specified in the FSP.



EXPLANATION

- ▲ Proposed Samples
- - - Property Boundary
- - - Areas of Interest
- Buildings

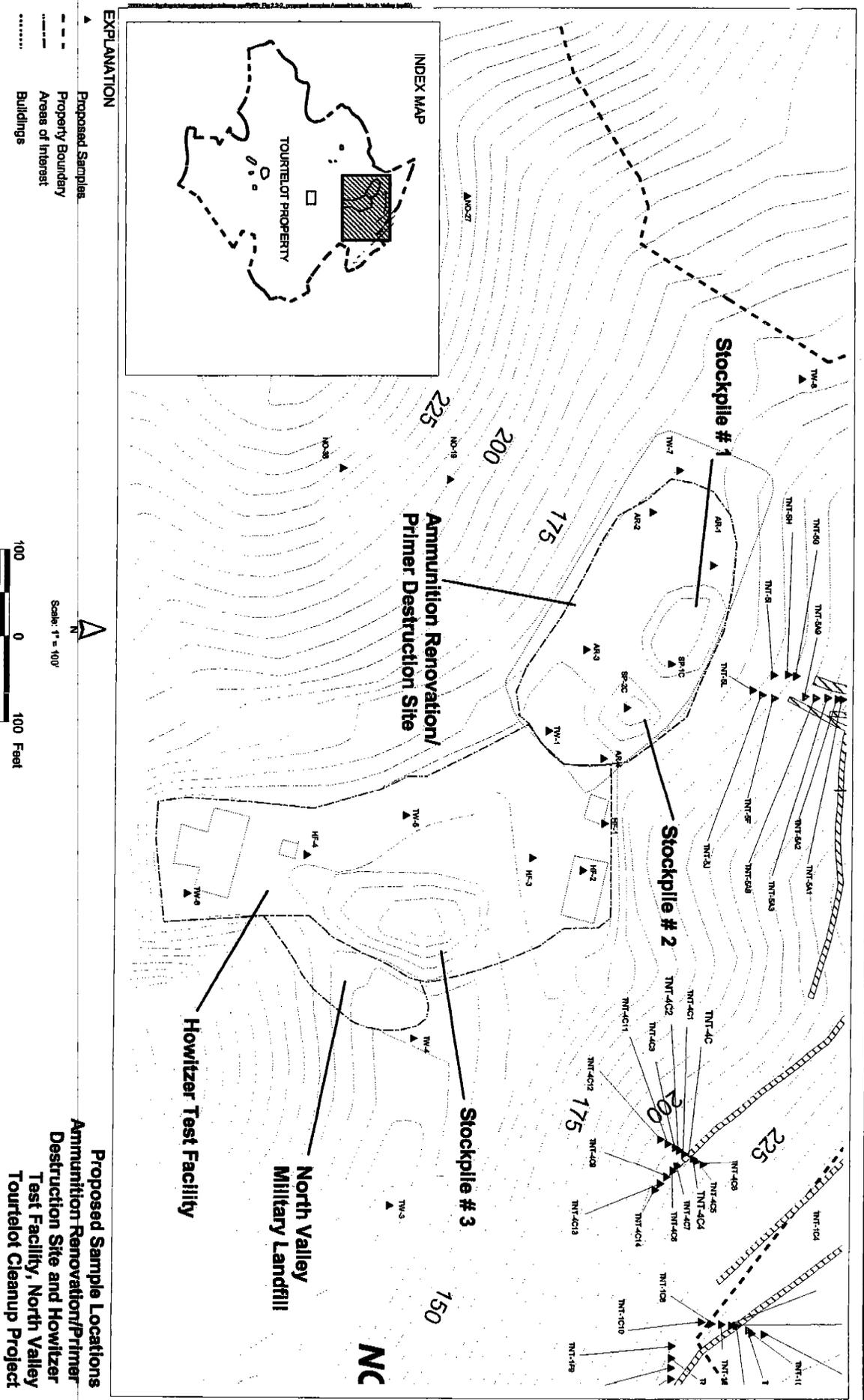


Scale: 1" = 100'

Proposed Sample Locations TNT Strips

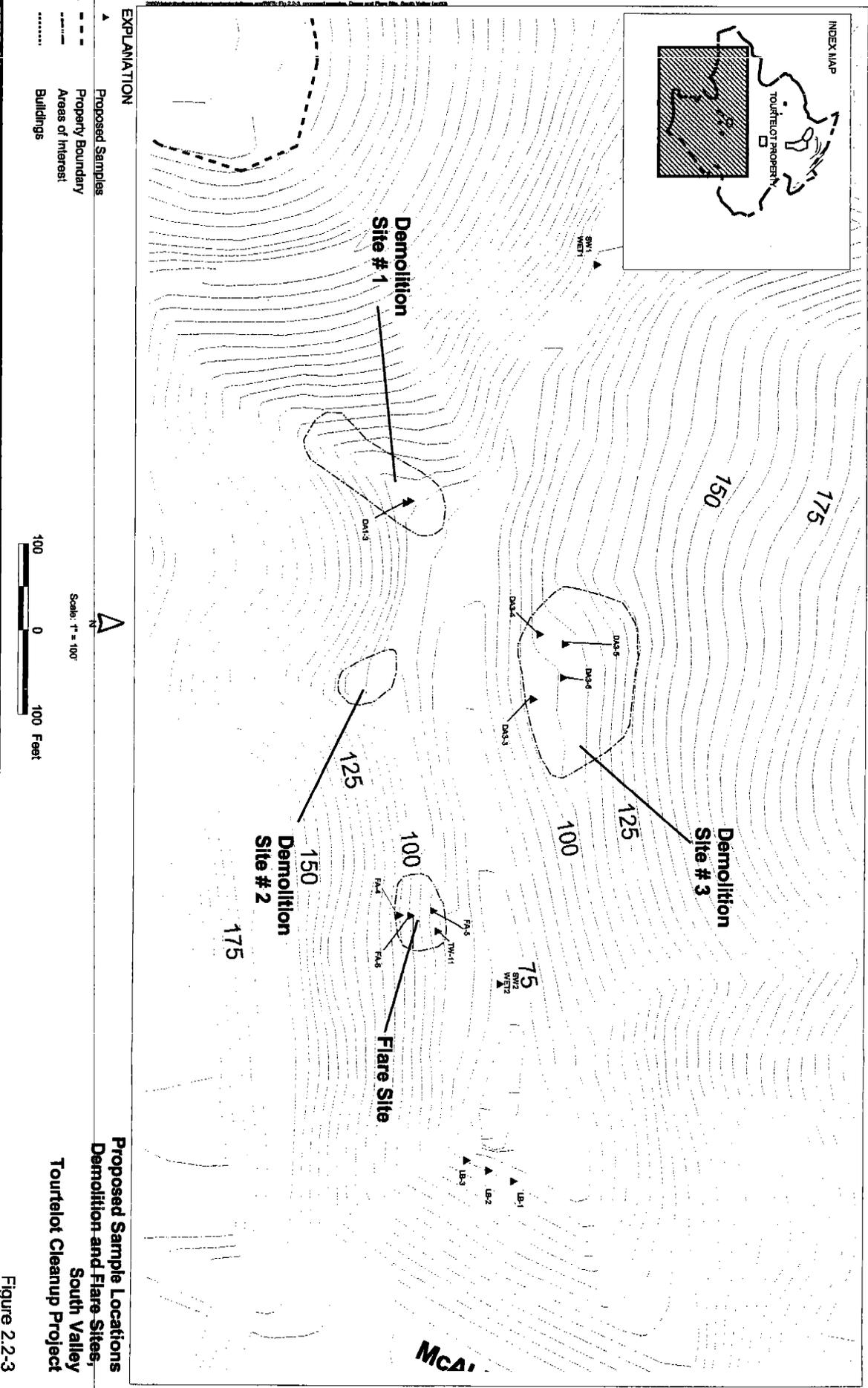
Tourtelot Cleanup Project

Figure 2-2-1



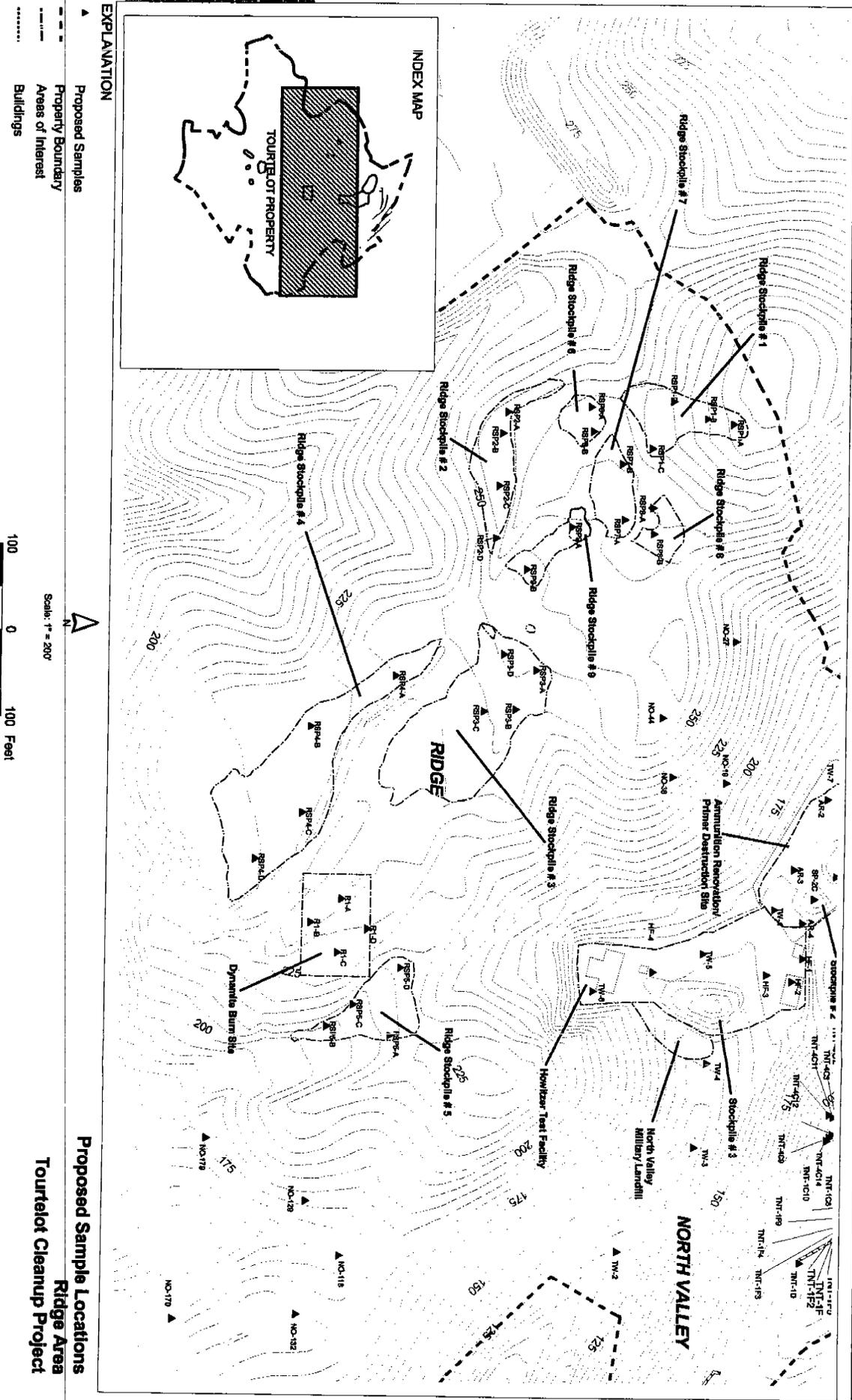
Proposed Sample Locations
Ammunition Renovation/Primer
Destruction Site and Howitzer
Test Facility, North Valley
Tourtlet Cleanup Project

Figure 2.2-2



**Proposed Sample Locations
Demolition and Flare Sites,
South Valley
Tourtelot Cleanup Project**

Figure 2.2-3



EXPLANATION

- ▲ Proposed Samples
- - - Property Boundary
- - - Areas of Interest
- Buildings



Scale: 1" = 200'

**Proposed Sample Locations
Ridge Area
Tourlet Cleanup Project**

Figure 2.2-4

See City Attorney's Office for Full Size
707-746-4216



200 0 200 400 Feet

A horizontal scale bar with alternating black and white segments. The segments are labeled with the numbers 200, 0, 200, and 400, followed by the word 'Feet' at the right end.

Scale: 1" = 200'

Plate 2.2-1

Proposed Sample Locations
for Ordnance and Explosives
Investigation/Feasibility Study
Courtelot Cleanup Project

15 February 2000

3.0 QUALITY ASSURANCE PROJECT PLAN

This document describes the QA and QC procedures for field activities, sampling, analytical, and data management aspects of the work conducted at the Tourtelot Property in Benicia, California (the Project Site), according to the *Non-Ordnance and Explosives Remedial Investigation (RI)/Feasibility Study (FS) Work Plan, Tourtelot Cleanup Project, Benicia, California* (the RI/FS Work Plan), and may be referenced for additional Work Plans for follow-up activities at the Project Site. These procedures will be used to assure accurate, precise, complete, representative, legally defensible, and comparable data for the hazardous, toxic, and radioactive waste (HTRW) investigation efforts.

This QAPP was prepared in accordance with the following EPA guidance for developing QAPPs: *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA QA/R-5, Draft Interim Final, August 1994); *EPA Guidance for Quality Assurance Project Plans* (EPA QA/G-5 Final, August, 1997); and complies with USACE requirements in *EM 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans, September 1994* and *Environmental Data Quality Management Program Specifications, U.S. Army Corps of Engineers (USACE) – Sacramento District, Version 1.08, Draft Final 1999*. This QAPP also complies with the following U.S. EPA guidance on developing and using data quality objectives: *Guidance for the Data Quality Objectives Process* (EPA QA/G-4 Final, September, 1994); *Data Quality Objectives Process for Superfund* (EPA/540/G-93/071, September 1993a); *Guidance for Environmental Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process* (EPA QA/G-2, July 1993b); and *Guidance for Data Quality Assessment* (EPA QA/G-9 QA96 Version, July 1996).

3.1 PROJECT MANAGEMENT

3.1.1 Project Organization and Responsibility

A detailed description of the project organization, including Earth Tech member responsibilities, is presented in Chapter 5.0 of the RI/FS Work Plan. The organizational structure for this project (see Figure 5.2-1 of the RI/FS Work Plan) provides the Project Engineer with a dedicated project team, including project and QC managers, technical and administrative support staff, and subcontracting managers. This section establishes the functional responsibilities of key staff, levels of authority among key participants, and lines of communication for activities affecting quality.

It is the personal responsibility of all Earth Tech and subcontractor personnel involved in field sampling or laboratory analytical procedures to understand and maintain the QCs applicable to their work.

3.1.1.1 Earth Tech Project Personnel.

The project team has been selected to provide the specific technical and management capabilities and qualifications as required by the investigative and/or remedial action tasks. These personnel have appropriate educational qualifications and specific previous project experience on related projects. The project organization will ensure that all project objectives are met in a timely, cost-effective manner. A list of key personnel and their project titles is provided on Figure 5.2-1 of the RI/FS Work Plan.

3.1.1.2 Laboratory Project Personnel.

For definitive-level analyses, Quanterra Incorporated (Quanterra) in West Sacramento, California, has been identified as the primary fixed-base analytical laboratory subcontractor, with mobile laboratory analyses to be performed by ONSITE Environmental Laboratories, Inc. (ONSITE) of Fremont, California.

Quanterra Incorporated (*Severn Trent Laboratories, Sacramento)
880 Riverside Parkway
West Sacramento, California 95605
(800) 522-1275; (916) 373-5600/FAX: (916) 372-1059

ONSITE Environmental Laboratories, Inc.
5500 Boscell Common
Fremont, California 94538
(510) 490-8571/FAX: (510) 490-8572

(Quanterra is being acquired by Severn Trent Laboratories and will be known as Severn Trent Laboratories [STL], Sacramento, starting February 1, 2000.)

Definitive-level special analytical services (SAS) for perchlorate are being subcontracted to S. Babcock & Sons, Inc., in Riverside, California.

E. S. Babcock & Sons, Inc.
6100 Quail Valley Court
Riverside, California 92507
(909) 653-3351/FAX: (909) 653-1662

Additional laboratories may be used for analytical services if such laboratories can meet the requirements, reporting limits, and control limits specified in this QAPP for each method. If a reporting limit or other specified requirement cannot be met, an addendum to this QAPP will be issued. For analytical methods meeting the requirements of this QAPP, notification of the regulators, including the laboratory name, point of contact, and analyses to be performed, will serve as an addendum.

The responsibilities and authorities of key laboratory personnel are discussed in the following paragraphs.

Laboratory Project Manager

The analytical laboratory PM will have ultimate responsibility for analytical performance, including adherence to contract requirements and QC requirements. This individual will serve as the primary laboratory contact person for the client and Earth Tech. This individual will process and record any change in the scope of work, monitor the progress and timeliness of the work, and review work orders and all laboratory reports. The analytical laboratory PM is responsible for ensuring that corrective action is taken to address problems identified by QC sample results or QA audit findings. Diana Brooks has been identified as the project manager for Quanterra/STL.

Laboratory Project Quality Assurance Officer

The laboratory QA Officer has responsibility for development and administration of the project-specific QA/QC program. This role includes preparation of written documents defining QA/QC procedures, review and approval of laboratory QC procedures, supervision of sample control operations, and oversight of interlaboratory testing programs and laboratory certifications. In addition, this individual will submit control samples to the analysts, maintain control charts with warnings and control limits, and evaluate acceptability of control sample results. The laboratory QA Officer will be responsible for spot-checking data sets to ensure that the appropriate QC measures have been taken and for evaluating the effectiveness of the laboratory QA/QC program through audits. Unacceptable findings will be reported to the laboratory PM for follow-up. Gail Celaschi has been identified as the laboratory QA Officer for Quanterra/STL.

Analytical Supervisors

The analytical supervisors will assign tests within the schedule established by the laboratory PM and will closely monitor operations performed by laboratory analysts. Each supervisor is responsible for reviewing and approving data generated by his staff. This review assures that the internal QC criteria have been met and that calculations have been performed properly. No results may be reported without a supervisor's written approval of the data. Quanterra/STL has separate analytical supervisors for different sections of the laboratory.

Mobile Laboratory Supervisor

Peter Balas, Laboratory Vice President for ONSITE Environmental Laboratories, is the point of contact for all analytical activities performed by ONSITE. He will have responsibility for set-up and removal of the laboratory facility and related waste, and for analytical performance including adherence to quality control requirements. He will monitor the progress and timeliness of the work, and

review work orders and laboratory reports. He is responsible for ensuring that corrective action has been taken to address problems identified by QC sample results or QA audit findings.

SAS Laboratory Project Managers

The SAS laboratory PM will have ultimate responsibility for analytical performance, including adherence to contract and QC requirements. This individual will serve as the primary laboratory contact person for the client and Earth Tech. This individual will process and record any change in the scope of work, monitor the progress and timeliness of the work, and review work orders and all laboratory reports. The analytical laboratory PM is responsible for ensuring that corrective action is taken to address problems identified by QC sample results or QA audit findings. Sean Jenkins has been identified as the project manager for E.S. Babcock.

3.1.2 Project Definition and Background

The project description, including site history; site, location, and area maps; geology/hydrology; and sampling locations, is included in Chapter 1.0 of the RI/FS Work Plan.

3.1.3 Project Description

The purpose of this project is to outline methods and procedures for characterizing the nature and extent of HTRW at the Project Site. The data collected during this investigation will be used to quantify the volume of, and assess remedial measures for, potential HTRW. The objective of remediating the site is to remove all HTRW, thus making the site completely safe and suitable for residential land use. A detailed description of the project is included in Chapter 1.0 of the RI/FS Work Plan. Additional project descriptions detailing follow-up activities at the Project Site may be specified in Work Plans for which this QAPP may be referenced.

3.1.4 Data Quality Objectives

The primary function of field sampling and measurement is to generate data of quantity and quality sufficient to support project decision-making. To achieve this goal, DQOs will be employed for this project to determine the type, quantity, and quality of project data that needs to be collected. The DQO development process is described in the EPA guidance documents entitled *Guidance for the Data Quality Objectives Process* (EPA QA/G-4 Final, September 1994) and *Data Quality Objectives Process for Superfund* (EPA/540/G-93/071, September 1993). DQOs are qualitative and quantitative statements developed by data users to specify the quality and quantity of data from field and laboratory data generation activities required to support project decision making or regulatory actions, while

minimizing data collection expenditures by defining data requirements and acceptable levels of decision errors during the planning stage of projects.

The DQO process provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when and where to collect samples, the tolerable level of decision errors for the study, and how many samples to collect. The final product of the DQO process is a data collection design that meets the quantitative and qualitative needs of the study.

To evaluate the data using the DQO process, it is necessary to have first established decision quality criteria using the DQO process or its equivalent. DQOs for field record and analytical data QA/QC are included in this QAPP. These DQOs define criteria for valid and defensible data, and include all of the elements and objectives for data quality specified throughout the QAPP. DQOs for environmental assessment are included in Section 2.1.1 of the Field Sampling Plan, Chapter 2.0 of the RI/FS Work Plan (the RI/FS FSP). These DQOs include the remaining elements and objectives in the DQO process, such as sampling locations, number of samples collected and analyses performed, criteria for interpretation of the data, and statistical analysis (if required) of the data. Additional DQOs for follow-up activities at the Project Site may be specified in the appropriate sections of Work Plans for which this QAPP may be referenced.

3.1.4.1 The Seven-Step DQO Process.

The DQO process involves the following seven steps:

1. Problem Statement. Summarize the problem that requires environmental data acquisition and identify the resources available to resolve the problem.
2. Decision Identification. Identify the decision that requires acquisition of environmental data to address the problem. Identify the intended uses of data projected to be acquired. Data uses shall be prioritized.
3. Identification of Decision Input. Identify the information needed to support the decision and specify the inputs requiring environmental measurements.
4. Definition of Study Boundaries. Specify the spatial and temporal aspects of the environmental media that the data must represent to support the decision.
5. Decision Rule. Develop a logical statement that defines the conditions that would cause the decision-maker to choose among alternative actions.

6. Limits on Decision Error. Specify the decision-maker's acceptable limits on decision errors, which are used to establish appropriate performance goals for limiting uncertainty in environmental data.
7. Optimization of the Data Collection Design. Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy project DQOs.

The seven steps of the DQO process for this project are specified in Section 2.1.1 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

3.1.4.2 Definition of Data Quality Criteria.

The quality of analytical data is measured through the use of data quality criteria, which include accuracy, precision, completeness, representativeness, comparability, and sensitivity.

Accuracy. Accuracy is the degree of agreement of a measurement or average of measurements with an accepted reference or "true" value. Accuracy is a measure of bias in the system.

Accuracy of the measurement data will be assessed and controlled as follows. Results for blank, matrix, laboratory control, and surrogate spikes will be the primary indicators of accuracy. Accuracy for organic analyses shall be evaluated through the collection and analysis of matrix spike (MS)/matrix spike duplicate (MSD) samples, laboratory control samples (LCSs), and by spiking all samples with surrogate compounds where applicable. Accuracy for inorganic analyses shall be evaluated through the collection and analysis of MS samples and LCSs. Only samples from this project will be used for MS/MSD procedures. Trip blanks and rinsate samples will not knowingly be used for MS/MSD analyses. These results will be used to control accuracy within acceptable limits by requiring that they meet specific criteria. As spiked samples are analyzed, spike recoveries will be calculated and compared to pre-established acceptance limits.

Acceptance limits will be based upon established laboratory capabilities for similar samples using control chart techniques. In this approach, the control limits reflect the minimum and maximum recoveries expected for individual measurements for an in-control system. Recoveries outside the established limits indicate some assignable cause, other than normal measurement error, and need for corrective action. This includes recalibration of the instrument, reanalysis of the QC sample, the samples in the batch, or flagging the data as suspect if the problems cannot be resolved. For highly contaminated samples, recovery of MSs may depend on sample homogeneity.

Precision. Precision is a measure of mutual agreement among individual measurements of the same property under prescribed similar conditions. Precision is independent of the error (accuracy) of the analyses and reflects only the degree to which the measurements agree with one another, not the degree to which they agree with the "true" value for the parameter measured.

Precision of the measurement data for this project will be based upon duplicate analyses (replicability), control sample analyses (repeatability), and results for duplicate field samples (sampling replicability). Field duplicates are defined as two samples collected independently at a single sampling location during a single act of sampling for analysis at one laboratory for each specified method. Field duplicates will be collected for groundwater samples using separate bailers and will be analyzed for all parameters. Field duplicate soil samples will generally be collected from a single liner or from two adjacent sample liners collected at one borehole or sampling location during a single act of sampling. Field duplicates will be treated as separate samples and will undergo sample preparation and analysis for the same analytes at one laboratory for each specified method. Field duplicate soil samples will number 10 percent of the original sample number on a project-wide basis (rather than a sampling round basis).

Discretely sampled field duplicates are useful in determining sampling variability. However, greater than expected differences between duplicates may occur because of variability in the sample material. In these instances, a visual examination of the sample material will be performed to document the reason for the difference. Field duplicates will be used as a quality control measure to monitor precision relative to sample collection activities. Analytical precision will be evaluated by using MS/MSD samples, duplicate LCSs/laboratory control duplicates (LCDs), or by using sample duplicates.

Precision is calculated in terms of Relative Percent Difference (RPD), which is expressed as follows:

$$RPD = \frac{|X_1 - X_2|}{(X_1 + X_2)/2}$$

where X_1 and X_2 represent the individual values found for the target analyte in the two replicate analyses. RPDs must be compared to the laboratory-established RPD for the analysis. Precision of duplicates may depend on sample homogeneity.

The analyst or his supervisor must investigate the cause of data outside stated acceptance limits. Follow-up action includes recalibration, reanalysis of laboratory QC samples, sample reanalysis, or flagging the data as suspect if problems cannot be resolved.

Completeness. Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under correct, normal conditions. The overall assessment of completeness is the extent to which the database resulting from a measurement effort fulfills objectives for the amount of data required.

Completeness is generally defined as the valid data percentage of the total tests requested.

$$\text{Completeness(\%)} = \left(\frac{\text{number of valid analyses per method}}{\text{number of requested analyses per method}} \right) \times 100$$

Valid analyses are defined as those where the sample arrived at the laboratory intact, properly preserved, in sufficient quantity to perform the requested analyses, and accompanied by a completed COC form. Furthermore, the sample must be analyzed within the specified holding time and in such a manner that analytical QC acceptance criteria are met to the degree that the result is usable for decision-making purposes.

Completeness for the entire project also involves completeness of field and laboratory documentation, whether all samples and analyses specified in the FSP have been processed, and whether they were processed according to the procedures specified in the Work Plan and laboratory standard operating procedures (SOPs). Therefore, completeness will be evaluated in terms of four goals to be calculated and discussed in the quality control systems report (QCSR) with regard to project goals: technical completeness, analytical completeness, field sampling completeness, and contractual completeness.

Technical completeness is defined as the ratio of usable sample results to all sample results. The goal for technical completeness is 95 percent. Usable results are results that are not rejected. Results qualified as estimated are considered usable unless the qualification compromises the ability of the result to be used for decision making purposes.

Analytical completeness is defined as the ratio of unqualified sample results to all sample results. The goal for analytical completeness is 90 percent.

Field sampling completeness is defined as the ratio of collected samples to the total number of samples planned. The goal for field completeness is 100 percent.

Contractual completeness is defined as the ratio of contractually compliant sample analyses to the total number of tests requested of the laboratories. The goal for contractual completeness is 100 percent. In addition, the goal for sample analyses within maximum holding time is 100 percent. All samples identified as critical to project decision-making objectives must meet 100-percent completeness.

The completeness goals will be evaluated qualitatively as well as quantitatively. The quantitative evaluation of completeness will be determined according to the foregoing definitions. The qualitative evaluation of completeness will evaluate the impacts of each of the completeness goals on the DQOs for the project, including all events contributing to the sampling event and the effects of incomplete data. Technical and analytical completeness will include the percentage of contract laboratory-controlled QC parameters that are acceptable. QC parameters that shall be assessed for quantitative determinations of completeness shall include initial and continuing calibrations, surrogate percent recovery for organic analyses, analysis of laboratory duplicates for RPD, analysis of MS/MSD analyses for percent recovery and RPD, analysis of LCS for percent recovery, and holding times. The completeness standard shall be applied to the entire list of parameters described previously for each analytical method with acceptable QC criteria as described previously and in other chapters of this document. The quantitative assessment of completeness shall be calculated for each analytical method as the ratio of acceptable sample results to all sample results.

Representativeness. Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

The characteristics of representativeness are usually not quantifiable. Subjective factors to be taken into account are as follows:

- Degree of homogeneity of a site
- Degree of homogeneity of a sample taken from one location in a site
- Available information on which a sampling plan is based.

Sampling replicability, as defined under precision, is also used to assess representativeness. Two samples collected at the same location and at the same time are considered to be equally representative of this condition at a given point. To maximize representativeness of results, sampling techniques, sample size, and sampling locations will be carefully chosen in order to provide laboratory samples representative of the site and the specific area. For instance, properly installed monitoring wells ensure that the water being sampled originates from the aquifer of concern. Care must be taken to ensure proper stabilization of measured water parameters, clarity, and color before groundwater samples are taken. Precautions such as not operating combustion engines near a well during sampling must be taken so that introduction of extraneous compounds does not threaten the representativeness of the samples. Soil and sediment samples are even less homogeneous than water; consequently, it is important for the sampler and analyst to exercise good judgment when removing a sample. Samples exhibiting obvious stratification or lithologic changes should not be used as replicates. Within the laboratory, precautions are taken to extract from the

sample container an aliquot representative of the whole sample. This includes premixing the sample and discarding pebbles from soil samples. For samples requiring analysis of VOCs, premixing or homogenizing should be kept to a minimum.

Comparability. Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved sample collection techniques and analytical methods, consistency in the basis of analysis (e.g., wet weight, volume), consistency in reporting units, and analysis of standard reference materials.

Data comparability will be achieved by using standard units of measure (i.e., micrograms per liter [$\mu\text{g/L}$] for metals and inorganics in water samples, $\mu\text{g/L}$ for organics in water, and mg/kg [dry weight] for both inorganics and organics in soil samples).

The use of standard methods to collect and analyze samples, along with instruments calibrated against Standard Analytical Reference Materials (SARM), which are NIST-traceable standards, will also ensure comparability.

Comparability also depends on the other data quality characteristics. Only when data are judged to be representative of the environmental conditions, and when precision and accuracy are known, can data sets be compared with confidence.

Sensitivity. Quantitation limits are based on the extent to which the equipment, laboratory or field, or analytical process can provide accurate, minimum data measurements of a reliable quality for specific constituents in actual field samples. The actual quantitation limit for a given analysis will vary depending on instrument sensitivity and matrix effects. PQLs and MDLs are defined in Section 3.2.4.2. Data will be reported on a dry-weight basis, and MDLs and PQLs will be adjusted accordingly for each sample. The minimum project requirements have been considered when setting the quantitation limits for this project. Analytical laboratories used for this project may use laboratory-specific PQLs as long as the PQLs are less than or equal to the PQLs specified in this QAPP (see Section 3.2.4.2 and Table 3.1-1).

3.1.4.3 Quantitative Laboratory Data Quality Objectives.

Project analytical DQOs are quantifiable for accuracy, precision, and completeness. Accuracy and precision are specified for laboratory analyses as acceptance criteria, which are discussed in Section 3.2.5.2. QC procedures and control limits are discussed, and summary tables for acceptance criteria are presented in Section 3.2.5.3. Procedures used to assess data precision, accuracy, and completeness are presented in Section 3.2.5.4.

3.1.4.4 Appropriate Analytical Levels.

Two descriptive data categories, screening data and definitive data, have been developed and are described in the EPA document, *Data Quality Objectives Process for Superfund* (EPA 540-R-93-071, September 1993). These data categories are associated with the type of site, level of precision and accuracy required, and intended use of the data (i.e., the type of data to be generated depends on the qualitative and quantitative DQOs developed for the project). Only definitive data are expected to be used for this project. However, screening-level analyses may be used if they provide information that allows more cost-effective and/or rapid generation of definitive data (i.e., allowing project managers to focus or redirect project resources while equipment and personnel are deployed in the field, thus efficiently aiding in meeting project DQOs). Field assay detection of TNT may be used, as described in Section 2.8 of the RI/FS FSP. Any additional screening methods will be included in or added to the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

Definitive data are generated using rigorous analytical methods, such as approved EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined. Definitive data must meet the data reporting criteria specified in Section 3.1.6.3.

Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantification, although the quantification may be relatively imprecise. Screening data based on fast turn-around-time (TAT) of analyses by methods referenced in this QAPP must meet the minimal QA/QC requirements specified in the method. At least 10 percent of the screening data are confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality.

3.1.5 Special Training Requirements/Certification

All Earth Tech and subcontractor project personnel will be qualified and adequately trained to perform the work which they are assigned. The PM will determine the minimum qualifications and training required for project personnel. Copies of personnel qualifications and training received will be maintained in training files by the responsible supervisor. The Earth Tech FTL and laboratory PM, or their respective designees, will document, prior to the start of work, that all

field and analytical personnel have received, read, and understood all procedures pertinent to the work that project personnel are assigned to perform.

Training for the HTRW investigation and any follow-up activities at the Project Site will include:

- Briefings on site-specific technical and quality issues and procedures as they relate to each worker's duties. Examples include project mission, objectives and quality requirements, sampling and shipping protocols, COC requirements, project safety and biological/cultural resources issues.
- Documentation of experience or training for specific field equipment to be operated by workers. This includes operation, field calibration (as applicable), and maintenance/repair.

Personnel training will be reviewed by the PM to ensure that the training is appropriate, adequate, and current.

3.1.6 Documentation and Records

3.1.6.1 Laboratory Documentation.

In most cases, calculations from raw data are included in discussions of analytical procedures presented in the EPA methods. These data reduction and validation procedures will not be repeated herein. Details of data reduction, validation, and reporting not addressed elsewhere are discussed in this section.

Calculations. Data reduction calculations used for this project are typically included on the standard reporting forms developed by the laboratories and associated with each individual method or group of methods. Calculations not covered on the standard reporting forms include computer-based data reduction programs. The laboratory is responsible for maintaining a listing of these data reduction programs and for being able to demonstrate their validity. The complete calculation procedures used in computer-based data reduction programs (e.g., gas chromatography [GC]/mass spectrometry and GC analyses) are based on the calculation procedures specified in each method and will not be covered herein.

Some instruments are configured to operate independently and without computers. For these, the signal is recorded as a strip chart trace, numerical output on a printer strip, or direct reading from a digital or analog dial. In such cases, additional work is required by the analyst to reduce the data to a reportable format. The original signal must be multiplied by a calibration factor or compared with a standard curve. The aliquot result must be divided by the mass or volume of sample to produce a concentration-based final result. Most calculations are carried out on hand-held scientific calculators; simple programs

are used for some. All of these data are recorded in a dedicated bench book for the particular determination in question. Results for single- or multiple-component tests are hand entered by the analyst in the assigned book.

Some laboratory tests, such as titrations or sensory evaluations, are not instrumented. For these, the quantitative result or observation is recorded directly in a bound book by the assigned analyst. Calculations like those described above may be needed; these are recorded in the same book.

Unless otherwise specified, all data will be calculated and reported in units consistent with other organizations reporting similar data to allow comparability of databases among organizations. Data will be reported in $\mu\text{g/L}$ for organics (except total petroleum hydrocarbon [TPH] methods); milligrams per liter [mg/L] for TPH methods, metals, and inorganics in aqueous samples; and mg/kg (dry weight) for soils. Dioxins and furans will be reported in nanograms per liter (ng/L) for aqueous samples and $\mu\text{g/kg}$ (dry weight) for solid samples.

Data Integrity. Data integrity during collection and reporting of data will be assured through use of approved data forms and bound logbooks. The forms and logbooks will be signed and dated and checked by another equally competent person. Changes to documentation must be dated and initialed, and files of data secured. The same principles will be followed for both field and laboratory data. The integrity of databases will be assured by limited access. Corrective actions will be implemented and documented when data or instrumentation do not meet criteria. The tables specifying calibration and internal procedures include specific corrective actions and requirements.

Treatment of Outliers. Control charts and calibration curves will be used to review the data and identify outlying results. QC charts are prepared from laboratory control samples. Control limits are statistically calculated from a minimum of 20 data points. Control limits are set as the mean ± 3 standard deviations. Results that are more than 3 standard deviations from the mean are "out of control" and are cause for immediately halting the analysis and investigation.

Warning limits are at the mean ± 2 standard deviations. Results exceeding the warning limits but not the control limits alert the analyst to a potential problem. Sample results are accepted, but the procedures and standards are checked. If the LCS exceeds the acceptance criteria, the analyst will stop work on the analysis. The analyst and supervisor will investigate potential causes of the problem. After the cause is determined and corrected, samples from the original set may be reanalyzed along with duplicate spiked samples and a LCS after the impact on the data generated has been assessed.

All QC information will be recorded in the notebooks and printouts in the same format used for sample results. It is the analyst's responsibility to check the QC information against limits for the analysis. When an analysis of a QC sample

(blank, spike, check standard, replicate, or similar sample) shows that the analysis of that batch of samples is not in control, the analyst will immediately bring the matter to the attention of the supervisor. The supervisor will, if necessary, consult with the laboratory QA Officer and/or the laboratory PM to determine whether the analysis can proceed, or if selected samples should be rerun, or if specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses must be documented by the supervisor. The analyst or supervisor will file a corrective action report with the laboratory QA Officer.

Laboratory Data Management. When the laboratory receives and logs in the contents of the shipping containers, the laboratory's sample custodial supervisor or the laboratory PM will log the sample information into the Laboratory Information Management System (LIMS). As analyses proceed, additional data for all analyses will be maintained in the LIMS. Upon completion of all analyses, the laboratory will produce an electronic data deliverable (EDD) in the required format for delivery with the hard copy data package to the Earth Tech project chemist.

Data Archive. Data storage and documentation will be maintained using logbooks and data sheets that will be kept on file. All computer-acquired/generated raw data are stored on magnetic tape, floppy disk, or other required media format, and the paper hard copies are kept on file in the job folders at the laboratories for 5 years. The central file for the sampling and analytical effort will be maintained by Earth Tech in the Colton office for a period of 5 years after the final report is issued.

3.1.6.2 Field Documentation.

Field data documentation includes bound field notebooks and data sheets, such as borehole logs, well completion logs, and field parameter stabilization forms. Field personnel record all on-site measurements and field observations (e.g., all pertinent sampling information, equipment calibration). Use of COC forms ensures that the sample is controlled at all times and that transfer of control is properly documented. Sample collection and COC requests for analysis should conform with specified requirements for sample preservation, container, and holding time requirements summarized in Table 3.1-2, which is reproduced as Table 2.10-1 of the RI/FS FSP, and may be updated to include additional methods in the appropriate tables for Work Plans for which this QAPP may be referenced. Field data requirements and procedures are specified in Section 2.18 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

3.1.6.3 Data Reporting.

Field data reporting includes reporting of field data documentation specified in the previous section and in Section 2.18 of the RI/FS FSP, or in the appropriate

sections of Work Plans for which this QAPP may be referenced. All field data will be reviewed by the FTL and forwarded to the QCSM or project chemist for review, validation, and storage with the project files in the Earth Tech Colton office.

Laboratory data reporting is an extensive activity beginning with a department report of reviewed data compiled into a complete data package, and finalized by laboratory PM/project QA review and approval. Upon completion of data review at all levels, and subsequent clerical preparation and final typographical review, reports are signed by the laboratory PM and/or designate. The project analytical laboratory will provide several types of definitive level data reporting, including:

1. Electronic data files in ASCII files that are importable into the Earth Tech database. Any laboratory subcontracting analyses to other approved laboratories is responsible to ensure that acceptable EDDs are provided for those analyses unless otherwise specified in the contract with Earth Tech. Files for reference in configuring EDDs are available from the Data Coordinator.
2. Hard copy analytical data packages with results in the form of Comprehensive Certificates of Analysis (considered equivalent to EPA Level III for definitive analyses), which will include the following:
 - (a) The original of the signed COC form and cooler receipt form documenting receipt in laboratory.
 - (b) A cross-reference of field sample number to laboratory sample number.
 - (c) A cross-reference to identify all applicable laboratory QC samples with the field sample.
 - (d) A glossary to define the symbols and terms used in the laboratory report.
 - (e) Sample collection, extraction, and analysis dates for each sample (may be included on the sample summary results forms).
 - (f) PQLs, MDLs, and dilution factors for each sample (may be included on the sample summary results forms).
 - (g) A reference for the analytical methodology used (may be included on the sample summary results forms).
 - (h) A case narrative that discusses the QA/QC results and the corrective actions taken whenever laboratory control limits are exceeded. Any other problems that affect data quality will also be discussed.

- (i) Sample results summary reports (the analytical results for the sample), including the date of analysis, analytical method used, sample results reporting each analyte as a detected concentration or as less than the detection limit, reporting limits, MDLs, dilution factors, surrogate recoveries (where applicable), laboratory qualifier flags, and adequate information to correlate the analytical results to the run log such as the time and date, instrument identification and/or file identification for GC and GC/mass spectrometry. PQLs and MDLs will be corrected for the dilution factor.
- (j) Sample results for GC analyses of fuels by California LUFT modified EPA Method SW8015B will include the chromatograms and quantitation reports for all reported field samples.
- (k) QA/QC summary reports providing data on method blanks, check samples, surrogate recoveries, internal standard areas, laboratory duplicates, MS/MSDs, LCSs, serial dilution results (EPA Method SW6010B), whichever are applicable to the particular method. QA/QC summary reports will also list laboratory qualifier flags (or a flag to indicate that the result exceeds the QC limit, such as an asterisk), laboratory control limits, and definitions of laboratory qualifiers.

Method blank results will report any detected concentration for all analytes in the method. The QA/QC summary report will also list laboratory control limits and discuss the corrective actions taken whenever laboratory control limits are exceeded. Any other problems that affect data quality will also be discussed.

- (l) For EPA Method SW8290, the 2,3,7,8-tetrachlorodibenzo-dioxin (TCDD) toxicity equivalence factors (TEFs) will be reported in addition to the individual analyte results (see the method description in Section 3.2.4.2 for further details).
- (m) Results of initial and continuing calibrations clearly correlating the sample analyses with the associated calibration check samples. This will include initial calibration (ICAL) summary worksheets, including time, date, instrument identification, file identification, response factors (RFs), percent relative standard deviation (RSD) or correlation coefficient (r); and continuing calibration verification (CCV) reports or worksheets including time, date, injection number, true value (or ICAL average RF), found value (or RF), and percent difference (%D), as appropriate. Instrument tuning results will be reported on summary sheets with required criteria for GC/mass spectrometry methods.

- (n) Sample preparation logs or worksheets and injection or analytical run logs.
- (o) For all methods, each analysis will be performed at and reported from the lowest possible dilution free of interference. For metals by EPA Method SW6010B and other multi-analyte inorganic methods, results for analytes requiring dilution due to exceeded calibration range, detector saturation, or associated wavelength interference will be reported from the diluted analysis as required, while all other analytes will be reported from the undiluted analysis. When analyses for organic analyses are performed at more than one dilution to quantitate compounds within the calibration range, results for each analysis will be reported, including associated QC results.

Raw data packages (considered equivalent to EPA Level III for definitive analyses) will be provided for 10 percent of the data. The raw data packages will include all information specified above for the hard copy analytical data packages, plus the raw data generated from each analytical method performed, including chromatograms, mass spectra, and instrument-generated quantitation reports, or bench sheets, worksheets, and calculation sheets. In addition, printouts for all manual integrations for GC/mass spectrometry methods will be included in the raw data packages. Earth Tech will specify project sample groups to be reported with raw data packages on the COC/request for analysis forms.

Laboratories reporting screening-level data will provide data that will consist of the following:

- A copy of the signed COC record and sample receiving records indicating the date and time of sample receipt in laboratory.
- Adequate information to cross-reference field sample numbers to laboratory sample numbers and to identify applicable laboratory QC samples with the field samples.
- Summary forms which include the analytical method used, date of extraction (if applicable), date of analysis, sample results, detection limits or reporting limits, surrogate recoveries (where applicable), laboratory qualifier flags, and definitions for laboratory qualifiers.
- QA/QC summary reports providing data on method blanks, laboratory duplicates (if applicable), MS/MSD recoveries, LCS recoveries, and other QC required in the referenced analytical method. QA/QC summary reports shall also list laboratory qualifier flags (or a flag to indicate that the result exceeds the QC limit, such as an asterisk), laboratory control limits, and summarize definitions of laboratory qualifiers.

- Sample results for GC analyses of fuels by California LUFT modified EPA Method SW8015B will include the chromatograms and quantitation reports for all reported field samples.
- For GC analyses (with the exception of multicomponent analyses such as for California LUFT Modified EPA Method SW8015B), confirmation summary reports with primary and confirmation results for confirmed hits.
- EDDs if applicable and requested.

3.2 MEASUREMENT/DATA ACQUISITION

3.2.1 Sampling Process Design

A detailed discussion of the sampling design, sample types and matrices, and sampling frequencies is provided in Section 2.2 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

3.2.2 Sampling Methods Requirements

Detailed discussions of the sampling methods requirements, including investigation location clearance, drilling, well installation, water level measurement, sample collection, and decontamination, are provided in the FSP. EPA Methods to be used for field analyses are summarized in Section 3.2.4.1 of the QAPP. Specific requirements for the use of these methods are included in Section 2.7 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

3.2.3 Sample Handling and Custody Requirements

3.2.3.1 Sample Collection.

A detailed discussion of sampling collection protocols is provided in Section 2.7 of the RI/FS FSP, with sample preservation requirements presented in Section 2.10 of the RI/FS FSP. Sample preservation, container, and holding time requirements are summarized in Table 3.1-2. Field QC is summarized in Section 3.2.5.1 of the QAPP and discussed in detail in Section 2.9 of the RI/FS FSP. Documentation of field sampling activities is discussed in Section 2.18 of the RI/FS FSP. To maintain sample integrity, all requirements in the above-referenced sections of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced, must be followed and documented.

In an effort to control common problems (e.g., labeling errors, COC errors, preservation failures), Earth Tech provides training for field personnel in the proper execution of these procedures, as well as concurrent review by QA personnel. Daily communication with field personnel and the laboratory is also

part of these preventative measures. Corrective action is discussed in Section 3.3.2.4 of this QAPP.

3.2.3.2 Field and Laboratory Sample Custody.

Field Operations. Sample custody procedures are based on EPA-recommended procedures that emphasize careful documentation of sample collection and sample transfer. To ensure that all of the important information pertaining to each sample is recorded, the documentation procedures detailed below and in the referenced sections of the FSP will be executed and reviewed for compliance in the data quality assessment (refer to Section 3.3.3 of the QAPP).

Sample Identification. The field sample identification numbers will be designated by a three-part code. The field sample numbering system is described in Section 2.11.2 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

Samples are identified by a sample label that will be affixed by the sampler to the sample container used, as described in Section 2.11.3 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

Sample Packaging and Shipping. All samples will be packaged carefully to avoid breakage or contamination, and will be shipped to the laboratory at proper temperatures. Shipping time will be minimized to prevent holding time violations. The sample packaging and shipping requirements are specified in Section 2.11.4 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

Sample Custody in the Field. Procedures to complete COC records are described in Section 2.18.2 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced. To maintain and document sample custody, the following COC procedures will be strictly followed. A sample is considered to be under custody if:

- It is an actual possession of the responsible person
- It is in view, following physical possession
- It is in the possession of a responsible person and is locked or sealed to prevent tampering
- It is in a secure area.

Laboratory Operations. All sample log-in, storage, and COC documentation are the responsibility of the sample control supervisor, who is responsible for retaining shipment documents and verifying data entered into the sample custody records. In addition, the sample control supervisor will ensure that sample storage is secure and maintained at the proper temperature.

When the laboratory receives and logs in the contents of the shipping containers, the laboratory's sample control supervisor or the laboratory PM will fax the sample log-in summary with completed cooler receipt forms and COC Records to Earth Tech's QCSM or project chemist within 24-48 hours. The cooler receipt forms shall be used by the laboratory for each cooler to verify sample condition, (e.g., including proper sample containers, volumes, preservation) and to document any problems noted.

Earth Tech's QCSM or project chemist will verify the completeness of the shipment, the accuracy of sample information, and coordinate with the laboratory to confirm that there is adequate sample volume for planned analyses. If a problem arises, Earth Tech's QCSM or project chemist will coordinate a solution with the Earth Tech field team, the laboratory PM, and the party that shipped the samples.

Sample Handling. Upon receipt in the laboratory, the integrity of the shipping container will be checked by verifying that the custody seal is not broken. The temperature of the temperature blank will be measured and preservation of samples checked (except for volatiles); the samples will be checked for breakage, leakage, damage, and the contents of the shipping container verified against the COC documentation. Documentation of custody seal integrity, temperature, and sample preservations will be made on the cooler receipt form. Samples must be received at a temperature of 6°C or less, but not frozen.

Any problems will be documented on the COC form or on a sample control communication form, and the Earth Tech PM is to be contacted immediately. The sample custodian will document the following:

- Date of sample receipt
- Source of sample
- Sample accession number
- Analytical test requested
- Matrix
- Number of samples
- Final disposition of sample (after final data validation and acceptance by client).

Samples will be placed in the appropriate 4°C sample refrigerator. Aqueous samples for metal analyses do not require refrigeration at 4°C. Information about samples with suspected high contamination levels will be noted by the sample collectors on the COC forms. Samples identified as having high contamination levels will be stored separately, as will samples submitted for volatile analysis. All refrigerators must be maintained at 4°C ± 2°C, and temperatures are monitored and recorded daily by sample control personnel. Preservatives, containers, holding times, and volume requirements for project-required tests are provided in Table 3.2-1. All samples will be kept under the proper environmental control until after holding times have expired and there are no QA/QC problems with any analysis on those samples.

Sample Identification. Each sample received will be assigned a unique laboratory sample accession number.

This unique accession number, along with pertinent sampling information, will be logged into the sample control database system and the LIMS. One of the functions of the LIMS is to assist in tracking samples while they are in the custody of the laboratory. Other information recorded will include date and time of sampling, sample description, location, and required analytical tests. Samples of similar matrix will be batched in lots of 20 or fewer at the time of sample preparation, or at the time of analysis, if no preparation is required.

Sample Custody Records. All samples will be accompanied by a COC record. A COC record must also be used if the laboratory relinquishes control of the samples to subcontractor laboratories or returns the samples to the originator. A sample sign-out sheet will be used to track the samples within the laboratory. All COC records will be filed permanently with the analytical data. The completed original COC record will be forwarded to Earth Tech with the final report.

3.2.4 Analytical Methods Requirements

3.2.4.1 Field Parameters.

Detailed discussions of field measurement parameters, protocols, equipment, and its calibration and maintenance are presented in the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

Properties of water and soil samples will be measured during field activities. Geophysical techniques will be used for clearance activities. Groundwater samples will be measured for EC, pH, temperature, and turbidity. Also measured will be depth to water in wells and the volume of water discharge. A brief description of the methods can be found in the following paragraphs:

Field Analytical Procedures

EPA Method 120.1 - Specific Conductance (Field). The specific conductance of water samples will be determined in the field using a conductivity meter. The conductivity meter will be calibrated daily against a standard solution per manufacturer's instructions.

EPA Method 150.1 - pH (Field). The pH of water samples will be measured in the field potentiometrically using a standard pH meter. The pH meter will be routinely calibrated in accordance with manufacturer's recommended procedures using buffered standards and will be checked daily and when activities or environmental changes occur that might affect instrument accuracy.

EPA Method 170.1 - Temperature (Field). Temperature will be measured for selected water samples according to EPA Method 170.1 using a calibrated thermometer.

EPA Method 180.1 - Turbidity (Field). Turbidity will be measured in the field nephelometrically using a turbidimeter and reported in NTUs. The turbidimeter will be calibrated routinely per manufacturer's instructions and standardized before each use.

TNT EnSys® Soil Test by EPA Method SW8515. In order to determine the extent of the step-out field sampling program at the TNT Strips, a soil test kit *may* be used to obtain rapid data in the field. The TNT EnSys® soil test system (or equivalent) will be used. This system detects TNT, TNB, and DNT in soil samples and provides quantitative results using approved EPA Method SW8515. The assay range is 1 to 30 mg/kg (or ppm) total TNT in soil. All QA/QC procedures specified in the "Control (QA/QC) Check" section, pages 8-10 of the User's Guide for this test method, will be followed. This includes the following:

- Maintain sample documentation, analysis documentation, and documentation of all QA/QC
- Follow daily method calibration requirements in the User's Guide
- Analysis of the TNT control sample provided with the test kits at a minimum frequency per field crew of once daily before sample analysis and once daily after analysis of the last sample
- Analysis of a method blank (acetone) at a minimum frequency per field crew of once daily before sample analysis and once daily after analysis of the last sample

- Analysis of a site specific matrix sample from a known contaminated area and one from an uncontaminated area to document possible matrix effects at a frequency of once per site with different soil matrix characteristics
- Analysis of a field sample from a known contaminated area and one from an uncontaminated area to document at a frequency of once per field effort to document matrix effects and method effectiveness
- Analysis of field duplicate samples at a minimum frequency of one per 20 samples to document field and method precision
- Definitive level analyses of a minimum of 10 percent of all field samples and 100 percent of all critical samples and contamination defining samples for confirmation
- Analysis of one performance evaluation sample (depending on availability) and/or one MS sample (depending on availability) to document method accuracy and possible matrix effects.

All field personnel performing the field tests for TNT will undergo training and initial supervision by the project chemist or a qualified designee. All data from this method will be reviewed daily by the project chemist or a qualified designee to ensure the method is working appropriately, and to determine if additional definitive-level samples require analysis. The method is discussed in further detail in Section 2.1.8, and the User's Guide is presented in Appendix G.

Equipment Calibration and Maintenance. Detailed discussion of field equipment calibration and maintenance is presented in Section 2.14 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

The equipment used in collecting field data will include a variety of instruments. Proper maintenance, calibration, and operation of each instrument will be the responsibility of the field personnel assigned to the project. All instruments and equipment used during the studies will be maintained, calibrated, and operated according to the manufacturers' guidelines and recommendations.

All instruments will be stored, transported, and handled with care to preserve equipment accuracy. Damaged instruments will be taken out of service immediately and not used again until repaired and recalibrated by a qualified technician.

Field equipment will be calibrated prior to use in the field as appropriate. The calibration procedures will follow standard manufacturer's instructions to ensure that the equipment is functioning within tolerances required by the project.

Calibration procedures for commonly used equipment are described in Section 2.14 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced. A record of field calibration of analytical instruments will be maintained by field personnel on the appropriate Instrument Calibration Logs. These records will be subject to QA audit. In addition, any notes on unusual results, changing of standards, battery charging, and operation and maintenance will be included in the logbook.

Decontamination. Detailed discussion of field decontamination procedures is presented in Section 2.15 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

Control Parameters. Before groundwater samples are taken, temperature, pH, EC, and turbidity are monitored to establish whether they have stabilized. Acceptable values for stabilization are specified in Section 2.7.5 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced. Temperature, pH, EC, turbidity, and dissolved oxygen measurements will be taken at the time groundwater samples are collected for laboratory analyses. Duplicate groundwater samples, which will number 10 percent of the entire sampling program, will be measured for temperature, pH, EC, turbidity, and dissolved oxygen.

Record Keeping. Detailed discussions of field documentation procedures are presented in Section 2.18 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced.

3.2.4.2 Laboratory Analytical Procedures.

The purpose of the laboratory analyses is to identify the types and concentrations of contaminants in soil, sediment, groundwater, and surface water. The analytical procedures for the definitive analyses of the samples in this project specified in Table 3.1-2 will conform to the requirements specified in *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846 3rd edition (U.S. Environmental Protection Agency, 1986a), Final Update I (U.S. Environmental Protection Agency, 1992), Final Update II (U.S. Environmental Protection Agency, 1994d), and Final Update III (U.S. Environmental Protection Agency, 1996b); *Methods for Chemical Analysis of Water and Wastes*, EPA Manual 600/4-79-020 (U.S. Environmental Protection Agency, 1983 with additions); *Leaking Underground Fuel Tank Field Manual* (State of California, 1989); and *Annual Book of ASTM Standards: Vol. 4.08, Soil and Rock, and 11.01, Water* (ASTM, latest edition).

The analyses expected to be required for this project include the following: California Assessment Manual (CAM) 17 Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc) plus aluminum, calcium, iron, manganese, magnesium, phosphorous, potassium, and sodium by EPA

Methods SW6010B, SW7470A, and SW7471A; TPH as gasoline by California LUFT modified EPA Method SW8015B and TEPH as diesel, kerosene, and motor oil (30 weight) by California LUFT modified EPA Method SW8015B; organochlorine pesticides by EPA Method SW8081A; volatile organic compounds (VOCs) by EPA Method SW8260B; semivolatile organic compounds (SVOCs) by EPA Method SW8270C; dioxins and furans by EPA Method SW8290; PAHs by EPA Method SW8310; nitroaromatics and nitroamines, including PETN and nitroglycerin (explosives) by EPA Method SW8330 (the ONSITE mobile laboratory will analyze PETN and nitroglycerin by EPA Method SW8330/8332); total organic carbon (TOC) by EPA Method SW9060 for soils or EPA Method 415.1 for waters; total dissolved solids (TDS) by EPA Method 160.1; total suspended solids (TSS) by EPA Method 160.2; common anions (chloride, nitrate-N, nitrite-N, and sulfate) by EPA Method 300.0; perchlorate by California Department of Health Services (CADHS) Sanitation and Radiation Laboratories Branch (SRLB) modification of EPA Method 300.0 (CADHS 300.0-Mod); and soil moisture content by ASTM Method D2216. In general, SVOCs by SW8270C will be used only for the determination of PAHs when severe interference is encountered during analysis of PAHs by SW8310. A brief description of the digestion and analytical methods to be used is presented in the following subsections.

For each method, the target analyte list (TAL) for inorganics or the target compound list (TCL) for organics is specified in Table 3.1-1 with a listing of the required PQLs. PQLs will be based on and must exceed laboratory-specific MDLs by a minimum factor of two. Laboratory-specific PQLs may be used as long as the PQLs are less than or equal to the PQLs specified in Table 3.1-1. Quality control criteria for the analytical program are presented in Section 3.2.5 of this QAPP. However, instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the detection limits or associated quality control criteria. In such instances, the reason for deviations from these detection limits that result in noncompliance with QC criteria will be reported on a QC NCR and in the QA report, and will be included in the monthly status reports to the technical PM.

Metals Analyses. Inductively coupled plasma (ICP) atomic emission spectroscopy and cold vapor atomic absorption (CVAA) will be employed to measure levels of specified metals in the samples. Sample digestion is required prior to all ICP and CVAA analyses.

Preparation Methods

EPA Method SW3005A - Acid Digestion of Waters and Ground Waters For Total Recoverable or Dissolved Metals. This digestion method is used to prepare surface water and groundwater samples for analysis by ICP. For the analysis of dissolved metals, the sample must be filtered with a 0.45-micron filter at the time of collection, prior to acidification with nitric acid. The preservation (i.e., pH) of water samples collected for metals is checked and documented prior to digestion.

A 100-mL aliquot of the acidified sample is heated with 2 ml of concentrated nitric acid (HNO₃) and 5 mL of concentrated hydrochloric acid (HCl) until the volume is reduced to 15 to 20 mL. Filtering with a 5.0-micron filter may be performed if insoluble material is present. The final volume is adjusted to 100 mL. The laboratory may perform the digestion using a 50-percent proportion of the volumes specified above.

EPA Method SW3050B - Acid Digestion of Sediments, Sludges, and Solids. This digestion method is used to prepare sediment and soil samples for analysis by ICP and trace ICP. A portion of the sample is digested with repeated additions of nitric acid and hydrogen peroxide. The digestate is then refluxed using concentrated HCl for ICP. The final volume is adjusted to 100 ml.

Sample digestion procedures for analysis of mercury by EPA Methods SW7470A (waters) and SW7471A (soils) are included in the respective methods.

Analysis by Inductively Coupled Plasma

EPA Method SW6010B - ICP. ICP determines elements in solution. All matrices, including groundwater, surface water, industrial wastes, soils, sludges, and sediments, require digestion by EPA Methods SW3005A (aqueous samples) or SW3050B (solid samples) prior to analysis.

This method provides simultaneous multi-elemental determination of analytes by ICP. Element-emitted light is measured by optical spectrometry. Samples are nebulized, and the resulting aerosol is transported to a plasma torch.

Element-specific atomic line emission spectra are produced by radio-frequency ICP. The spectra are dispersed and the lines monitored by photomultiplier tubes. The background will be measured and the results corrected for background levels.

Elements traditionally requiring analysis by Graphite Furnace Atomic Absorption (GFAA) (e.g., antimony, arsenic, cadmium, lead, selenium, thallium) to achieve the detection limits required for this project are analyzed by ICP trace analysis on a Thermo Jarrell Ash ICAP 61 E Trace Analyzer or similar instrument, which can achieve the detection limits specified in Table 3.1-1.

Analysis by Atomic Absorption Spectroscopy

EPA Methods SW7471A and SW7470A - Mercury by CVAA. Mercury will be determined in solid samples using EPA Method SW7471A, and in aqueous samples using EPA Method SW7470A. Methods SW7471A and SW7470A are CVAA procedures for determining the concentration of mercury in waste samples. Sample preparation is specified in the method. Following dissolution, mercury in the sample is reduced to the elemental state, aerated from solution in a closed system, and passed through a cell positioned in the light path of an

atomic absorption spectrometer. Mercury concentration is measured by the absorption of radiation by mercury vapor.

Organic Analyses. This section presents brief summaries of the extraction and analysis procedures for organic compounds that will be used by the analytical laboratory to analyze the soil and groundwater samples collected during the project.

Extraction and Cleanup Procedures - For water samples, EPA Method SW5030B will be used for purgeables and SW3510C or SW3520C will be used for nonpurgeables. For soil samples, EPA Method SW5035 will be used for purgeables and SW3540C or SW3550B will be used for nonpurgeables. EPA Method SW5030A may be used for on-site laboratory soils analyses of purgeables as long as samples are analyzed within 48 hours, as specified for unpreserved samples in EPA Method SW5035. In addition, silica gel cleanup by EPA Method SW3630C will be performed prior to fuel analyses by California LUFT modified EPA Method SW8015B for Total Extractable Petroleum Hydrocarbons (TEPH) and PAH analyses by EPA Method SW8310 and florisil cleanup by EPA Method SW3620B will be performed for pesticide analyses by EPA Method SW8081A. Additional cleanup according to EPA Methods SW3630C (silica gel cleanup), SW3640A (gel permeation cleanup) or SW3660B (sulfur cleanup) may be performed for the SW8081A analyses, if required. All surrogate or MS/MSD recoveries for samples undergoing silica gel or florisil cleanup will have a lower control limit (LCL) of 30 percent recovery. Sample extraction procedures for analysis of dioxins by EPA Method SW8290 and explosives by EPA Method SW8330 are included in the respective methods. A modification of the extraction procedure specified in EPA Method SW8330 may be used for on-site laboratory soils analyses (see SW8330 method description, below).

EPA Method SW3510C - Separatory Funnel Liquid-Liquid Extraction. Method SW3510C is a procedure for isolating and concentrating nonpurgeable water-insoluble and slightly water-soluble organic compounds from aqueous samples prior to chromatographic analyses. A measured volume of sample is placed into a separatory funnel, adjusted if necessary to a specific pH, and serially extracted with methylene chloride. The extract is dried, concentrated (if necessary), and exchanged into a solvent compatible with the cleanup or determinative method to be used (if necessary).

EPA Method SW3520C - Continuous Liquid-Liquid Extraction. Method SW3520C is a procedure for isolating and concentrating nonpurgeable water-insoluble and slightly water-soluble organic compounds from aqueous samples. A measured volume of the sample is placed into a continuous liquid-liquid extractor, adjusted if necessary to a specific pH, and extracted with methylene chloride for 18 to 24 hours. The extract is dried, concentrated (if necessary), and exchanged into a solvent compatible with the cleanup or determinative method to be used (if necessary).

EPA Method SW3540C - Soxhlet Extraction. Method SW3540C is a procedure for extracting nonvolatile and SVOCs from solids such as soils, sediments, and concrete. The soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent. Extraction is accomplished by mixing the solid sample with anhydrous sodium sulfate and extracting it for 16 to 24 hours with an appropriate solvent in the soxhlet extractor. The extract is then dried, concentrated, and treated using a cleanup method or analyzed directly by the appropriate measurement technique.

EPA Method SW3550B - Sonication (Ultrasonic) Extraction. EPA Method SW3550B is a procedure for extracting nonvolatile and SVOCs from solids such as soils, sediments, sludges, concrete, and waste. The sonication process ensures intimate contact of the sample matrix with the extraction solvent. A weighed sample of the solid material is ground (if necessary), mixed with anhydrous sodium sulfate to form a free-flowing powder, and then dispersed into the solvent using sonication. The sonication extraction into solvent is repeated three times for the low concentration method, and one time for the medium concentration method. The extract is then separated by vacuum filtration or centrifugation, dried, concentrated and, if required, treated using a cleanup method (see below). The resulting solution is analyzed using the appropriate method. Methylene chloride will generally be used as the solvent, although other solvents may be used for specific analytical applications as noted in each analytical method.

As indicated in SW-846 Update III, EPA Method SW3550B may result in the degradation of phosphate esters. Accordingly, care will be taken when applying EPA Method SW3550B to the preparation of soil samples for analysis by EPA Method SW8270C. When sonication is used as the extraction method, the temperature of the cooling bath will be monitored to minimize degradation of the phosphate esters that may exist in the sample.

EPA Method SW3620B Florisil Cleanup. The florisil cleanup method provides cleanup using a packed florisil column to eliminate interferences with the analyte peaks on the GC/ECD. The column is packed with the required adsorbent, topped with a water adsorbent, and loaded with the sample. Elution is effected with a suitable solvent, leaving the interfering compounds on the column. The eluate is concentrated, if necessary. This cleanup method will be used unless otherwise requested on SW8081A extracts. All surrogate, LCS, or MS/MSD recoveries for samples undergoing florisil cleanup will have a lower control limit of 30-percent recovery.

EPA Method SW3630C - Silica Gel Cleanup. The silica gel cleanup method provides cleanup using standard column cleanup of sample extracts or solid-phase extraction cartridges for TEPH fuels. In the standard column cleanup protocol, the column is packed with the required amount of adsorbent, topped with a water adsorbent, and then loaded with the sample to be analyzed. The solid-phase extraction cartridge is solvent-washed and loaded with sample

extracts. The column or cartridge is eluted with suitable solvent. A vacuum manifold is required for the cartridge to obtain reproducible results. Collected fractions may be further concentrated before analysis. This cleanup method will be used for TEPH fuel analyses by California LUFT modified EPA Method SW8015B and may be used when required for PAH analyses by EPA Method SW8310 and for pesticide analyses by EPA Method SW8081A. All surrogate, LCS, or MS/MSD recoveries for samples undergoing silica gel cleanup will have a lower control limit of 30-percent recovery.

EPA Method SW3640A - Gel Permeation Cleanup. The gel permeation cleanup (GPC) method is a size exclusion cleanup procedure using organic solvents and hydrophobic gels in the separation of synthetic macromolecules. GPC is recommended for the elimination from the sample of lipids, polymers, copolymers, proteins, natural resins, and high molecular weight compounds. The column is packed with the required amount of preswelled absorbent, and is flushed with solvent, for an extended period. The column is calibrated and loaded with the sample extract. Elution is effected with a suitable solvent, and the product is then concentrated. GPC is applicable to PAH, pesticide, and semivolatile organic analyses extracts, if required, or upon request.

EPA Method SW3660B - Sulfur Cleanup. The sulfur cleanup is required when high levels of native sulfur are encountered in environmental samples for pesticides analysis by EPA Method SW8081A. Samples are routinely screened for sulfur, and when determined to be present at interfering levels, 1 to 3 drops of mercury are added to 1.0 mL of sample extract, the sample agitated mechanically for up to 2 hours, and the extract pipetted off for analysis.

EPA Method SW5030B (for Waters) - Purge and Trap. EPA Method SW5030B is a preparation and extraction method for the analysis of VOCs in waters. For waters, an aliquot of a liquid sample is placed in a purge chamber. An inert gas is then bubbled through the liquid aliquot at ambient temperatures, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is heated to elute the components, which are detected by the appropriate detector. Extraction can be employed for nonaqueous and solid samples when high concentrations are expected. This involves a single extraction of the sample into methanol. An aliquot of this methanol extract is then added to reagent water and purged as described above.

EPA Method SW5035 (for Soils) - Closed System Purge and Trap and Extraction. EPA Method SW5035 will be used for soil sample analysis for volatile components. EPA Method SW5035 is a preparation and extraction method utilizing a closed-system purge-and-trap process for the analysis of VOCs in solid materials (e.g., soils, sediments, solid waste). While the method is designed for

use on samples containing low levels of VOCs, special procedures are also provided for collecting and preparing solid samples containing high concentrations of oily waste. These sample preparation procedures may be used in conjunction with any appropriate determinative GC procedure, including EPA Methods SW8015B, SW8021B, and SW8260B.

The low-level method (for solid samples with VOC concentrations in the range of 0.5 to 200 $\mu\text{g}/\text{kg}$) utilizes a pre-weighed, hermetically sealed sample vial that contains a stirring bar and a sodium bisulfate preservative solution. An approximately 5-gram sample is collected, weighed in the field at the time of collection, and placed in the pre-weighed vial. After sampling, the vial is sealed and shipped to the laboratory where the entire vial is placed unopened into the instrument autosampler. The seal is never exposed to the atmosphere from the time of sampling to the time of analysis. Immediately before analysis, organic free reagent water, surrogates, and internal standards (if applicable) are automatically added without opening the sample vial. The vial containing the sample is heated to 40°C and the volatiles purged into an appropriate trap using an inert gas combined with agitation. After purging is completed, the trap is heated and backflushed with helium to desorb the components onto a gas chromatograph for analysis.

Alternatively, EPA Method SW5035 recognizes the use of the Encore™ sampler as an appropriate solid sample storage device for up to 48 hours after sampling, pending further evaluation. Use of the Encore™ allows for an unpreserved sample to be taken in the field, shipped to the laboratory and analyzed directly on an autosampler within 48 hours, or for the sample to be transferred to an approved container and preserved with methanol per specifications of the method (14-day holding time from date of collection). The advantage of this method, including sample analysis within 48 hours, would be the lower detection limits applicable to unpreserved soil samples.

In the high-concentration soil method (for solid samples with VOC concentrations greater than 200 $\mu\text{g}/\text{kg}$), one of two methods may be used:

- VOCs are determined by collecting a bulk sample in a vial or other suitable container without the use of the preservative solution (sodium bisulfate). A portion of that sample is removed from the container in the laboratory and is dispersed in a water-miscible solvent (methanol) to dissolve the VOCs. An aliquot of the solution is added to 5 mL of reagent water in a purge tube. Surrogates and internal standards (if applicable) are added to the solution, then purged using EPA Method SW5030B, and analyzed using an appropriate determinative method.
- VOCs are determined by collecting an approximately 5-gram sample in a preweighed vial with a septum-sealed screw-cap that contains 5 mL of water-miscible organic solvent (e.g., methanol). At

the time of analysis, surrogates are added to the vial, then an aliquot of the solvent is removed from the vial, purged using EPA Method SW5030B, and analyzed by an appropriate determinative method.

Organic Analysis by Gas Chromatograph

Modified EPA SW8015B (California LUFT) - Total Petroleum Hydrocarbons by GC/flame ionization detector (FID). The analysis of petroleum, oil, and lubricants (POL) may be required for this project. California LUFT modified EPA Method SW8015B for TEPHs is expected to be used to quantitate POL. This method will be used to determine TPHs (diesel, kerosene, motor oil, and other petroleum fuels or oils) by the extraction, injection into a GC, and detection by a FID. This analysis requires extraction (EPA Methods SW3510C for water and SW3550B for soil samples) and silica gel cleanup of extracts (EPA Method SW3630C) prior to GC analysis. All surrogate or MS/MSD recoveries for samples undergoing silica gel cleanup will have a lower control limit of 30 percent recovery.

EPA Method SW8081A - Organochlorine Pesticides. EPA Method SW8081A employs GC to determine organochlorine pesticides at ppb levels. Prior to the use of the methods, appropriate sample extraction techniques must be used. Both soil and groundwater samples can be analyzed by this method. EPA Method SW3510 or SW3520 will be used to prepare groundwater samples, and EPA Method SW3550 will be used to prepare soil samples for analysis. In both cases, the initial extraction solvent is methylene chloride, which is exchanged to hexane before analysis. A 1- to 2- μ L aliquot of the sample extract is injected into a gas chromatograph using the solvent flush technique, and target compounds are detected in the GC effluent gas stream by an electron capture detector (ECD).

If interferences prevent detection of the analytes, the extracts may undergo one or more cleanup procedures prior to reanalysis, including: florisil column cleanup (SW3620A), silica gel cleanup (SW3630B), gel permeation chromatography (GPC) cleanup (SW3640A), and sulfur cleanup (SW3660B) for pesticides. The florisil cleanup will generally be used on all pesticide extracts unless otherwise specified for a sample or set of samples. All surrogate or MS/MSD recoveries for samples undergoing florisil or silica gel cleanup will have a lower control limit of 30-percent recovery.

Second Column Confirmation. Where confirmation is not performed by mass spectrometry (MS), second-column confirmation using a dissimilar column will be employed for GC methods (except CA LUFT Modified SW8015B/SW8021B gasoline/BTEX and EPA Method SW8082) for all analytes present at concentrations above the PQLs listed in Table 3.1-1. Both primary analysis and second-column confirmation will be completed within the required holding times. Confirmation will be quantitative (following the same calibration as for primary

column), and data from both the initial and confirmatory analyses will be reported. Sample results are reported from the primary column.

Organic Analyses by Gas Chromatography/Mass Spectrometry

EPA Method SW8260B - Volatile Organics by GC/Mass Spectrometry. EPA Method SW8260B is based upon a purge-and-trap GC/mass spectrometry procedure and is used to determine VOCs that have boiling points below 200°C and that are soluble or slightly soluble in water. It is applicable to nearly all types of sample matrices, regardless of water content.

VOCs are introduced into the GC by the purge-and-trap method. The components are separated via the GC and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information. For aqueous samples, a 25-mL aliquot is purged directly (EPA Method SW5030B). Soil samples will be prepared according to EPA Method SW5035. Refer to the extraction procedures for EPA Method SW5035 for further details.

In the purge-and-trap process, an inert gas is bubbled through the solution at ambient temperature or at 40°C (40°C is required for low-level soils), and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column (trap) is heated and backflushed with inert gas to desorb the components onto a GC column. The gas chromatographic column is then heated to elute the components, which are detected with a mass spectrometer. Qualitative identifications are confirmed by analyzing standards under the same conditions used for samples and comparing the resultant mass spectra and GC retention times. Each identified component is quantified by relating the mass spectrometry response for an appropriate selected ion produced by that compound to the mass spectrometry response for another ion produced by an internal standard. The mass spectrometer provides both qualitative and quantitative information.

EPA Method SW8270C - Semivolatile Organic Compounds by GC/MS. SVOCs will be determined using EPA Method SW8270C. This method will be used as a back-up for the analysis of PAHs when severe interference makes analysis by EPA Method SW8310 impractical. This method can be used to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride/acetone. Such compounds include PAHs, chlorinated hydrocarbons, phthalate esters, nitrosamines, anilines, quinolines, and phenols, including nitrophenols. Prior to using this method, samples must be prepared for GC using appropriate sample preparation methods: generally sonication extraction (EPA Method SW3550B) for soil samples, and separatory funnel (EPA Method SW3510C) or continuous (EPA Method SW3520C) extraction for water samples. In addition, silica gel cleanup by EPA Method SW3630C may be used when required on extracts prior to analyses. All surrogate or MS/MSD recoveries for samples undergoing silica gel cleanup will have a lower control limit of 30-percent

recovery. The analysis may be requested with or without quantitation of tentatively identified compounds (TICs), depending on the requirements of the situation.

Organic Analyses by Gas Chromatography/High-Resolution Mass Spectrometry (GC/HRMS)

U.S. EPA Method 8290 - Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS). EPA Method SW8290 is appropriate for the detection and quantitation of PCDDs (tetra- through octa-chlorinated homologues) and PCDFs (tetra- through octa-chlorinated homologues) in a variety of sample matrices at part-per-trillion (ppt) to part-per-quadrillion (ppq) concentrations.

EPA Method SW8290 is used to detect dioxins and furans in a variety of matrices and uses additional QCs to allow more sophisticated determinations of detection limits and MS recoveries than other routine GC and GC/mass spectrometry methods. EPA Method SW8290 requires isotopically labeled analogs of target analytes to be spiked into each sample before extraction, and uses nine C13 analogs, one furan, and one dioxin at each chlorination level. These isotopically labeled analogs elute and behave as target analytes, without interfering with the analysis. Target analytes are quantitated relative to the isotope analog; therefore, their calculated concentration is compensated for extraction efficiency.

There is a three-tiered approach to reporting and detection limits according to current laboratory conventions (alternate reporting conventions are available upon request). In the absence of target analytes, a sample-specific estimated detection limit (EDL) is calculated based on signal-to-noise (S/N) ratios at the retention time of the analyte. The target analyte is then reported as "not detected" at the EDL. When target analytes are found, they are reported to the lowest calibration standard concentration without conditional modifiers such as a J flag. Below the SW-846 specified reporting limits, qualitatively confirmed analytes are reported as "estimated" to the target detection limit (TDL) to denote the less certain quantitation. The TDL is a value set by the laboratory at which there is no significant chance of false positives. If there is a peak below the TDL, and all qualitative criteria such as retention time, ion ratios, S/N ratio, the absence of diphenyl ether, and analyst judgment are not met, a detection limit based on the ion peaks is calculated and the target analyte is reported as "not detected" at that calculated detection limit.

The assessment of matrix effects on method performance can be met in EPA Method SW8290 with the isotopically labeled analogs. These isotopes are spiked into each sample, and therefore, matrix effects on method performance can be judged by the recovery of these isotopes for each sample. Sample analysis acceptance is controlled by the performance of these isotopes in the sample. Furthermore, the batch-specific LCS are also not required since the

batch-specific method blank uses isotopically labeled analogs of the target analytes and controls the batch. Quanterra/STL still analyzes LCS at a 5-percent frequency as an ongoing system and standard check. No MS/MSD is performed for SW8290 sample analyses (unless specifically requested by the client), and batch control will be done by the recovery of the spiked, isotopically labeled analogs in the method blanks.

The TCDD toxicity equivalence will be calculated in accordance with the procedures given in U.S. EPA "Update of TEFs for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs/CDFs)" March 1989 (EPA 625/3-89/016) and as described in the U.S. EPA Contract Laboratory Program Statement of Work, DFLM01.0. TEFs are assigned to each of the 2,3,7,8-substituted PCDDs/PCDFs in order to relate their toxicity to that of 2,3,7,8-TCDD. TEFs for each dioxin and furan are included with the PQLs in Table 3.1-1. Note that EDL and detection limit values are not normally included in the TEF-adjusted concentration. Second column confirmation will be performed only for 2,3,7,8-TCDF presumptive positives greater than the TDL.

Organic Analysis by High Performance Liquid Chromatography (HPLC)

EPA Method SW8310 - Polyaromatic Hydrocarbons. EPA Method SW8310 is a high-performance liquid chromatographic (HPLC) method with ultraviolet (UV) and fluorescence with photodiode array detection for the detection of ppb levels of certain PAHs. Prior to use of this method, appropriate sample extraction techniques must be used (EPA Methods SW3510C for water and SW3550B for soil samples). In addition, silica gel cleanup by EPA Method SW3630C may be used when required on extracts prior to analyses. All surrogate or MS/MSD recoveries for samples undergoing silica gel cleanup will have a lower control limit of 30 percent recovery. A 5- to 25-microliter (μL) aliquot of the extract is injected into an HPLC, and compounds in the effluent are detected by UV and fluorescence detectors. All concentrations greater than the MDL must be confirmed on the alternate detector.

EPA Method SW8330 - Explosives. EPA Method SW8330 is an HPLC method for the determination of ppb levels of certain explosive residues in soil, sediment and aqueous matrices. Due to their prevalence at defense installations, nitroglycerin and PETN have been included as additional analytes and are being requested as indicated by site-specific conditions. Nitroglycerin and PETN require separate extraction procedures and analytical runs to meet the required detection limits and to remove interferences. Prior to using this method, appropriate sample preparation techniques must be used, as specified in the method. The ONSITE mobile laboratory will analyze PETN and nitroglycerin by modified EPA Method SW8330/8332 (see method description below).

The ONSITE SW8330 modification for soils involves the use of limited sample drying and a 4-hour temperature controlled sonication extraction technique instead of the 3-day sample drying and 18-hour extraction. In addition, the ONSITE modifications for both waters and soils utilize an UV Diode Array Detector (DAD) to monitor compound response at multiple wavelengths. This modification provides a mechanism for compound confirmation of detected explosives based on differences in responses to the different wavelengths. Utilizing the DAD, three separate wavelengths are monitored allowing the collection of multiple wavelength responses for target nitroaromatic, nitroamine explosives and related by-product compounds detected. The collection of multiple wavelength responses for detected compounds provides multiple determination information for a given compound to be used for positive identification. As an alternative, the chemist may obtain additional confirmation information from a spectral library of explosive compounds and breakdown products. The spectral library allows comparison of peak spectra across several wavelengths to be compared to that of pure standard compound spectra developed for the HP Chemstation HPLC data system. Peak purity or fit of the sample peaks is matched to that of known standards. The modified techniques have been used extensively for USACE projects and has been demonstrated to provide acceptable target analyte recoveries (see Standard Operating Procedure for Analysis of Nitroaromatics and Nitroamines (Explosives) by HPLC for Joliet Army Ammunition Plant; Joliet, Illinois, Using Modified EPA 8330 REM (Rapid Extraction Method)).

In the low-level, salting-out method with no evaporation, aqueous samples of low concentration are extracted by a salting-out extraction procedure with acetonitrile and sodium chloride. The small volume of acetonitrile that remains undissolved above the saltwater is drawn off and transferred to a smaller volumetric flask. It is back-extracted by vigorous stirring with a specific volume of saltwater. After equilibration, the phases are allowed to separate, and the small volume of acetonitrile residing in the narrow neck of the volumetric flask is removed using a Pasteur pipet. The concentrated extract is diluted 1:1 with reagent-grade water. An aliquot is separated on a C-18 reverse-phase column, determined at 254 nanometers (nm), and confirmed on a cyanide (CN) reverse-phase column. Alternatively, solid-phase extraction cartridges or other acceptable and appropriate techniques may be used for extraction.

In the high-level direct injection method, aqueous samples of higher concentration can be diluted 1:1 volume-to-volume (v/v) with methanol or acetonitrile, filtered, separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a CN reverse-phase column. If HMX is an important analyte, methanol is used.

Soil and sediment samples are extracted using acetonitrile in an ultrasonic bath and filtered before chromatography.

EPA Method SW8330/8332-Modified - Nitroglycerin and PETN. ONSITE uses a hybrid method of 8330/8332 for the extraction and analysis of soil and water samples for the analysis of nitroglycerin/PETN. The following is an overview of the extraction and analysis method by matrix:

Soil Samples

| | |
|-------------------|---------------------------------------|
| Extraction Method | 8330 (with 2-hour extraction*) |
| Analysis Method | 8332 (see operating conditions below) |

Water Samples

| | |
|-------------------|---------------------------------------|
| Extraction Method | 8330 (Salting Out Method**) |
| Analysis Method | 8332 (see operating conditions below) |

* The extraction method is the same as for Method 8330, except with a 2-hour extraction process. The 2-hour extraction is referenced in method 8332 for use on soil samples. Although 8332 is mainly a water method, it does have the provision that it may also be used for other matrices. Specifically, the method states, "If solid matrices are extracted using an ultrasonic bath as the extraction technique, the period of extraction should not exceed 2 hours or degradation of nitroglycerine may occur."

** The sample prep method referenced in Method 8332 is a 1 to 1 dilution of the sample with acetonitrile prior to analysis. This method would not achieve the reporting limits required for the project. ONSITE utilizes its extraction procedure for 8330 water samples, which is a salting out procedure. ONSITE has used this method successfully on water samples for other projects; however, it took some method development to achieve acceptable recoveries.

The following are the operating conditions that ONSITE uses for the analysis of Explosives and nitroglycerin/PETN. The operating conditions are consistent with the respective EPA methods:

| | SW8330 | SW8330/8332 |
|--------------|------------|-------------|
| Wavelength | 254 nm | 254 nm |
| | 250 nm | 214 nm |
| | 240 nm | 193 nm |
| Mobile Phase | 55% water | 40% water |
| | 31.5% MeOH | |
| | 13.5% ACN | 60% ACN |

Low surrogate and LCS/LCSD recoveries may be encountered for water samples. This may be caused by retention of analytes in the matrix or on the surface of extraction glassware or during an additional concentration step added to provide the lowest possible detection limits to achieve the required QAPP reporting limits. In previous projects, the concentration step has not contributed adversely to the detection of explosives and nitroaromatic compounds.

Nonmetals Inorganic Analyses

EPA Method 150.1 - pH/EPA Method 9045 - Soil pH. The pH of water samples will be measured potentiometrically using a standard pH meter.

Soil samples are mixed either with Type II water or with a calcium chloride solution, depending on whether the soil is calcareous or noncalcareous. The pH of the solution is then measured with a pH meter.

EPA Method 160.1 - Total Dissolved Solids. TDS are determined by thoroughly mixing the sample solution, passing the solution through a standard glass fiber filter, then evaporating the filtrate to isolate any residue. The residue is dried at a constant temperature of 180°C until dry. Residue mass is proportional to the volume of sample analyzed.

EPA Method 160.2 - Total Suspended Solids. TSS are determined by thoroughly mixing the sample solution, then passing the solution through a standard glass fiber filter. The residue retained on the filter is dried at a constant temperature of 180°C until dry. Residue mass is proportional to the volume of sample analyzed.

EPA Method 300.0 - Common Anions - Chloride, Nitrate-N, Nitrite-N, and Sulfate. This is an ion chromatographic (IC) method applicable to determinations of anions in water. A small volume of sample (0.2 to 0.5 mL) is introduced into an IC. Samples that contain particles larger than 0.45 micrometers (μm) require prior filtration. The anions of interest are separated in an anion separator column, eluted through the addition of a sodium carbonate/sodium bicarbonate solution, and measured by a conductivity detector. Anions are identified based on their retention times and quantitated using the peak area in comparison to the calibration curve generated from the known standards.

CADHS Modified EPA Method 300 - Perchlorate. Analyses for perchlorate using modified EPA Method 300 consistent with the June 1997 CADHS SRLB modification of EPA Method 300.0 for perchlorate will be performed by E.S. Babcock & Sons, Inc., in Riverside, California. All appropriate QA/QC procedures specified in this QAPP apply to this laboratory. This laboratory is one of a small number of laboratories authorized to perform the analysis of perchlorate by the CADHS SRLB. Water samples are directly injected while soil samples require a deionized water extraction. A portion of the aqueous sample or extract is injected into an eluant stream comprising a sodium hydroxide-cyanophenol solution. The perchlorate is separated from other anions that may be present in the sample by a commercially prepared anion exchange column. The perchlorate is detected by a conductivity detector, which gives a response proportional to the concentration of perchlorate in the sample. This procedure is readily applicable to all normal quality control standards including duplicates, spikes, calibration verification standards, and laboratory control samples.

EPA Method 365.2/365.3 - Total Phosphorus. This method will not be used for the determination of total phosphorous. Total phosphorous will be determined by EPA Method SW6010B. However, EPA Methods 365.2 and 365.3 are included in this QAPP to allow for the use of this method if required in future sampling events. EPA Methods 365.2 and 365.3 cover the determination of specified forms of phosphorus in drinking, surface and saline water, and domestic and industrial wastes. Either method may be used, depending on the laboratory used for the analysis. Specifically, the method is based on reaction for the orthophosphate ion. Ammonium molybdate and antimony potassium tartrate react in an acid medium with dilute solutions of phosphorus to form an antimony-phospho-molybdate complex. This complex is reduced to an intensely blue-colored complex by ascorbic acid. The color is proportional to the phosphorus concentration. Only orthophosphate forms a blue color. The extract is analyzed by a spectrophotometer with measurements at 650 or 880 nm and a light path of 1 centimeter or longer. For the purposes of this project, total phosphorus will be measured using the persulfate digestion prior to the procedure for orthophosphate.

EPA Method 415.1 - Total Organic Carbon (Water). Organic carbon in water and wastewater is determined by a combustion-infrared method. A sample preserved with sulfuric acid (H_2SO_4) to pH <2 is homogenized and diluted as necessary. Carbon dioxide (CO_2) is purged from a sample aliquot and injected into a persulfate/UV/oxygen reaction chamber. The water is vaporized, and the organic carbon is oxidized to CO_2 and water. The CO_2 from oxidation of organic carbon is transported in the carrier-gas streams and is measured by means of a nondispersive infrared analyzer.

EPA Method SW9060 - Total Organic Carbon (Solids). This method will be used for TOC in solid samples. Organic carbon in soil is measured using a carbonaceous analyzer. This instrument converts the organic carbon in a sample to CO_2 by catalytic combustion, then converts to CO_2 to methane for measurement by FID. Quadruplicate analyses are required, and results are averaged.

ASTM D 2216 - Soil Moisture Content. All solid samples must be analyzed for soil moisture content so the results can be reported on a dry weight basis. Determining soil moisture content involves transferring a weighed sample to a tared container, then placing the sample and container to dry in a preheated oven at $110^\circ C \pm 5^\circ C$. During the drying period, a current of dried air should flow through the oven. After the drying period, the sample will be removed and allowed to cool in a desiccator before weighing. The modified formula for calculating moisture, listed below, will be used for the calculations:

$$w = [(W1-W2)/(W1-WC)] \times 100$$

Where: w = Moisture content, %
 W1 = Weight of container and moist soil, grams
 W2 = Weight of container and oven-dried soil, grams
 WC = Weight of container, grams.

ASTM D 422 - Particle-Size Analysis of Soils. ASTM D 422 (nonhydrometer) will be used to determine soil grain size.

Additional Analytical Methods. If methods other than those specified in the project FSP are to be used, the following procedure must be completed before using an unspecified analytical method, or as soon as possible after use if the method is used to replace a specified method due to unforeseen circumstances. A copy of the proposed method, the expected precision and accuracy, and an explanation for the change must be submitted to the laboratory QA Officer, the client, and DTSC for review and approval.

Detection Limits. Detection limits are required for all methods of quantitative analysis to evaluate method performance. Detection limits for many analytical procedures are often highly dependent on the matrix of the sample or material that is tested. Interferences frequently require sample dilution and/or method modifications that change the detection limit.

Terminology. The MDL is an empirically derived value used to estimate the lowest concentration a method can detect in a matrix-free environment. EPA Method SW846 defines MDL as the minimum concentration of an analyte that can be detected and reported with 99-percent confidence that the value is above zero. PQLs refer to the lowest concentration of an analyte that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The instrument detection limit (IDL) refers to the smallest signal above background noise that an instrument can reliably detect. The detection limit actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects. IDLs are used for analysis of aqueous extracts of metals, and are used to calculate the MDLs for metals methods.

Procedures. MDL studies for GC and GC/mass spectrometry are performed per 40 CFR Part 136, Appendix B, by analysis of a standard solution (each analyte in reagent-grade water) at a concentration of three to five times the instrument manufacturer's suggested IDL, with seven consecutive measurements in one day. The IDL studies for ICP and atomic absorption (AA) are performed per EPA Contract Laboratory Program Statement of Work, dated July 1988. The PQL is validated by analysis of a standard at the level of PQL. The PQL is generally two to five times the laboratory-determined MDL or IDL, and the PQL is always at least greater than or equal to the MDL/IDL.

Values. All sample results will be reported to the MDL. The highest MDL for a method may be used when multiple instruments and sample preparation procedures are available in the laboratory. Analytes found above the MDL, but

below the PQL, are quantitated and flagged (J) as an estimated value. Matrix effects requiring dilution will be considered in assessing laboratory compliance with requirements for sensitivity.

Project-specific reporting limits (maximum acceptable PQLs) are presented in Table 3.1-1. Analytical laboratories used for this project may use laboratory-specific PQLs as long as the PQLs are less than or equal to the PQLs specified in Table 3.1-1).

3.2.5 Analytical Quality Control Requirements

3.2.5.1 Quality Control for Field Activities.

Samples will be collected using the sampling procedures discussed in Section 2.7 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced. QC procedures will be an integral part of each sampling methodology. These procedures will focus upon ensuring the collection of representative samples that are free from external contamination.

Although different extraction and/or analytical procedures will be used for the various parameters of interest, certain general QC procedures are applicable to all methods. Generally, these include the following; however, specific field QC requirements are addressed in detail in Section 2.9 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced:

- Sampling apparatus will be thoroughly cleaned between each sampling event to prevent cross-contamination of the samples. Sampling equipment used to collect samples for semivolatile organic analysis will not be allowed to come in contact with any type of plastic (e.g., plastic storage bags).
- One set of equipment blanks will be collected each day of soil sampling. For samples collected with disposable bailers, daily rinsate samples will not be required. One disposable bailer blank will be collected per lot of bailers used. For water samples collected with reusable (Teflon™) bailers, one equipment blank per day will be collected. For water samples pumped through a sampling device (except for metal filtration chambers, which require a filtration blank), one equipment blank will be collected per pump each day of sampling. For soil samples collected with reusable equipment such as split spoon samplers, one equipment blank will be collected per sampling crew each day of sampling. Soil samples collected in certified, pre-cleaned, stainless steel liners driven directly into the sample medium without possible cross-contamination from other equipment will not require an equipment blank. Equipment blanks will be

analyzed for all analyses performed on associated samples of the same matrix.

- Equipment blank analyses for some methods such as EPA Method SW8290 may be placed on hold for analysis if the associated field samples include detected results. Equipment rinsate blank results will be routinely monitored to assess the effectiveness of decontamination procedures. If rinsate results are detected, field procedures will require revisions to address the source of contamination. If results are routinely nondetected (ND), the frequency of equipment blank sampling may be reduced with permission of the regulators.
- One source water sample shall be obtained at the beginning of each field effort for each source of water used for rinsing. If source water is obtained from an on-site source water outlet, the frequency will be generally be collected once per field effort. If bottled water is used, the frequency will be one per vendor lot. This sample may be collected as the first equipment blank on the first day of sampling. The sample will be analyzed for all COPCs, which must be less than their respective PQLs. Source water sample analyses may be placed on hold for EPA Method SW8290, pending detection of target analytes during analysis of equipment rinsate blanks using the same water. Source water will be monitored on an ongoing basis by the evaluation of equipment blanks. If equipment blanks indicate COPC contamination, an additional source water sample will be analyzed for the COPC to determine if the water or the decontamination procedures are the source of contamination.
- Filter blanks will be collected only if filtration becomes required. For water samples pumped through a metal filtration chamber, one field filter blank will be collected per filter unit each day of sampling. Field filter blanks will be analyzed for inorganic analyses requiring filtration due to high sediment content when required.
- Trip blanks will accompany each cooler shipment of water samples, soil samples, or soil and water samples sent to the laboratory for analysis of VOCs (EPA Methods SW8260B, SW8021B, or CA LUFT Modified SW8015B/SW8021B gasoline/BTEX). A trip blank is a set of VOA vials containing Type II analyte-free water that is prepared in the laboratory, taken to the sampling site, and returned to the laboratory with samples submitted for analysis of VOCs. Trip blanks shall not be opened in the field. One trip blank will accompany each cooler containing either water samples, soil samples, or water

and soil samples to be analyzed for VOCs. The trip blank shall be analyzed by the same VOC analytical methods as the samples, and (in the case of water samples) shall be part of the same preparation batch as the samples.

- Temperature blanks will accompany each cooler shipped to the laboratory for analysis.
- Duplicate water and soil samples will be collected at a frequency of 10 percent to provide a measure of method variability (i.e., total variability due to both sampling and analytical procedures) and natural variability of the parameter of interest within the water matrix. Duplicate samples will be collected at the locations most likely to contain contamination, based on information at the time of sampling. The frequency of 10 percent will be determined on a project-wide, rather than sampling-round, basis. Duplicate samples will be analyzed for the same parameters as the original field samples.
- MS/MSDs should be field designated by the sampler for each shipment of samples. For every analytical batch of 20 or fewer soil samples within a sampling event from a major lithological type or from a major, distinct aqueous matrix, the laboratory will prepare and analyze an MS/MSD pair from a project sample collected by Earth Tech. The sampler will designate one or more of the samples in each shipment by noting on the COC record that the sample(s) are for MS/MSD (in the Remarks column but not on the sample). It is important to provide a sufficient volume of MS/MSD water samples. Three times the usual volume, or more if specified by the laboratory, should be provided for the MS/MSD and marked on the COC record. For water samples that require multiple containers (usually one for each analysis), a single sample number will apply to all containers of that sample. Samples designated for MS/MSD analysis should be typical of the matrix and should not be highly contaminated in order to minimize MS/MSD imprecision resulting from high levels of environmental contamination. In order to minimize the effects of soil heterogeneity, the laboratory will use a single or adjacent liners.
- COC records will accompany all samples.

3.2.5.2 Quality Control for Laboratory Analyses.

Internal QC focuses on ensuring that each chemical measurement has the highest probability of meeting method protocol in terms of precision and accuracy. QC samples such as method blanks, spikes, duplicates and spiked

duplicates are evaluated and documented on a routine basis. Spike and surrogate recoveries are compared on an ongoing basis with standards and surrogates obtained from suppliers of concentrated mixtures with certified concentrations with purity checks exceeding 95 percent. These comparisons are used to develop laboratory-established control limits, which are calculated at a 99-percent confidence level. Where obtainable, spiking compounds and surrogates will be The American Association for Laboratory Accreditation (A2LA)-certified reference materials procured from Supelco, ULTRA Scientific, or an equivalent A2LA-registered reference materials supplier. Table 3.2-1 specifies QC protocol required for each method and corrective actions to be taken when QC parameters are out of control.

Laboratory QA/QC Samples and Protocol

Preparation Batch. The preparation batch shall be defined as samples of the same or similar matrix that are prepared together by the same person, or group of people within the same time period or within limited continuous time periods, which follow the same method, using the same type of equipment and same lots of reagents. Each preparation batch shall contain the requisite number and type of calibration solutions, blanks, quality control samples, and regular analytical samples as defined by the analytical method. These requirements shall be completely defined in the laboratory SOPs and are summarized in part in the following sections. The use of clean-up methods is included as part of the preparation batch. All field- and batch-specific QC samples within the batch should be subjected to all preparatory and clean-up procedures employed.

Analytical Batch. The analytical batch is defined as a preparation or QC batch. The analytical batch will not exceed 20 samples and is defined as a set of samples that are extracted/analyzed concurrently or sequentially with the same lots of reagents and with manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each QC batch should be of similar composition. Significant gaps (greater than 2 hours) in the analytical sequence will result in the termination of the previous sequence and the initiation of a new analytical sequence.

The analytical batch shall be analyzed sequentially on a single instrument. The practice of "holding a batch open" and performing a single set of batch QC samples (method blank, LCS, MS/MSD, matrix duplicate) for all analyses performed during that period is unacceptable relative to the requirements of these specifications. If samples are analyzed sequentially and the sequence extends beyond an instrument operating cycle (e.g., 12-hour GC instrument cycle), all batch QC, with the exception of matrix-specific QC (MS/MSD, duplicates, serial dilution) must be repeated in each cycle. If an analytical batch cannot be analyzed sequentially on a single instrument, all batch QC samples, including matrix-specific QC samples, must be analyzed with each sequence. Each analytical batch must include an MS/MSD, even if a sample not designated for MS/MSD is chosen. If inadequate sample volume for an additional MS/MSD

does not exist, an LCS/laboratory control sample duplicate (LCSD) will be analyzed instead.

For TOC analysis of soils according to EPA Method SW9060, quadruplicate manual injections requiring 10-20 minutes each are required; consequently, it is not possible to have one continuous analytical sequence, and it is not reasonable to reanalyze batch QC each analytical day. Therefore, the following variance is to be applied:

For TOC analyses according to SW9060, the analytical batch is defined as a preparation or QC batch composed of 20 samples or less with MB, LCS, MS, and laboratory duplicate sample to be prepared and analyzed in the same manner using the same reagents and instrumentation. The analytical batch and analytical sequence (defined below) will be modified to allow for the preparation or QC batch to be analyzed using the same instrument within multiple analytical days. The MB/LCS will be analyzed first as these analyses are indicative of the effectiveness of the preparation procedure for the entire batch. During each analytical day, the instrument calibration is verified daily and for every 16 injections (4 samples instead of 10). Each analytical sequence shall contain the requisite number and type of calibration solutions and regular analytical samples as defined by the analytical method. The MB/LCS/MS/duplicate do not need to be reanalyzed during each analytical day.

Analytical Sequence. The analysis sequence or instrument run sequence shall be defined as samples that are analyzed together within the same time period or in continuous time periods on one instrument under the control of one continuing calibration verification. Analysis sequences are bracketed by the appropriate continuing calibration verification standards and other QC samples as defined by the analytical method. In general, if an instrument is not used for periods of time or is shut down (e.g., overnight), a new analysis sequence shall be initiated. Each analysis sequence shall contain the requisite number and type of calibration solutions, quality control samples, and regular analytical samples as defined by the analytical method.

Batch QC Samples. The Contract Laboratory shall, as a minimum, analyze internal QC samples at the frequency specified by the method and in these specifications for all analytical methods. The minimum QC samples for each analytical batch shall include method blanks (MB), MS/MSD analyses (laboratory duplicates and MS for inorganic analyses), and laboratory control samples (LCS). The matrix used for LCS analyses shall be reagent grade water for aqueous analyses and reagent sand for soil/sediment matrices. A summary of these and additional required QC samples for each preparation batch are presented in Table 3.2-1, and are summarized in the following subsections. All calibrations and QC samples analyzed shall be uniquely identified and traceable to that unique sample preparation batch.

Method Blank. A method blank is an artificial sample used to monitor the analytical system for interferences and contamination from glassware, reagents, and similar materials. The method blank is taken through the entire sample preparation process, and is included with each batch of extractions/digestions prepared or with each 20 samples, whichever is more frequent. Method blanks for analyses of aqueous samples will be deionized or Type II reagent-grade water, depending on the analysis. A clean, solid matrix (e.g., baked, acid-washed sand) will be used as a method blank sample for analyses of soil or sediment samples for most analyses.

Matrix Spikes and Duplicates. Depending on the method, laboratory (matrix) duplicate samples or MS/MSDs are analyzed for each analytical batch for each different sample matrix. For inorganic methods, protocol generally requires analysis of a laboratory duplicate sample and one spiked sample. Laboratory duplicate or spiked samples that do not meet established accuracy criteria will be further evaluated under the laboratory data validation protocol. Only samples from the project will be spiked or used as duplicates. Organic matrix spiking solutions are prepared from either neat materials or sources independent of the calibration standards and contain all analytes of interest. Inorganic MSs are prepared by adding the analytes of interest at an appropriate concentration. The spiking concentrations should be in the expected range of detectable concentrations for samples (mid-range). For ICP trace analyses of arsenic, lead, selenium, and thallium, spike concentrations should be consistent with spikes used for graphite furnace, as the ICP spiking concentrations are generally at concentrations only applicable to ICP analyses without trace analyzers. The spiking concentrations should be consistent for the MS/MSD and LCS for each analyte. Table 3.2-2 lists MS/MSD percent recovery and RPD control limits for each method. Table 3.2-1 specifies corrective actions required for each method when MS, MSD, or matrix duplicate analyses are out of control.

The laboratory data validation protocol will include accuracy and precision measurements from MS/MSDs and laboratory duplicate samples. Individual analyte recoveries and RPDs will be compared with acceptance limits specified in Table 3.2-2. In the event a laboratory duplicate, MS, or MSD analyte fails acceptance criteria, the laboratory duplicate or MS/MSD will be reextracted/reanalyzed once. Only those target analytes that fail laboratory duplicate or MS criteria must be within acceptance limits in the reextraction/reanalyses for the MS/MSD method to be considered in control.

For analytes that fail acceptance criteria in the MS and/or MSD that have passed acceptance criteria in the LCS, these analytes will be considered out of control due to sample matrix effects. If these analytes also fail the acceptance criteria in the LCS, the samples must be re-extracted/reanalyzed with appropriate QC. If corrective action is not performed, impact on the data will be assessed and the incident will be discussed in the case narrative.

All samples analyzed or prepared in a process batch without an MS and MSD will, at a minimum, have a method blank and LCS/LCSD included in their process batch. The RPD will be reported in addition to the percent recoveries in this case.

Post-Digestion Spikes. For metals analyses, when an interference is indicated by MS/MSD or other QC results, post-digestion spikes (PDSs) should be performed to confirm the interference. PDSs should be incorporated into an analytical sequence to assess matrix effects based upon (1) the occurrence of new and unusual matrices included within the batch, or (2) contingency analysis based upon serial dilution (SD) or MS failures. PDSs are prepared by the addition of the primary source standard to the digestate for the same metals and at approximately the same concentration as is used for the MS. PDS control limits are the same as those for MS/MSDs in Table 3.2-2.

Serial Dilutions. For metals analyses, a 5X (1:4) serial dilution test may be performed for an analyte to evaluate matrix interference if the analyte concentration in the original (undiluted) sample is at least 50 times the MDL for ICP or 25 times the MDL for mercury. Because ICP results often meet this criterion, serial dilution should be routinely performed as batch QC for ICP. Matrix effects are suspected if the RPD between the undiluted and diluted result is >10 percent for such elements. If this criterion is not met, further confirmation of the interference via implementation of PDS is necessary when matrix interference is suspected, and calculation of the result through the use of MSA may be required when such matrix interference is confirmed.

NOTE: When serial dilutions are used to address matrix interference, only the lowest dilution which yielded acceptable results needs to be reported. However, the reported result must be qualified (i.e., D-flag) and the dilution factor specified. The associated PQLs or MRLs must also be adjusted based on the dilution factor.

Laboratory Control Samples. LCS (MSs) is defined as blank soil or reagent water spiked with a known amount of analyte from a source different from that used for the calibration standards and included with every batch of samples. The LCS measures method performance under interference-free conditions. LCS results, together with MS results, can establish the presence of any matrix effects. LCSDs must be prepared and analyzed for each process batch. All analytes of interest will be spiked into the LCS. The spiking concentrations should be in the expected range of detectable concentrations for samples (mid range). For ICP trace analyses of arsenic, lead, selenium, and thallium, spike concentrations should be consistent with spikes used for graphite furnace, as the ICP spiking concentrations for ICP are generally at concentrations only applicable to ICP analyses without trace analyzers. The spiking concentrations should be consistent for the MS/MSD and LCS for each analyte. Table 3.2-3 lists LCS/LCSD percent recovery and RPD control limits for each method. Table

3.2-1 specifies corrective actions required for each method when LCSs are out of control.

The laboratory data validation protocol will include accuracy measurements from LCSs. Individual compound recoveries will be compared with LCS acceptance limits specified for each method in Table 3.2-3. If an LCS recovery does not meet acceptance criteria, the analyte will be considered out of control and corrective action will be required, as specified in Table 3.2-3. If LCS analytes that are out of control exceed the upper limit and the associated sample results are ND, no further action is required. If LCS analytes that are out of control are below the lower acceptance limit, the LCS, blank, and associated samples are reanalyzed. If the reanalysis does not yield acceptable data, the samples are re-extracted with appropriate QC, if the samples are still within holding times. If these analyses also fail the acceptance criteria in the LCS, impact on the data will be assessed and the incident will be discussed in the case narrative.

Surrogate Compounds. For GC and GC/mass spectroscopy analyses, the analytical process includes the addition, subsequent detection, and recovery calculations of surrogate spiking compounds. Surrogate compounds are added to every sample at the beginning of the sample preparation, and the surrogate recovery is used to monitor matrix effects and sample preparation. Compounds that meet the following criteria are suitable surrogate compounds:

- Compounds not requested for analysis
- Compounds that do not interfere with the determination of required analytes
- Compounds that are not naturally occurring, yet are chemically similar to the required analytes
- Compounds exhibiting similar response to analytes under determination. Samples are re-extracted/reanalyzed once when surrogate recovery is outside control limits. Table 3.2-4 specifies the surrogate spike compounds and percent recovery control limits for the methods in this project. Table 3.2-1 specifies corrective actions required for each method when surrogates are out of control.

Internal Standards. Internal standards are compounds not found in the sample that are added at the time of analysis and used to quantitate results and correct for injection variability. EPA Method SW8290 employs the use of internal standards for quantitation, calibration, and instrument optimization.

Reagents. Laboratory reagent water that meets the requirements of Type II reagent water, as described in ASTM Part 11, is checked daily. The resistivity of

the water is measured and recorded in a logbook. Blanks are routinely analyzed for purity and accompany each batch tested.

High-purity reagents are purchased as dictated by each test method and are documented by batch, lot number, and supplier, as well as time period of laboratory use (date opened, date depleted).

Establishment of Control Limits. Each laboratory monitors the percent spike recovery in LCS, MS, and MSD, and the surrogate recovery in all samples where surrogates are appropriate. The RPD in MS/MSD or sample/duplicate, depending on the method, is also monitored. From these results, in-house control limits are calculated. The MS, LCS, and surrogate acceptance limits are updated annually. Before an update occurs, the laboratory will notify Earth Tech. In-house laboratory control limits must meet or exceed the control limits specified in this QAPP; otherwise, the control limits in the QAPP must be implemented.

Spikes and duplicates/spike duplicates will be run for each different matrix and at least once for every 20 samples or each batch. Surrogate spikes are used in every sample where appropriate for the method.

Control charts have been established to monitor trends, warning, or out-of-control situations as they happen. After a minimum of 20 results have been obtained for a spiked blank, spiked sample, or spiked duplicate for each particular analysis, the mean result and its standard deviation will be tabulated. The control chart will be a graph of the mean value line with upper and lower warning control lines. The warning limit will be set at ± 2 standard deviations of the mean and the out-of-control limits at ± 3 standard deviations of the mean. This will be performed for each procedure and matrix type. Results from the same matrix type and procedure will be plotted for the most recent 20 data points. Control limits are evaluated periodically and updated at least annually.

3.2.5.3 Quality Control Procedures and Control Limits.

Summaries of QC procedures for selected methods are provided in Table 3.2-1. See laboratory method protocols for details.

Criteria for evaluating MS QC data are presented in Table 3.2-2. Percent recovery and RPD are listed for each method, matrix, and spiking compound. Spike concentrations are also included in the table. Table 3.2-3 shows the QC criteria and control limits for LCSs. Surrogate recovery criteria are listed in Table 3.2-4. Laboratory-established criteria are used for QC criteria except in the case of metals, for which standard EPA Contract Laboratory Program (CLP) criteria will be used.

3.2.5.4 Procedures Used to Assess Data Precision, Accuracy, and Completeness.

The two aspects of data quality of primary concern are precision and accuracy. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter and includes elements of both bias and precision. Precision is a measure of the variability associated with the measurement system. The completeness of the data will be evaluated based upon the valid data percentage of the total tests conducted.

Control charts are useful tools in assessing QC efforts through graphical displays of a parameter and its variability over time. The parameter plotted is related to control sample testing, either in terms of percent recovery or RPD in the case of duplicates.

Unless otherwise noted, control chart ranges span ± 2 and ± 3 standard deviations from the mean. A Gaussian distribution will provide 5-percent outliers from 2 standard deviations. QC results require corrective action referencing the sample batch related to the out-of-control QC. A group of seven QC data points that occur sequentially above or below the calculated mean also indicates the need for corrective action.

Precision. QC procedures, such as control sample analyses and replicate analyses, represent the primary mechanism for evaluating measurement data variability or precision. Replicate analyses will be used to define analytical replicability, while results for replicate samples may be used to define the total variability (replicability) of the sampling/analytical system as a whole.

Control limits for control sample analyses, acceptability limits for replicate analyses, and response factor agreement criteria specified herein are based upon precision in terms of the RSD, or RPD. The standard deviation is a measure of the average distance of individual observations from the mean. It is usually denoted "s" and defined as:

$$s = \sqrt{\frac{\sum_{i=1}^n x_i^2 - \left[\frac{\sum_{i=1}^n x_i}{n} \right]^2}{n-1}}$$

In this equation, n is the number of observations, and x_i is the *i*th observation.

The percent RSD is a measure of variability that is adjusted for the magnitude of the values in the sample:

$$\%RSD = \frac{\text{Standard Deviation}}{\text{Sample Mean}} \times 100$$

The percent RSD is used when the size of the standard deviation changes with the size of the mean.

RPD is another measure of variability that is adjusted for the magnitude of the measured values. It is used only when the sample contains only two observations and is given by:

$$RPD = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100$$

where X_1 and X_2 are duplicate sample measurement results. RPD is directly related to RSD for duplicate results by:

$$RPD = \sqrt{2} \text{ RSD}$$

RSD is used for calculating precision of response factors in calibration procedures and acceptability of the calibration. RPD is calculated on sample duplicates or MS/MSDs. The arithmetic mean and standard deviation of the RPDs are calculated, and the upper control limits, set at ± 3 standard deviations, constitute the acceptance criteria for precision. RPDs are based on MS/MSD or laboratory duplicate analyses. RPD for field measurements are based on sample duplicates. RPDs cannot be calculated in the instance that one or both values are NDs. In these cases, an evaluation will be made during data validation on the replication.

Accuracy. For surrogate compounds, laboratory control samples, and continuing calibration check standards, a database of percent recovery is collected. The calculation formula for percent recovery is:

$$\% \text{ Recovery} = \frac{\text{Concentration found}}{\text{Concentration spiked}} \times 100$$

A similar calculation used to determine the performance of a method for recovery of a spike concentration added to a sample is the percent spike recovery:

$$\% \text{ Spike Recovery} = \frac{\text{Value of sample plus spike} - \text{Value of unspiked sample}}{\text{Value of spike added}} \times 100$$

The arithmetic mean and standard deviation of the percent (spike) recoveries are calculated on a minimum of 20 points. From this information, warning limits and control limits for accuracy are determined. Warning limits are defined as mean ± 2 standard deviations. Control limits are mean ± 3 standard deviations. The percent recovery of each subsequent QC sample is plotted on a control chart and compared with the calculated control limits.

For MSs, the assignable cause for recoveries outside acceptable limits may be, and often is, due to matrix interferences. The analytical system performance will be checked by analysis of an LCS. If a matrix effect is confirmed by acceptable performance on the LCS, the MS/MSD data will be flagged. These LCS results will provide another measure of accuracy of the measurement data.

Blanks will make up one other group of QC checks that will address measurement bias. Instead of assessing and controlling overall accuracy, field and laboratory blanks will be used to control bias due to sample contamination and to assess the extent to which this source of bias affects the measurement results. Since sample contamination generally occurs at relatively low concentrations, contamination effects are most pronounced, in terms of relative error, for low-concentration samples.

Method blanks will be used to control contamination introduced during sample preparation and analysis. Blank acceptability is detailed in Section 3.4.1 of the QAPP for laboratories and in Section 3.4.2 for data validation.

Field blanks will be used primarily to assess the overall magnitude and extent of contamination. Contamination introduced during sample collection may be estimated from the difference between field and laboratory blank results. Some types of field blanks, such as equipment blanks, will be used primarily in a qualitative role.

Completeness. The overall assessment of completeness is the extent to which the database resulting from a measurement effort fulfills objectives for the amount of data required. Completeness will be calculated for: technical completeness, analytical completeness, field sampling completeness.

Completeness for each parameter is calculated as:

$$\text{Technical Completeness} = \frac{\# \text{ usable results} \times 100}{\# \text{ results reported}}$$

The goal for technical completeness is 95 percent. Usable results are results that are not rejected. Results qualified as estimated are considered usable unless the qualification compromises the ability of the result to be used for decision making purposes.

$$\text{Analytical Completeness} = \frac{\# \text{ unqualified results} \times 100}{\# \text{ results reported}}$$

The goal for analytical completeness is 90 percent. Unqualified results exclude the number of sample results qualified for any reason.

$$\text{Field Sampling Completeness} = \frac{\# \text{ samples collected and analyzed} \times 100}{\# \text{ samples planned}}$$

The goal for field completeness is 100 percent. The goal for sample analyses within holding time is 100 percent.

The goal for sample analyses within holding time is 100 percent.:

$$\text{Contract Completeness} = \frac{\# \text{ unqualified tests} \times 100}{\# \text{ tests performed}}$$

The goal for contractual completeness is 100 percent. Unqualified tests exclude the number of sample analyses qualified for contract compliance failure.

In addition, the goal for sample analyses within holding time is 100 percent. All samples identified as critical to project decision making objectives must meet 100 percent completeness.

Routinely, the value reported for "contract compliance completeness" should be at or near 100 percent while the value reported for "analytical completeness" may be less than that as a function of matrix effects. Each metal and organic compound is considered as a separate analytical parameter rather than being placed in a single analytical category for the purpose of calculating completeness. A single number for completeness in each category will be presented to describe the overall data quality, with breakdowns for each analytical method presented when completeness goals for a method are not achieved. Other QC elements include holding time, calibration, laboratory blanks, LCS, etc. Analytical QC elements include other QC elements and the matrix-related QC elements specified for evaluation in this QAPP.

The completeness goals shall be evaluated qualitatively as well as quantitatively. The qualitative evaluation of completeness will address the impacts of each of the completeness goals on the data quality objectives for the project, including all events contributing to the sampling event and the effects of incomplete data. Factors *other than* QC that adversely affect various completeness objectives include:

- Receipt of samples in broken containers
- Receipt of samples in which COC or sample integrity is compromised in some way

- Samples received with volume insufficient to perform initial analyses or repeat analyses, if initial efforts do not meet QC acceptance criteria
- Improperly preserved samples, causing the analytical results to be unusable
- Samples held in the field or laboratory longer than expected, thereby jeopardizing holding time requirements, causing the analytical results to be unusable

These factors need to be discussed in the QCSR, if appropriate.

3.2.6 Instrument/Equipment Testing, Inspection, and Maintenance

The primary objective of a preventive maintenance program is to help ensure the timely and effective completion of a measurement effort by minimizing the down time of crucial sampling and/or analytical equipment due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas: maintenance responsibilities; maintenance schedules; and adequate inventory of critical spare parts and equipment.

3.2.6.1 Maintenance Responsibilities.

Maintenance responsibilities for laboratory equipment are assigned to the respective laboratory managers. The laboratory managers then establish maintenance procedures and schedules for each major equipment item. These are contained in the maintenance logbooks assigned to each instrument.

3.2.6.2 Maintenance Schedules.

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. A specific schedule is established for all routine maintenance activities. Other maintenance activities may also be identified as requiring attention on an as-needed basis. Manufacturers' recommendations and/or sample throughput provide the basis for the established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., GC/mass spectrometry instruments, atomic absorption spectrometers, analytical balances). Maintenance activities for each instrument are documented in a maintenance log that indicates the required frequency for each procedure and provides for dated entries. A list of laboratory instrumentation, spare parts for project laboratory equipment, and maintenance schedules will be maintained and available for inspection at the laboratory.

3.2.6.3 Spare Parts.

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. This inventory emphasizes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

The laboratory manager is responsible for maintaining an adequate inventory of necessary spare parts. Sufficient equipment must be on hand to continue analyses in the event that an instrument encounters problems. In addition to backup instrumentation, a supply of spare parts such as GC columns, fittings and septums, atomic absorption lamps, mirrors and diaphragms, graphite furnace tubes, and other ancillary equipment must be maintained.

3.2.7 Laboratory Instrument Calibration Procedures and Frequency

Analytical instruments will be calibrated using traceable standards in accordance with the specified analytical methods and manufacturers' procedures. At a minimum, calibration procedures include the equipment to be calibrated, the reference standards used for calibration and calibration verification, the calibration techniques and the sequential actions, acceptable performance tolerances, frequency of calibration verification, and calibration documentation format. Records of standard preparation and instrument calibration will be maintained. The analysis daily benchlogbook, maintained for each analytical instrument, will include, at a minimum, the date and time of calibration, the initials of the person performing the calibration, and the calibrator reference number and concentration. Table 3.2-5 provides a summary of laboratory calibration practices for the project.

Note that the analysis and selective reporting of duplicate CCV standards is not an acceptable practice. If duplicate CCVs are analyzed, results for CCVs that bracket reported sample or QC results must be reported and applied for corrective action purposes. If sample or QC results are reported from before and after a pair of CCVs, results for both CCVs must be reported and results applied to bracketed samples.

3.2.7.1 Standards.

When available, standards will be A2LA-certified reference materials purchased from Supelco, ULTRA Scientific, or an equivalent registered reference materials supplier. These standards are used for calibration standards. Whenever possible, standards traceable to EPA or NIST standards will be maintained for use as an independent viability check (IVC) of the reference materials purchased for calibration of instrumentation. NIST standards are available from the NIST. Wherever practicable, the multipoint calibration curve will include a standard at a concentration at or below the PQL.

A standard logbook is used to document the preparation of standards and provide a means to trace each solution to the starting materials. Each entry is dated and signed by the preparer. The following information is documented for each standard:

- Name of standard solution
- Lot number and manufacturer
- Initial concentration of each compound or solution
- Volume of each standard and solvent used
- A unique identification number to track the standard used
- Final volume of solution
- Final concentration of solution components
- Date prepared and initials of person who prepared the standard
- Expiration date.

Standards are labeled by:

- Reference to standard log
- Identification of material or method
- Nominal concentration
- Preparation and expiration dates
- Identification of preparer.

Individual entries are described in reagent sections of SOPs describing standard solutions required for analysis. The final check of standard viability is analysis and subsequent comparison against a certified traceable standard independent of the prepared working standard.

Stock and working solutions must be prepared fresh as often as required by their stability and must be checked regularly for signs of deterioration (e.g., discoloration, formation of precipitates, changes in concentrations). Stock and working solutions will be discarded if signs of discoloration are evident or on their expiration date. Expired standards may be revalidated by comparison with fresh standards.

Stock solutions for VOCs should not be held for more than 30 days. Working calibration standards should be prepared fresh weekly. Stock solutions for SVOCs should not be held for more than 12 months. Dilutions below 1 ppm should not be held more than 30 days.

3.2.7.2 Calibration Procedures.

Calibration procedures for field methods are presented in Section 2.14 of the RI/FS FSP, or in the appropriate sections of Work Plans for which this QAPP may be referenced. For laboratory analytical methods, calibration procedures for each type of instrument or technique are discussed below. Method-specific procedures and acceptance criteria are listed in Table 3.2-5.

Inductively Coupled Plasma. The ICP will be calibrated daily before sample analysis. The calibration method chosen from the ICP computer method file must be appropriate for the analysis requested. Calibration for the elements of interest is accomplished by aspirating calibration standards in order according to instructions in the SOP. The percent RSD for the elements in the standards aspirated should be equal to or less than 5. If the RSDs are higher than this limit, the standard must be reaspirated. All elements in the initial calibration verification and interference check standards will be within ± 10 percent and ± 20 percent of the true value, respectively. If an element is not within these limits, a recalibration for that element is necessary. Continuing calibration check standards will be run every ten samples with an acceptance limit of ± 10 percent of the true value. If an element does not meet QC limits, sample analysis will be stopped and recalibration for that element performed. The method of standard additions (MSA) may be used to quantitate results for samples with demonstrated matrix interference.

Atomic Absorption. Daily calibration is performed on both AA flame, graphite furnace, and cold vapor techniques. A minimum of three concentrations are run to optimize sensitivity and instrument linearity. If the correlation coefficient is ≤ 0.995 , additional calibration runs are performed. Background correction for light scattering, ionization, and spectral interference is used. The MSA may be used to quantitate results for samples with demonstrated matrix interference.

Atomic Absorption - Cold Vapor. Calibration of the vapor accessory and preparation of calibration standards for mercury determinations will be performed daily. Standards are prepared by successive dilutions of a stock mercury standard with 5 percent HNO_3 . The calibration standards and the calibration blank are prepared with the same reagents in the same proportions that are used for sample preparation. A calibration blank and a minimum of five standards in increasing concentrations are read for calibration. Calibration verification is performed every ten samples, with an acceptance limit of ± 20 percent of the true value. If this criteria is not met, sample analysis will be stopped and recalibration performed.

Gas Chromatography. The external standard calibration technique is used for calibrating the gas chromatograph. Calibration standards are prepared according to the standard operating procedure for the method.

A calibration curve is prepared for each analyte of interest at five concentration levels for EPA SW846 8000 series methods, including the California LUFT Modified EPA 8015B methods. One of these standards should be slightly above the MDL. The other standards should bracket the range expected in real samples but should not exceed the working range of the detector being used.

A reagent water blank is run prior to calibration to show the absence of interferences. The calibration standards are introduced into the system, and a

calibration curve is generated for each analyte. The calibration factor is calculated as follows:

$$\text{Calibration factor (CF)} = \frac{\text{Total Area of Peak*}}{\text{Mass injected (in nanograms)}}$$

For multiresponse analytes (e.g., polychlorinated biphenyls [PCBs]), the area from at least five major peaks will be used for quantitation.

Acceptance criteria for instrument response linearity checks are based upon the correlation coefficient, *r*, of the best fit line for the calibration data points or the RSD for calibration factors calculated for each analyte at each level over the working range. The correlation coefficient is calculated as:

$$r = \frac{n \sum (xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

where:

x = Calibration concentrations
 y = Instrument response (peak area)
 n = Number of calibration points (x,y data pairs).

The percent RSD is calculated as:

$$\% \text{ RSD} = \frac{SD}{\bar{x}} \times 100$$

where:

\bar{x} = Mean of five initial calibration factors for a compound
 SD = Standard deviation of the calibration factors for a compound.

$$SD = s = \sqrt{\frac{\sum_{i=1}^n x_i^2 - \left[\frac{\sum_{i=1}^n x_i}{n} \right]^2}{n-1}}$$

If the coefficient of correlation, *r*, is ≥ 0.995 , or the RSD ≤ 20 percent for all compounds, the calibration is valid. The use of *r* or percent RSD is instrument-

specific. This acceptance criterion cannot be used interchangeably on a single instrument.

The calibration curve or calibration factor must be checked daily by injecting at least one calibration standard, usually the mid-range standard.

The percent difference is calculated and should be within ± 15 percent.

$$\text{Percent Difference} = \frac{R_1 - R_2}{R_1} \times 100$$

where:

R_1 = Average calibration factor from initial calibration

R_2 = Calibration factor from continuing calibration

Retention time windows must be established per SW846, EPA Method 8000, for each analyte during initial calibration. A check of the retention time window must be made prior to sample analysis using the calibration check standard. A warning limit specific to the method is used. Failure of the standard to meet the retention time window will result in recalibration.

Gas Chromatography/Mass Spectrometry. A 50-ng sample of 4-bromofluorobenzene (BFB) is injected into the GC/mass spectrometry to check instrument tuning for volatile analysis. The resulting mass spectra must meet all the criteria listed in Table 3.2-5, footnote (D), before analysis begins. A 50-ng sample of decafluorodiphenylphosphine (DFTPP) is injected into the GC/mass spectrometry to check instrument tuning for analysis of SVOCs. The resulting mass spectra must meet all the criteria listed in Table 3.2-5, footnote (E), before analysis.

Calibration standards at a minimum of five concentration levels are prepared from a secondary dilution of stock standards. All or part of the compounds listed in EPA Method SW8260B or SW8270C can be used as calibration standards. Based on availability and elution compatibility, all compounds listed in Table 3.1-1 will be used for calibration standards.

Each calibration solution, including internal standards and surrogates, is purged according to EPA Method SW5030 for VOCs in water samples and Method SW5035 for VOCs in solid samples, or injected for SVOCs. A relative RF is tabulated for each compound relative to the internal standard whose retention time is closest to the compound being measured. The RF is calculated as follows:

$$RF = (A_x C_{is}) / (A_{is} C_x)$$

where:

- A_x = Area of characteristic ion for the compound being measured
- A_{is} = Area of characteristic ion for the specific internal standard
- C_{is} = Concentration of the specific internal standard
- C_x = Concentration of the compound being measured.

The average relative response factor (RF) is calculated for each compound using the values from the five-point initial calibration. In accordance with SW-846, quantitation for each compound will be based on the RF if the percent RSD (% RSD) between the RFs is 15 or less. If the % RSD exceeds 15, quantitation may be based on a calibration curve using first or second order regression fit of the five calibration points, whichever introduces the least calibration error. At the discretion of the analyst, first or second order regression fit may be used for analytes that do meet the RSD limits. A system performance check must be made before the calibration is accepted as valid. The system performance check compounds (SPCCs) are checked for a minimum average relative response factor. The five volatile SPCCs are chloromethane, 1,1-dichloroethane, 1,1,2,2-tetrachloroethane, bromoform, and chlorobenzene. The four semivolatile SPCC compounds are n-nitroso-di-n-propylamine, hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-nitrophenol. The minimum acceptable average for VOC SPCCs is 0.10 (0.30 for 1,1,2,2-tetrachloroethane and chlorobenzene) and 0.05 for SVOCs.

The percent RSD for the Calibration Check Compounds (CCCs) is calculated from the RFs in the initial calibration and must meet specified criteria. Volatile CCCs are: 1,1-dichloroethane, chloroform, 1,2-dichloropropane, toluene, ethylbenzene, and vinyl chloride. Semivolatile CCCs include acenaphthene, 1,4-dichlorobenzene, hexachlorobutadiene, N-nitroso-di-phenylamine, di-n-octylphthalate, fluoranthene, benzo(a)pyrene, 4-chloro-3-methylphenol, 2,4-dichlorophenol, 2-nitrophenol, phenol, pentachlorophenol, and 2,4,6-trichlorophenol. The calculation is performed as follows:

$$\% RSD = \frac{SD}{\bar{x}} \times 100$$

where:

RSD = Relative standard deviation

\bar{x} = Mean of 5 initial RFs for a compound

SD = Standard deviation of the RFs for a compound.

$$SD = s = \sqrt{\frac{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}}{n-1}}$$

For individual compounds, if the RSD \leq 15 percent, the coefficient of correlation, r , is \geq 0.995, or the coefficient of determination, $r^2 \geq$ 0.990, the calibration is valid for that compound. In addition, if the mean of all RSDs for all compounds is \leq 15 percent, the calibration is valid for sample analysis. If the mean of all RSDs for all compounds is $>$ 15 percent, the calibration is not valid, unless the calibrations for all compounds are performed using acceptable linear or quadratic calibration curves. The laboratory should be sensitive to the requirements for projects and not allow criteria for compounds of interest to grossly exceed ($>2X$) acceptance criteria.

Every 12-hour shift, each GC/MS must be tuned by purging or injecting BFB for volatiles or DFTPP for semivolatiles. Also, initial calibration of the GC/mass spectrometry shall be checked by analyzing a calibration standard (usually the mid-level standard) and checking the SPCC and CCC performance. If the minimum RF for SPCCs are not met, corrective action must be taken before sample analysis begins. The RF of all CCCs are calculated. The percent difference of the current RF compared to the average relative response factor from the initial calibration is calculated if quantitation is based on RF. The percent drift is calculated if quantitation is based on regression curves.

$$\text{Percent Difference} = \frac{(R_1 - R_2)}{R_1} \times 100$$

where:

R_1 = Average calibration factor from initial calibration

R_2 = Calibration factor from continuing calibration.

$$\text{Percent Drift} = \frac{(C_i - C_c)}{C_c} \times 100$$

where:

C_i = True value of standard

C_c = Calculated value

If the percent difference criteria for each CCC compound are met and the average percent difference for all of the compounds is \leq 20 percent, the initial calibration is assumed to still be valid and sample analysis can proceed. If the average %D $>$ 20, or if the criterion is not met for any one CCC, corrective action must be taken. In addition, if more than six non-CCC compounds exceed 50 percent D, corrective action must be taken. A new five-point calibration must be generated if no source of the problem can be found. The laboratory should be sensitive to the requirements for projects, and not allow criteria for compounds of interest to the project to grossly exceed ($>50\%$ D) acceptance criteria.

The internal standard responses and retention times in the check calibration standard must be evaluated. If any internal standard retention time changes by more than 30 seconds from the last calibration check (12 hours), the system must be checked for malfunctions and corrections made as necessary. If the extracted ion current profile (EICP) area for any of the internal standards changes by a factor of two from the last daily calibration standard check, the system must be checked for malfunctions and corrections made as necessary. All samples analyzed during the time the system was malfunctioning must be reanalyzed.

High Performance Liquid Chromatography. The external standard calibration technique is used for HPLC calibration. Calibration standards are prepared according to the SOP for the method. Before using any clean-up procedures, the analyst should process a series of calibration standards through the procedure to confirm elution patterns and the absence of interferences from the reagents.

A calibration curve is prepared for each analyte of interest at five or more concentration levels for each analyte of interest. One of these standards should be at or near the PQL. The other standards should bracket the range expected in real samples but should not exceed the working range of the detector being used. Two types of calibration curves may be used: linear or nonlinear.

A reagent water blank is run prior to calibration to show the absence of interferences. The calibration standards are introduced into the system and a calibration curve is generated for each analyte, and the calibration factor is calculated as for GC, addressed previously.

Acceptance criteria for instrument response linearity checks are based upon the correlation coefficient, r , of the best fit line for the calibration data points or the RSD for calibration factors calculated for each analyte at each level over the working range. If the correlation coefficient, r , is ≥ 0.995 or the average percent RSD is ≤ 20 percent for all compounds, the calibration is valid, and a calibration factor may be used for quantitation. The use of r or percent RSD is instrument-specific. This acceptance criterion cannot be used interchangeably on a single instrument. The calibration factor or calibration curve for each analyte and surrogate is compared to the ICAL responses prior to sample analysis.

After every ten samples a continuing CCV is analyzed, usually the mid-range standard. The percent difference is calculated for each analyte and the average percent difference for all compounds should be within ± 15 percent. Otherwise, the analysis is suspended and corrective actions implemented.

Retention time windows must be established per SW846, Method 8000, for each analyte during initial calibration. A check of the retention time window must be made prior to sample analysis using the calibration check standard. A warning limit specific to the method is used. Failure of the standard to meet the retention time window will result in recalibration.

Gas Chromatography/High Resolution Mass Spectrometry. The calibration for dioxins and furans by GC/HRMS is very complex and is not presented in its entirety here. The reader is directed to Section 7.7 of EPA Method SW8290 for a detailed description of the calibration procedure. A very brief summary is presented below. A summary of calibration requirements and criteria is presented in the Table 3.2-5 footnote.

The instrument is tuned with a 2- μ L injection of PFK. The resulting mass spectra must meet all criteria listed in Table 3.2-5 before analysis begins. A window defining mix (WDM) must be analyzed before ICAL, and once every 12 hours before sample analysis. The WDM must meet the criteria specified in Table 3.2-5. Calibration standards at a minimum of five concentration levels are prepared from a secondary dilution of stock standards. All of the compounds listed in EPA Method SW8290 must be used as calibration standards. The ICAL must meet the criteria specified in Table 3.2-5. Continuing calibration standards (CCALs) must be analyzed daily, and at a minimum of once per 12 hours prior to sample analysis. The CCALs must meet the criteria specified in Table 3.2-5. Failure to meet the criteria specified in the method and in Table 3.2-5 will result in the corrective actions specified in Table 3.2-5.

Total Organic Carbon Analyzer. The total carbon analyzers for EPA Methods SW9060 and 415.1 are calibrated prior to analysis at full scale and blank to establish the calibration curve, and the calibration linearity for Method 415.1 is verified with a minimum of three standards plus a blank. Verification of calibration is performed initially by analyzing an ICV and at a frequency of 10 percent by running a CCV. Quadruplicate analyses are required for Method SW9060.

Ion Chromatography. Stock standards are prepared from sodium or potassium salts for each anion or purchased from a vendor. The system is calibrated using at least three standard levels and a blank. The standards should bracket the linear range of the IC analysis. The calibration is deemed linear if the coefficient of correlation, r , for the linearity is ≥ 0.995 . A mid-range check standard should be included after every 10 samples. The source of at least one check standard prior to sample analysis should be different from the calibration standards. Deviations of more than ± 10 percent require corrective action and possible recalibration. The retention times (RTs) are determined for each analyte, and are based on 3 times the standard deviation of each calibration standard analyzed on at least three different days. However, the experience of the analyst weighs heavily in the interpretation of chromatograms, and typically, a 10 percent window is used.

Ultraviolet/Visible Spectrophotometry. Working standard solutions must be prepared daily by diluting stock solutions with reagent water or reagent grade solvents prior to use. At least three standard solutions and preferably five standard solutions plus a blank are measured and a standard curve generated for

each method. The linearity of the calibration is acceptable if $r \geq 0.995$. A check standard is used every ten samples to verify calibration.

pH Meter. The pH meter is calibrated with commercially available buffers at a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart. The electrodes are immersed in the standard for 2 to 3 minutes or until a stable reading is obtained. The procedure is repeated until a consistent reading is obtained for the standard solution. After every ten samples, the calibration must be checked with one of the buffers. The reading must not differ from the theoretical value by more than ± 0.1 pH units.

Thermometer. All thermometers will be calibrated once a year using a NIST-certified thermometer as a reference. A minimum one-point calibration will be performed. If the readings are off by more than 0.3°C , the thermometer will be tagged showing the variation. A thermometer that reads more than $\pm 5^{\circ}\text{C}$ different from the reference thermometer will be discarded. Mercury thermometers will be checked for separation of the mercury column before calibration.

Turbidity Meter. The nephelometer is calibrated prior to analysis using two standards at 0 NTU and 40 NTU. Verification of calibration is performed at a frequency of every 5 samples.

Analytical Balance. All balances are serviced and calibrated at least twice per year to maintain calibration. Class "S" weights are used to verify the calibration of the balance each day it is used by recording the readings of known weights that bracket the sample weight. Calibration records are kept in logbooks maintained near the balances.

3.2.7.3 Target Analyte Identification, Quantitation, and Confirmation.

Target Analyte Identification. Employ procedures presented within the individual determinative methods for determining presence and identification of target analytes within samples.

For GC/MS analyses and any samples containing extraneous peaks not associated with the calibration standards, a scan against a mass spectral library may be performed for the purposes of tentative identification if warranted by project DQOs. Based upon the degree of match, evidence of similar pattern, and analyst professional judgment, compounds may be reported as Tentatively Identified Compounds (TICs) and the analytical values estimated.

For TPH analyses, the laboratory shall use the following hydrocarbon ranges as default identification ranges: gasoline C6-C12, diesel C10-C28, motor oil C20-C36. Specific ranges for these fuels and for kerosene may be generated by the laboratory using the ranges and patterns from the calibration standards as appropriate for each fuel. Identification of specific fuels will be based on

chromatographic pattern match with the calibration standards for each fuel. Results for nonmatching patterns will be reported with an appropriate laboratory qualifier or as an unknown hydrocarbon within a specified carbon range.

Target Analyte Quantitation. All samples shall be quantitated using the initial calibration curve, following procedures outlined within the determinative methods. Sample results that exceed the range of the initial calibration high standard must be diluted and reanalyzed, and sample analyte values reported below the PQL must be flagged as estimated quantities (i.e., J-flag). All dilutions must be applied to the sample results and reported accordingly. Solid samples are to be determined on a dry-weight basis. Sample target analyte values should be reported to the number of significant figures appropriate for the method. In general, this will be two significant figures for results less than ten, and three significant figures for results greater than or equal to ten.

Inorganic Analyses. Quantitative results are calculated using the mean value from the set of multiple exposures for Method 6010. The laboratory shall review the RPDs for duplicate injections/multiple exposures of samples exhibiting quantifiable concentrations. If the percent RPD/percent RSD is consistently > 20 percent and highly variable for concentrations greater than the low-level calibration standard, corrective action should be taken. When matrix interference is suspected/confirmed, the use of Method of Standard Additions (MSA) may be required to calculate the sample result (see requirements in Table 3.2-1). For MSA, the laboratory shall at a minimum use a series of three standard additions containing 50 percent, 100 percent, and 150 percent of the expected concentration. As outlined within the method, plot the absorbance of each solution at the concentration of the known standards. The concentration of the sample is then obtained from extrapolating the resulting line back to zero absorbance.

Organic Analyses. The laboratory should make a reasonable attempt to correct for any matrix interference encountered. Dilutions should not be routinely used in preference to clean up methods to address matrix interference. When matrix interference is present, samples should be processed using at least one clean up method as outlined by the determinative method. Refer to Section 3.2.4.2 for specified cleanup methods for this project. If the cleanup and reanalysis do not reduce the matrix interference, the laboratory shall discuss the impact on the data within the case narrative.

For TPH analyses, quantitation of specific fuels will be based on integration of peak areas for the specified ranges for each fuel, and comparison to the initial calibration curve for the fuel.

For EPA Method 8330, due to the lack of resolution between 2,4-DNT and 2,6-DNT, and between 2-Am-DNT and 4-Am-DNT, quantitation of these compounds may be expressed as "isomeric pairs."

Target Analyte Confirmation. Chromatography is a technique that relies upon the comparison of retention times between standards and unknown peaks for qualitative identification. Unless mass spectrometry is used as the detector, tentative identification is based solely on the retention time of an unknown peak falling within the prescribed retention time window of a known standard. In the absence of project-specific criteria, to minimize the possibility of incorrect identification (or false positives), confirmation shall be required for all organic chromatographic methods involving the analysis of single-component target analytes. Quantitative confirmation of results above the PQL is required for samples analyzed by GC or HPLC and shall be completed within the method-required holding times. Confirmation may be required for multi-component analytes even though identification is primarily achieved through pattern recognition (e.g., PCBs, gasoline). When available, it is recommended that confirmation techniques involve the use of (1) another analytical technique (i.e., GC/MS), (2) a second dissimilar column, or (3) multiple wavelenths for diode array detectors. When the laboratory is using the second dissimilar column, it shall be calibrated in the same manner as the primary column. After the target analyte has been identified, primary and confirmatory results are compared for agreement according to method-prescribed criterion. Analytical results are to be reported from the primary column unless interferences are noted. If quantitative results are reported from the confirmation column, the documentation from the analysis of all appropriate QC samples on the confirmation column shall also be required within the data package. Designation of which column is considered primary and which considered confirmation must be documented in the laboratory method-specific SOPs for each appropriate analysis. Once column designation has been established, the laboratory analysts will apply this designation consistently for all samples.

3.2.8 Inspection/Acceptance Requirements for Supplies and Consumables

When available, analytical standards will be A2LA-certified reference materials purchased from Supelco, ULTRA Scientific, or an equivalent registered reference materials supplier. These standards are used for calibration standards. Whenever possible, standards traceable to EPA or NIST standards will be maintained for use as an IVC of the reference materials purchased for calibration of instrumentation. NIST standards are available from the NIST.

Reagents used for organic analysis will be at least pesticide-grade or equivalent. Reagents for inorganic analysis will be at least American Chemical Standard (ACS)-certified grade or equivalent. Reagents for metals analysis will be at least trace-metal-grade or equivalent.

Glass water sample containers will be certified from the manufacturer for SVOC, pesticide/PCB, and metals analyses. Each case of containers will include a Certificate of Assurance or a Certificate of Analysis verifying that the containers conform to the manufacturer's performance-based specification. Plastic water

sample containers will be high-density polyethylene, leakproof and breakproof, and pre-cleaned and certified with independent laboratory analysis (Class 3000). Glass soil sample containers will be certified from the manufacturer for SVOC, pesticide/PCB, and metals analyses. Each case of containers will include a Certificate of Assurance or a Certificate of Analysis verifying that the containers conform to the manufacturer's performance-based specification. All soil sampling metal sleeves or other sample containers will also be certified as contaminant-free.

Water organic sample preservatives will be at least pesticide-grade or equivalent. Water inorganic sample preservatives for metals will be at least trace-metal-grade or equivalent. Sample preservatives for other inorganic analyses will be at least Certified Grade or equivalent.

Decontamination water (deionized) will be analyzed via field blanks for possible contamination. Field blanks will be analyzed once per sampling event per each source of water.

3.2.9 Data Acquisition Requirements (Nondirect Measurements)

Previously obtained data, published or unpublished, may be available in computer data bases, literature files, or from other sources. The acceptance of the data for use on the project must be preceded by an evaluation of the validity of the data. This evaluation must be based on information regarding the data validation procedures used on the data, and any qualifiers assigned; or, if no data validation was performed, a review of available documentation with respect to the data. Based on available information, a determination will be made as to the usability of the data and any use limitations.

3.2.10 Data Management

When the laboratory receives and logs in the contents of the shipping containers, the laboratory's sample custodial supervisor or the laboratory PM will log the sample information into the LIMS. As analyses proceed, additional data for all analyses will be maintained in the LIMS. Upon completion of all analyses, the laboratory will produce an EDD in the required format for delivery with the hard copy data package to the Earth Tech QCSM or project chemist.

Information in the laboratory EDDs will be uploaded and maintained in a database at Earth Tech. Electronic documentation is reviewed by the project chemist, or a designated representative such as a data manager. Laboratory data packages will be maintained in the project files at Earth Tech. Analytical and field QC data will be reviewed by the QCSM or project chemist and PM and included in the final report.

A data management flow chart is presented in Figure 3.2-1.

3.3 ASSESSMENT/OVERSIGHT

3.3.1 Contractor Quality Control

Key QC personnel roles and responsibilities are identified in Chapter 5.0 of the Work Plan along with their function and qualifications. All contractors will be required to follow all QA/QC requirements specified in the FSP, QAPP, and SSHP. The PM is responsible for verifying contractor QC. In the event that the QA/QC requirements in the Work Plan are not followed, the PM and QCSM will have the authority to stop work until corrective actions are implemented.

3.3.2 Assessments and Response Actions

During the course of a project, various assessments will take place. These assessments include peer review of plans and reports, readiness reviews, field and laboratory audits, performance evaluations, audits of data quality, and data quality assessments.

3.3.2.1 Peer Review.

Peer review will be performed on all planning documents (e.g., Work Plan, final reports) before delivery. The documents will be reviewed for technical adequacy, accuracy, compliance with technical procedures, contract and regulatory requirements, and editorial quality. Peer review will be documented, as will acceptance of responses to comments.

3.3.2.2 Readiness Review.

A readiness review will be conducted by the PM and QCSM prior to commencing field activities. The review will ensure that all plans have been completed and distributed, permits have been acquired, key personnel have been assigned and field personnel are trained, equipment is available and calibrated, subcontractors have been procured and meet project requirements, arrangements have been made for waste disposal, and that all possible precautions have been taken to prevent problems during the project.

3.3.2.3 Performance and Systems Audits.

A QA audit is an independent assessment of a measurement system. The purpose of performance evaluation audits is to quantitatively assess the measurement data quality. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data. A systems audit is a qualitative evaluation of the adequacy of the overall measurement system(s) to provide data of known quality that are sufficient, in terms of quantity and quality, to meet the program objectives. Questions regarding qualitative issues, such as management policies, sample custody procedures, record keeping, and data handling systems, are addressed.

QA Auditor. The QCSM will function as the QA auditor for field activities and will monitor the performance of the field and laboratory QA program. This will be achieved through regular contact with the field and analytical QA staff.

Field Audits. At least once in the course of each phase of field investigation for this project, the QCSM or his representative will designate an Earth Tech field auditor not associated with the project team to be on site to perform an independent field QA audit, which will include the following tasks:

- Observe procedures and techniques in use in the various measurement efforts, including field sampling and analysis
- Check and verify instrument and sampling equipment calibration records
- Assess the effectiveness of and adherence to the prescribed QA procedures
- Review document control and COC procedures
- Review completeness of data forms and notebooks
- Review the nonconformance reporting procedures
- Identify any weakness in the sampling/analytical approach and techniques
- Assess the overall data quality of the various sampling/analytical systems.

Generally, the role of the field auditor is to observe and document the overall performance of each of the various sampling and field analytical efforts. Upon completion of the field audit, the auditor will discuss any specific weaknesses with the field team leader (FTL) and make recommendations for corrective action. Based on the audit results, the auditor may, as necessary, initiate corrective action at the project level through the PM. Additional follow-up audits may be required upon initiation of different phases involving previously unaudited field activities, or to follow up on corrective actions. Discussion of any adverse audit findings will be summarized and distributed to the PM, QCSM, and FTL. It is the responsibility of the PM to respond to any deficiencies.

Laboratory Audits

Contractor Audits. Earth Tech maintains an ongoing QA program for analytical work integral to all federal and Department of Defense (DOD) programs, including an annual audit program. Earth Tech has performed an in-depth audit of Quanterra in West Sacramento (STL), the primary fixed-base laboratory

identified for this project, in September 1999. The audit was primarily performed for an Air Force Center for Environmental Excellence (AFCEE) project, and the audit team was accompanied by an AFCEE representative. The audit includes a full report with response items and full closure of all action items, which has been filed with the U.S. EPA and is available from Earth Tech upon request. Any other fixed based laboratory that may be used for this project in the future will also have successfully completed similar systems audits by a qualified Earth Tech audit team within 1 year of project start-up according to the following requirements, which apply to the Quanterra/STL audit.

Each section of the laboratory will be reviewed using an audit checklist, starting with sample receiving and moving through each preparation and analysis area, and concluding with report generation. Elements reviewed include capability of technical personnel, instrumentation, SOPs, document control, and QA/QC. A data file audit will also be performed. Upon completion of the audits, the auditor will discuss any specific weaknesses with the laboratory project manager and make recommendations for corrective action. An audit report will subsequently be prepared and distributed to the PM, the Program Manager, and the laboratory PM. This report will outline the audit approach and present a summary of results and recommendations. The laboratory PM shall respond to any noted deficiencies. Copies of laboratory audit reports summarizing auditing activities and findings, and any corresponding corrective actions that were implemented as a result of these audit activities, will be submitted to U.S. EPA Region IX, and will be available upon request.

For the purposes of this project, a follow-on, project-specific cursory audit will be performed while samples from this project are in-house. The audit will focus on project-specific QC requirements not generally required for non-USACE Sacramento District projects; will verify that the analysts have copies of the relevant sections of the QAPP, and have knowledge of and are complying with project-specific requirements; and will verify proper sample receipt, handling, and tracking within the laboratory.

In addition, for on-site laboratory analyses, the project chemist or a qualified designee will review laboratory procedures while project samples are being analyzed to verify that all method- and project-specific requirements are being met. Assessment of such review will be included in the discussion of data quality in the QCSR.

To ensure full understanding and compliance with the project-specific requirements specified in this QAPP, a project kick-off meeting in the form of a teleconference will be held with each laboratory prior to commencement of sampling for this project. The agenda and notes from the meeting will be kept and included in project documentation.

Federal Audits. All project laboratories will have successfully completed audits by the following state and federal agencies and national programs, as well as by private contractors for other federal projects:

- State of California Department of Health Services (DHS)
Environmental Laboratory Accreditation Program (ELAP)
California certification
- USACE
- A2LA Accreditation.

All audit times, dates, reports, and findings are on file at the laboratory and available for review upon request. Earth Tech, its client, or representatives of any regulatory agency associated with this project will be provided access to the project laboratory for auditing purposes if an on-site audit is deemed necessary.

Internal Audits. Systems audits are conducted periodically (at minimum, bi-annually) at each facility. These systems audits monitor the conformance of the laboratory to the QA program and include assessment of facilities, staff, SOPs, sample management, and general documentation procedures. At the completion of each audit, the auditor provides a written report detailing areas of concern. Internal laboratory audits are on file at the laboratory and may be reviewed upon request.

Performance Evaluation

Performance Evaluation Check Samples. The project laboratory participates in the following performance evaluation sample programs:

- EPA or equivalent semiannual drinking water performance check samples (WS series)
- EPA or equivalent semiannual wastewater performance check samples (WP series)
- California ELAP certification performance check samples
- USACE certification performance check samples.

The laboratory QA department evaluates performance evaluation results and develops a corrective action plan for "Non-Acceptable" results. This plan is then submitted to EPA or other appropriate regulatory agencies for review. All performance evaluation program sample results and corrective actions are available upon request at the laboratory.

In addition, the Earth Tech QA program for another DOD project has been submitting PE samples to Quanterra West Sacramento (STL), the primary fixed-base laboratory identified for this project, for many of the methods in this project bi-annually this year, and Quanterra/STL has performed satisfactorily on all methods.

Double-blind performance evaluation samples will be submitted by Earth Tech to each laboratory for this project at a minimum of once annually. The performance evaluation samples will consist of spiked aqueous samples generated by a third party vendor for all methods used for the project. Performance evaluation samples for the solid matrix will be submitted instead to the on-site laboratory for EPA Methods SW8310 and SW8330 if available; or if required for other methods, such as when soil sample results for a specified analytical method are specified in the FSP as critical to decision making. However, as soil samples cannot be submitted double blind and the laboratories perform solid PE sample analyses under the programs listed above, aqueous samples will be acceptable for most analyses.

At least 95 percent of all analytes in each method (or group of methods for inorganic general chemistry methods) are expected to meet the project goals for accuracy specified in Table 3.2-3. Failure to meet 95-percent compliance with respect to project goals will result in specific evaluation of the impact of the performance evaluation sample results on the DQOs, which will be presented in the QCSRs. In addition, further evaluation of the control limits for corrective action specified in Table 3.2-3 and of the reference control limits provided with the performance evaluation sample certified-concentrations will determine the need for laboratory corrective action. If PE sample failure for an analyte indicates DQOs cannot be met for any COPC, specific evaluation will be made to determine what course of action will be required, including laboratory contractual issues, re-analysis of samples or extracts with a follow-up PE sample, or resampling and reanalysis using a different laboratory.

Certification Programs. The project laboratory is accredited by the following agencies for the analyses required for this project:

- CA-DHS ELAP for the analysis of hazardous wastes, drinking water, and wastewater
- USACE - Missouri River Division - multimedia sample analysis for organic and inorganic parameters
- A2LA.

3.3.2.4 Corrective Action.

Field Activities. During the course of the project, it will be the responsibility of the PM, FTL, and field team members to see that all procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In

the event a problem arises, it is imperative that prompt action be taken to correct it. Engineering and scientific calculations will be checked and corrected as required by technical personnel, and normally require no QA reporting.

A nonconformance exists if there is a deviation from or noncompliance with contract specifications, the QA program, approved procedures, or Work Plans. Nonconformances also include major errors in documented analysis, data or results, and deficiencies in documentation or any other aspect of the project that affects quality. Personnel who identify a nonconformance should report the condition by completing Part A of the NCR and distributing the NCR to the supervisor, PM, and QCSM. The numbers of the samples affected by the nonconformance should be noted on the NCR. Figure 3.3-1 is an example of an NCR form. The supervisor, PM, and QCSM will review the NCR to determine if:

- Ongoing work should be stopped.
- The nonconformance involves a major deviation from the contract or client-approved Work Plans, or may significantly affect the cost or schedule of the work, in which case the nonconformance will be reported to the client.
- The nonconformance has any impact on previously obtained data or reports submitted to the client or other organization. If affected, the PM will note the impact in the Remarks section of the NCR and notify in writing all individuals and organizations that may be affected by the nonconformance and resulting data.

The evaluation will be documented by completing Part B of the NCR.

The supervisor will recommend corrective action to resolve the nonconformance by completing Part C of the NCR, and the recommended corrective action will then be reviewed and approved by the PM and QCSM and documented in Part D of the NCR.

The approved corrective action will be implemented by appropriate personnel, and the review and approval by the PM and QCSM will be implemented in Part D of the NCR.

Laboratory Activities. Corrective action is dictated by the type and extent of the nonconformance. Corrective action may be initiated and carried out by nonsupervisory staff, but final approval and data review by management is necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection.

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called "corrective actions," to resolve problems and restore proper functioning to the analytical system.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable windows for precision and accuracy
- Blanks, LCS/LCD contain contaminants above acceptable levels
- Undesirable trends are detected in spike recoveries or RPD between duplicates
- There are unusual changes in detection limits
- Deficiencies are detected by the QA department during internal or external audits or from the results of performance evaluation samples
- Inquiries concerning data quality are received from clients.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager, and/or QA department for further investigation. Once resolved, an anomaly form is filled out describing the corrective action procedure. The anomaly form is kept in a project folder, and a copy is filed with the QA department.

Samples are monitored closely so that they can be analyzed within the recommended holding time. However, should a sample be analyzed outside of holding time, an anomaly form is filled out and the laboratory PM is informed immediately. It is his/her responsibility to inform the Earth Tech QCSM and project chemist so that a decision can be made regarding resampling. All unresolved nonconformances that may affect data quality for this project must be discussed in the case narrative included in the data package. Nonconformances serious enough to warrant the rejection of data must be brought to the attention of the Earth Tech QCSM and project chemist within 24 hours of discovery.

3.3.3 Reports to Management

Effective management of a field sampling and analytical effort requires timely assessment and review of field and laboratory activities. This will require effective interaction and feedback between the field team members and Project Manager, and between the laboratories and the QCSM or project QC chemist.

3.3.3.1 Quality Assurance Reporting Procedure.

The laboratory PMs and appropriate project team members will be responsible for keeping the PM and QCSM up to date regarding the status of their respective tasks so that quick and effective solutions can be implemented should any data quality problems arise.

Sampling activities will be reviewed on a daily basis by the on-site task leader to determine if the sampling QC requirements are being fulfilled, such as the proper numbers of blanks and duplicate samples taken for each parameter sampled. All data sheets and logbooks will be reviewed daily. Any needed corrective action will be initiated and documented daily. Daily reports will be prepared when required by the project.

The FTL is also responsible for tabulating the number of borings and samples taken on a weekly basis. This information will be reported weekly to the QCSM and the PM.

The laboratory PM and QA officer have the responsibility of reviewing all laboratory analytical activities to ensure compliance with the QC requirements outlined in the QAPP. This review serves as a control function in that it should be conducted frequently so that deviations from method requirements will be immediately identified and corrected.

The laboratory PM is responsible for submitting a weekly sample status report to the project QC chemist. All laboratory data reports are also to be sent to the QCSM or project chemist as soon as they are finalized.

Upon receipt, each data package will be reviewed for completeness and adherence to the QC protocol established for each type of analysis. A summary report detailing the sampling and analysis status and any QA/QC problems will be prepared by the QCSM or project chemist after receipt of the field and laboratory reports and review of the analytical data reports, and sent to the PM. After validation, results of data validation will be reported in data validation reports, (DVRs) with sample results summarized in tables with validation qualifiers.

3.3.3.2 Report Content.

As appropriate, the required periodic reports will contain information on the status of the project and any quality problems. This includes:

- Activities and general program status
- Calibration and QC data problems
- Unscheduled maintenance activities

- Corrective action activities
- Status of any unresolved problems
- Assessment and summary of data completeness
- Any significant QA/QC problems and recommended and/or implemented solutions not included above.

The field auditor will prepare audit reports following each performance and systems audit that address the audit results and provide a qualitative assessment of overall system performance. These reports will be submitted to the Earth Tech PM. The laboratory PM will provide the QCSM with updates of any internal, state, or federal agency audits that occur within the project sampling period, including copies of audit reports and corrective actions if noncompliance with project-related activities is determined.

Problems requiring swift resolution will be brought to the immediate attention of the PM or QCSM via the nonconformance reporting/corrective action scheme discussed in Section 3.3.2.4.

3.4 DATA VALIDATION AND USABILITY

3.4.1 Laboratory Data Review, Validation, and Verification

The laboratory system for ensuring valid data includes several levels of review. Each level commands specific action to prevent the unqualified release of erroneous data and to correct any problems discovered during the review process.

All analytical data generated at the laboratory are extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and three levels of review, as described below.

Level 1 Review

The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. All data are generated and reduced following protocols specified in laboratory SOPs. Each analyst reviews the quality of his or her work based on an established set of guidelines. The analyst reviews the data package to ensure that:

- Sample preparation information is correct and complete; analysis information is correct and complete
- The appropriate SOPs have been followed

- Analytical results are correct and complete
- QC samples are within established control limits; blanks are within appropriate QC limits
- Special sample preparation and analytical requirements have been met
- Documentation is complete (e.g., all anomalies in the preparation and analysis have been documented; out-of-control forms, if required, are complete; holding times are documented).

This initial review step, performed by the analyst, is designated Level 1 review. The analyst then passes the data package to an independent reviewer, who performs a Level 2 review.

Level 2 Review

This is performed by a supervisor or data review specialist, whose function is to provide an independent review of the data package. This review is structured to ensure that:

- Calibration data are scientifically sound, appropriate to the method, and completely documented
- QC samples are within established guidelines
- Qualitative identification of sample components is correct
- Quantitative results are correct
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented; out-of-control forms, if required, are complete; holding times are documented)
- The data are ready for incorporation into the final report
- The data package is complete and ready for data archive.

Level 2 review is structured so that all calibration data and QC sample results are reviewed, and all of the analytical results from 10 percent of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is considered complete. If any problems are found with the data package, an additional 10 percent of the samples are checked to the bench sheet. The process continues until no errors are found or until the data package has been reviewed in its entirety. Level 2 data review is documented and the

signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared.

Level 3 Review

Before the report is released to the client, the Laboratory PM who is responsible for interfacing directly with Earth Tech reviews the report to ensure that the data meets the overall objectives of the project.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently.

In addition to the three levels of review discussed above, the divisional QA department conducts QA data audits of randomly selected projects. The frequency of the audits is determined by the error rate found. The QA data audit includes verifying that holding times have been met, calibration checks are adequate, qualitative and quantitative results are correct, documentation is complete, and QC results are complete and accurate. Any problems identified are reported to the appropriate laboratory managers for follow-up corrective actions.

The criteria for evaluation of blanks applies to any blank associated with the samples. If problems with any blank exist, all data associated with that batch must be carefully evaluated to determine whether or not there is an inherent variability in the data for that batch or if the problem is an isolated occurrence not affecting other data. Any detected concentration found in the blanks will be reported.

For organic analyses, the presence of target analytes in laboratory blanks above one-half the PQL (except common laboratory contaminants, which must be below the PQL) and detected in the associated samples at levels less than five times the level in the blank will result in re-extraction and reanalysis of associated samples and the blank.

For CAM-17 metals and wet chemistry analytes (except analytes not associated with DQOs, for example, chloride and sulfate), the presence of target analytes in laboratory blanks above one-half the PQL and detected in the associated samples at levels less than five times the level in the blank will result in reanalysis and/or re-extraction and reanalysis of associated samples and the blank. For metals not included in the CAM 17 target analyte list and wet chemistry analytes not associated with DQOs, the presence of target analytes in laboratory blanks above the PQL and detected in the associated samples at levels less than five times the level in the blank will not require reanalysis and/or re-extraction and reanalysis of associated samples and the blank.

3.4.2 Earth Tech Data Review, Validation, and Verification

3.4.2.1 Data Review and Verification.

Data review is performed both on field data sheets and laboratory data packages. Field data are checked for documentation completeness on data sheets and in logbooks, adherence to sample collection and testing procedures, inclusion of required field QC samples, correct preservation of samples, and complete and correct COC forms with signature and date at each transfer of custody.

Analytical laboratory data are checked for completeness of analyses as requested, inclusion of required frequency of QC samples, conformance to acceptance criteria for QC samples, adherence to holding time requirements, and second column confirmation where required.

For projects where electronic disk deliverables are provided by the laboratory, data may be further evaluated electronically using specialized programs and reports developed by Earth Tech personnel. Parameters for this evaluation include the following:

- Holding time compliance
- Contamination in laboratory as field blanks
- Surrogate recovery calculations and control limits
- MS/MSD and LCS recovery calculations and control limits
- RPD calculations for MS/MSD and field duplicates.

3.4.2.2 Data Validation.

Data validation is a systematic process of reviewing a body of data to provide assurance that the data are adequate for their intended use. The validation activities will be performed using the requirements and control limits specified in this QAPP and in the referenced methods in accordance with the following EPA documents as appropriate:

- *EPA National Functional Guidelines for Organic Data Review*, February 1994, EPA-540/R-94-012
- *EPA National Functional Guidelines for Inorganic Data Review*, February 1994, EPA-540/R-94-013
- *EPA Region IX. Guidance Document, Laboratory Documentation Requirements for Data Validation*, January 1990 (DCN 9QA-07-90).

A summary guideline for the assignment of data qualifiers is presented in Table 3.4-1. Qualifiers will be assigned according to the referenced guidance, Table 3.4-1, and the professional judgment of the validator.

Field data validation will include daily checks to ensure that all field data sheets are properly filled out, that the notebooks contain all the required information, and that all documents are signed and dated. It also includes a check that the information on the COC correlates with the field logs so that any discrepancies can be relayed to the laboratory immediately.

Final data validation by Earth Tech is the responsibility of the QCSM. Field data are checked for completeness of documentation on field data sheets and logbooks, for adherence to sample collecting and testing procedures, and for inclusion of the required number of field duplicates, equipments blanks, etc. COCs will be checked for signature and date at each transfer of custody, for correct information as compared to the field logbooks/data sheets, and for correct preservation documentation and analyses requests.

Earth Tech will request that the project analytical laboratory report 10 percent of project samples and associated field and laboratory QC samples in full raw data (EPA Level IV) packages. Earth Tech will specify the sample and sample groups using a random selection process for the 10 percent. Critical samples, if identified, or other samples determined to be of decision-making significance, will be included in the 10 percent. Validation of EPA Level III data packages will consist of cursory validation based upon review of the QC summary forms and other Level III documentation, and validation of Level IV data packages will consist of full validation based on review of all forms as well as review of the additional raw data for acceptable calibration criteria and frequency, spot checks of calculations, and use of proper procedures as documented in the laboratory notebooks. If any serious analytical problems are identified, Level IV data will be requested from the laboratory for additional data packages to receive full raw data review.

Data validation will include checking that required QC samples (e.g., method blanks, LCSs, MS/MSDs, check samples) have been performed at the required frequency and that the QC acceptance criteria listed in Section 3.2.5 have been met for these samples. Surrogate spikes will be checked to verify that they were performed where required, and that recovery acceptance criteria listed in Table 3.2-4 have been met. Instrument initial and continuing calibration data will be reviewed for completeness and conformance to acceptance criteria. Samples will be checked to confirm that sample preparation and analysis were performed within holding times, and that second chromatographic column or mass spectrometry confirmation were performed where required. Anomaly reports will be reviewed for acceptable corrective action for all out-of-control events.

Results from field duplicates and replicates will be compared and RPD values will be calculated, where possible. The RPD value is not defined for duplicate pairs for which one or both results are below reporting limits (RLs). For values less than 5 times the RL, RPDs will not be calculated. In these cases, results within one RL for waters, or within two RL for soils, will be considered acceptable. RPDs below 40 percent for soils and 30 percent for waters generally represent

good agreement. For higher RPDs or otherwise notable disagreement between duplicates, sample heterogeneity is generally the cause. If field duplicate pairs frequently exhibit differences greater than 40 percent for soils and 30 percent for waters, sampling and/or analytical procedures need to be reevaluated. Data are evaluated but not qualified for field duplicate results. The results of the evaluation will be examined and addressed in the final data report and in Data Quality Assessment (Section 3.4.3.1). All laboratory and field blanks associated with definitive data will be reviewed for blank contamination and the sample results qualified in the event that the contamination level is more than one-fifth (one-tenth for common laboratory contaminants) of the sample result. Blank qualified results are considered to be ND at the reported level, or at the PQL for organic compounds reported at less than the PQL, according to the blank qualification rules specified in the Functional Guidelines. If, in the professional judgment of the validator, results in a sample to be blank-qualified are due to real concentrations of an analyte in the sample, the result may be estimated without being considered to be ND. In instances where more than one blank is associated with a given sample, qualification should be based upon comparison with the associated blank having the highest concentration of a contaminant. Results for environmental samples must not be corrected by subtracting concentrations of analytes detected in associated blanks.

Qualifiers will be assigned by the reviewer to all data failing to meet the analytical and QC criteria specified in this QAPP, including criteria and control limits specified in Tables 3.1-1 and 3.2-1 through 3.2-5, according to the data flagging conventions summarized in Table 3.4-1 and the validation protocols specified above. Data qualified as "R" are rejected and considered unusable. Data qualified with the "J" qualifier are considered estimated and usable for limited purposes. "J+" indicates the possibility that the result may be biased high, and that the actual chemical level may be lower than the reported result. "J-" indicates the possibility that the result may be biased low, and that the actual chemical level may be higher than the reported result or detection limit reported for an ND result.

Most of the qualifiers to be used by the laboratory and in validation are taken from the *User's Guide to Contract Laboratory Program EPA/540/8-89/012*, December 1988. Matrix effects will be noted in the final data report for samples where the MS/MSD was out of criteria, but the LCS was within limits. ND sample results may be qualified where the LCS recovery is below control limits.

Data are reviewed and validated by experienced personnel in conformance with EPA data validation guidelines and the level of analytical quality prescribed for the project. Data review and validation is documented on special forms, included as Figures 3.4-1 through 3.4-7. For projects where EDDs are provided by the laboratory, data are evaluated electronically using specialized programs and reports developed by Earth Tech. In this case, the data required to be entered on the review forms are printed out in a format similar to the forms, and only some of the forms need to be filled out by the reviewer/validator.

Results of data validation will be reported in DVRs. All sample results will be presented in tables with validation qualifiers. Data quality and usability will be assessed in QCSRs.

3.4.3 Reconciliation with Data Quality Objectives

3.4.3.1 Data Quality Assessment.

Data Quality Assessment (DQA) is the scientific and statistical evaluation of data to determine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. DQA is built on the premise that data quality, as a concept, is meaningful only when it relates to the intended use of the data. The DQA process involves the following five steps according to EPA guidance on DQA in *Guidance for Data Quality Assessment: Practical Methods for Data Analysis* (EPA/QA G-9, July 1996):

- (1) Review the DQOs to assure they are still applicable, and review the sampling design and data collection documentation for consistency with the DQOs.
- (2) Conduct a preliminary data review by validating the data, reviewing the QCSR, calculating basic statistics, and generating tables or graphs of the data. Use this information to learn about the structure of the data and to identify patterns, relationships, or potential anomalies.
- (3) Select an appropriate statistical test to identify the underlying assumptions that must hold for the statistical procedures to be valid.
- (4) Verify the assumptions of the statistical test to evaluate whether the underlying assumptions hold, or whether departures are acceptable, given the actual data and other information about the study.
- (5) Draw conclusions from the data by performing the calculations required for the statistical test and document the inferences drawn as a result of these calculations as well as the performance of the sampling design.

The DQOs for this project specified in Section 3.1.4 of this QAPP will be assessed in two phases. DQOs for field record and analytical data QA/QC will be assessed by comparison to the requirements, control limits, or other QA/QC criteria, and goals specified in the QAPP. If the data meet the DQO elements and objectives for data quality specified throughout the QAPP, the data are considered valid and defensible data within the parameters of usability determined in the processes of data verification, validation and qualification, and usability assessment (Sections 3.4.1, 3.4.2, and 3.4.3). The data usability assessment is summarized in the final report, which is supported by the DVRs

and QCSR. After the environmental data have been collected, validated, and assessed for usability in accordance with the requirements of the QAPP, the data must then be evaluated to determine whether the project-specific DQOs specified in Section 3.1.4 of this QAPP were met. Assessment of these DQOs includes evaluation of the remaining elements and objectives in the DQO process, such as evaluation of sampling locations, number of samples collected and analyses performed; statistical analysis of the data according to the five steps previously described, if applicable; interpretation of the data with respect to decision errors and the decision rules; satisfactory resolution of the problem; and optimizing the DQOs for any future investigations performed based on the same sampling model or modifying the sampling model for further investigation.

For this project, the statistical processes may not be applicable, as the sampling plan calls for authoritative (judgment) sampling, wherein an expert determines sample location based on specific knowledge of contamination history instead of sampling in a probabilistic or otherwise statistically oriented manner.

3.4.3.2 Documentation.

Field QC procedures (e.g., duplicate sampling, blanks, and duplicate readings of field tests) are documented in the field notebooks and/or on field data sheets. All field documentation is reviewed by the FTL during audits and by the project chemist during validation at the end of the task.

Laboratory QC activities, (e.g., standard preparation, inclusion of MS/MSDs, results of blanks) are documented in logbooks, through computer printouts, and on analysis data sheets. All QC data is calculated and checked by the analyst and reviewed by the analytical supervisor. Review of QC activities is documented through the use of checklists that are signed by the reviewer and then checked by the laboratory PM as part of the laboratory report review. All QC NCR are reviewed, holding times are checked, and inclusion of second column confirmations are verified at this time. Originals of all laboratory-generated COC documentation and data sheets as well as customer-provided documentation are maintained in document files according to job number. Copies of all QC data except for data stored on computer disk are also stored in these files.

Data deliverables review procedures will be performed by Earth Tech. Information in EDDs will be maintained in a data base at Earth Tech. Electronic documentation is reviewed by the project chemist, or a designated representative such as a data manager. Documentation related to laboratory deliverables will be reviewed by the QCSM or the project chemist. Laboratory data packages will be maintained in the project files at Earth Tech. Data verification and validation activities will be documented in worksheets and communications records that will be filed with the laboratory data packages. Results of data validation will be reported in DVRs with sample results summarized in tables with validation qualifiers. Data quality and usability will be assessed in QCSRs. DVRs and QCSRs will be attached to the final reports for this project. All data deliverables and project reports will be maintained in the project files storeroom at the Colton office of Earth Tech.

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES

(Page 1 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) |
|---|-------------------|---------------------|-----------------|-----------------|-----------------|
| Metals (ICP/ ICP Trace) SW3005A (Waters) SW3050B (Soils) | SW6010B | Antimony | 60 | 3.0 | |
| | | Arsenic | 10.0 | 0.8 | |
| | | Barium | 10 | 1.0 | |
| | | Beryllium | 2.0 | 0.4 | |
| | | Cadmium | 5.0 | 1.0 | |
| | | Chromium | 10 | 2.0 | |
| | | Cobalt | 20 | 2.0 | |
| | | Copper | 25 | 3.0 | |
| | | Lead | 3.0 | 0.6 | |
| | | Molybdenum | 20 | 4.0 | |
| | | Nickel | 20 | 4.0 | |
| | | Selenium | 5.0 | 2.0 | |
| | | Silver | 10 | 2.0 | |
| | | Thallium | 10 | 2.0 | |
| | | Vanadium | 15 | 5.0 | |
| | | Zinc | 20 | 4.0 | |
| | | Aluminum | 200 | 40 | |
| | | Calcium | 1000 | 200 | |
| | | Iron | 200 | 15 | |
| | | Magnesium | 500 | 100 | |
| Manganese | 5.0 | 1.0 | | | |
| Phosphorous | 300 | 30 | | | |
| Potassium | 5000 | 500 | | | |
| Sodium | 1000 | 200 | | | |
| Mercury (Preparation included in method) | SW7470A (W) | Mercury | 0.2 | | |
| | SW7471A (S) | Mercury | - | 0.1 | |
| Total Petroleum Hydrocarbons SW3510C (Waters) SW3550B (Soils) SW3630C (Extracts) | SW8015B * LUFT | TEPH Diesel | 50 | 1.0 | |
| | | TEPH Kerosene | 50 | 1.0 | |
| | | TEPH Motor Oil | 500 | 10 | |
| | | | | | |
| Chlorinated Pesticides SW3510C (Waters) SW3550B (Soils) SW3620B (Extracts) and SW3630C upon request (Extracts) | SW8081A | Aldrin | 0.05 | 1.7 | |
| | | alpha-BHC | 0.05 | 1.7 | |
| | | beta-BHC | 0.05 | 1.7 | |
| | | delta-BHC | 0.05 | 1.7 | |
| | | gamma-BHC (Lindane) | 0.05 | 1.7 | |
| | | alpha-Chlordane | 0.05 | 1.7 | |
| | | gamma-Chlordane | 0.05 | 1.7 | |
| | | 4,4'-DDD | 0.1 | 3.4 | |
| | | 4,4'-DDE | 0.1 | 3.4 | |
| | | 4,4'-DDT | 0.1 | 1.7 | |
| | | Dieldrin | 0.1 | 3.4 | |
| | | Endosulfan I | 0.1 | 1.7 | |
| | | Endosulfan II | 0.05 | 3.4 | |
| | | Endosulfan sulfate | 0.1 | 3.4 | |
| | | Endrin | 0.1 | 3.4 | |
| | | Endrin aldehyde | 0.1 | 3.4 | |
| Endrin ketone | 0.1 | 3.4 | | | |

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES
(Page 2 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) |
|-----------------------------------|---------|----------------------------------|-----------------|-----------------|-----------------|
| | | Heptachlor | 0.05 | 1.7 | |
| | | Heptachlor epoxide | 0.05 | 1.7 | |
| | | Methoxychlor | 2 | 35 | |
| | | Toxaphene | 2 | 67 | |
| VOCs | SW8260B | 1,1-Dichloroethane | 3 | 0.005 | |
| SW3510C (Waters) | | 1,1-Dichloroethene | 1 | 0.005 | |
| SW3550B (Soils) | | 1,1-Dichloropropene | 1 | 0.005 | |
| SW3630C (Extracts) | | 1,1,1-Trichloroethane | 1 | 0.005 | |
| | | 1,1,1,2-Tetrachloroethane | 1 | 0.005 | |
| | | 1,1,2-Trichloroethane | 1 | 0.005 | |
| | | 1,1,2-Trichlorotrifluoroethane | 1 | 0.005 | |
| | | 1,1,2,2-Tetrachloroethane | 1 | 0.005 | |
| | | 1,2-Dibromoethane | 1 | 0.005 | |
| | | 1,2,-Dibromo-3- Chloropropane | 2 | 0.010 | |
| | | 1,2-Dichlorobenzene | 1 | 0.005 | |
| | | 1,2-Dichloroethane | 1 | 0.005 | |
| | | 1,2-Dichloropropane | 1 | 0.005 | |
| | | 1,2,3-Trichlorobenzene | 1 | 0.005 | |
| | | 1,2,3-Trichloropropane | 2 | 0.005 | |
| | | 1,2,4-Trichlorobenzene | 1 | 0.005 | |
| | | 1,2,4-Trimethylbenzene | 1 | 0.005 | |
| | | 1,3-Dichlorobenzene | 1 | 0.005 | |
| | | 1,3-Dichloropropane | 1 | 0.005 | |
| | | 1,3,5-Trimethylbenzene | 1 | 0.005 | |
| | | 1,4-Dichlorobenzene | 1 | 0.005 | |
| | | 2-Butanone | 10 | 0.020 | |
| | | 2-Chloroethyl vinyl ether | 5 | 0.020 | |
| | | 2-Chlorotoluene | 1 | 0.005 | |
| | | 2-Hexanone | 10 | 0.020 | |
| | | 2,2-Dichloropropane | 1 | 0.005 | |
| | | 4-Chlorotoluene | 1 | 0.005 | |
| | | 4-Methyl-2-pentanone | 10 | 0.020 | |
| | | Acetone | 10 | 0.020 | |
| | | Benzene | 1 | 0.005 | |
| | | Bromobenzene | 1 | 0.005 | |
| | | Bromochloromethane | 1 | 0.005 | |
| | | Bromodichloromethane | 1 | 0.005 | |
| | | Bromomethane | 2 | 0.010 | |
| | | Bromoform | 1 | 0.005 | |
| | | Carbon Disulfide | 2 | 0.020 | |
| | | Carbon Tetrachloride | 1 | 0.005 | |
| | | Chlorobenzene | 1 | 0.005 | |
| | | Chloroethane | 2 | 0.010 | |

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES
(Page 3 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) |
|-----------------------------------|--------|---------------------------|-----------------|-----------------|-----------------|
| | | Chloroform | 1 | 0.005 | |
| | | Chloromethane | 2 | 0.010 | |
| | | cis-1,2-Dichloroethene | 1 | 0.005 | |
| | | cis-1,3-Dichloropropene | 1 | 0.005 | |
| | | Dibromochloromethane | 1 | 0.005 | |
| | | Dibromomethane | 1 | 0.005 | |
| | | Dichlorodifluoromethane | 2 | 0.010 | |
| | | Ethylbenzene | 1 | 0.005 | |
| | | Hexachlorobutadiene | 1 | 0.005 | |
| | | Isopropylbenzene | 1 | 0.005 | |
| | | m & p-Xylene | 1 | 0.010 | |
| | | Methyl(tert)butylether | 2 | 0.005 | |
| | | Methylene Chloride | 2 | 0.020 | |
| | | n-Butylbenzene | 1 | 0.005 | |
| | | n-Propylbenzene | 1 | 0.005 | |
| | | Naphthalene | 1 | 0.010 | |
| | | o-Xylene | 1 | 0.005 | |
| | | p-Isopropyltoluene | 1 | 0.005 | |
| | | sec-Butylbenzene | 1 | 0.005 | |
| | | Styrene | 1 | 0.005 | |
| | | tert-Butylbenzene | 1 | 0.005 | |
| | | Tetrachloroethene | 1 | 0.005 | |
| | | Toluene | 1 | 0.005 | |
| | | trans-1,2-Dichloroethene | 1 | 0.005 | |
| | | trans-1,3-Dichloropropene | 1 | 0.005 | |
| | | Trichloroethene | 1 | 0.005 | |
| | | Trichlorofluoromethane | 2 | 0.010 | |
| | | Vinyl Acetate | 5 | 0.010 | |
| | | Vinyl Chloride | 10 | 0.020 | |

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES
(Page 4 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) |
|--------------------------------|---------|-----------------------------|--------------|--------------|--------------|
| SVOCs | SW8270C | 1,2-Dichlorobenzene | 10 | 1 | |
| SW3510C (Waters) | | 1,2-Dinitrobenzene | 10 | 1 | |
| SW3550B (Soils) | | 1,2,4-Trichlorobenzene | 10 | 2 | |
| SW3630C (Extracts) | | 1,3-Dichlorobenzene | 10 | 1 | |
| | | 1,3-Dinitrobenzene | 10 | 1 | |
| | | 1,4-Dichlorobenzene | 10 | 1 | |
| | | 1,4-Dinitrobenzene | 10 | 1 | |
| | | 2-Chloronaphthalene | 10 | 1 | |
| | | 2-Chlorophenol | 10 | 1 | |
| | | 2-Methylnaphthalene | 10 | 2 | |
| | | 2-Methylphenol | 10 | 2 | |
| | | 2-Nitroaniline | 50 | 2 | |
| | | 2-Nitrophenol | 10 | 1 | |
| | | 2,4-Dichlorophenol | 10 | 1 | |
| | | 2,4-Dimethylphenol | 10 | 1 | |
| | | 2,4-Dinitrophenol | 50 | 2 | |
| | | 2,4-Dinitrotoluene | 10 | 1 | |
| | | 2,4,5-Trichlorophenol | 50 | 2 | |
| | | 2,4,6-Trichlorophenol | 10 | 1 | |
| | | 2,6-Dinitrotoluene | 10 | 1 | |
| | | 3-Nitroaniline | 50 | 2 | |
| | | 3,3'-Dichlorobenzidine | 50 | 5 | |
| | | 3,4-Methylphenol | 10 | 1 | |
| | | 4-Bromophenyl-phenylether | 10 | 1 | |
| | | 4-Chloro-3-Methylphenol | 10 | 1 | |
| | | 4-Chloroaniline | 10 | 1 | |
| | | 4-Chlorophenyl-phenylether | 10 | 1 | |
| | | 4-Nitroaniline | 50 | 2 | |
| | | 4-Nitrophenol | 50 | 2 | |
| | | 4,6-Dinitro-2-Methylphenol | 50 | 2 | |
| | | Acenaphthene | 10 | 1 | |
| | | Acenaphthylene | 10 | 1 | |
| | | Anthracene | 10 | 1 | |
| | | Aniline | 10 | 2 | |
| | | Benzidine | 50 | 4 | |
| | | Benzo(a)anthracene | 10 | 1 | |
| | | Benzo(a)pyrene | 10 | 1 | |
| | | Benzo(b)fluoranthene | 10 | 1 | |
| | | Benzo(g,h,i)perylene | 10 | 1 | |
| | | Benzo(k)fluoranthene | 10 | 1 | |
| | | Benzoic Acid | 50 | 4 | |
| | | Benzyl Alcohol | 10 | 1 | |
| | | bis(2-Chloroethoxy) methane | 10 | 1 | |
| | | bis(2-Chloroethyl)ether | 10 | 1 | |

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES
(Page 5 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) |
|-----------------------------------|--------|-------------------------------|-----------------|-----------------|-----------------|
| | | bis(2-Chloroisopropyl)ether | 20 | 2 | |
| | | bis(2-Ethylhexyl)phthalate | 25 | 5 | |
| | | Butylbenzylphthalate | 10 | 1 | |
| | | Carbazole | 10 | 1 | |
| | | Chrysene | 10 | 1 | |
| | | Di-n-Butylphthalate | 25 | 5 | |
| | | Di-n-Octylphthalate | 10 | 1 | |
| | | Dibenzo(a,h)anthracene | 10 | 1 | |
| | | Dibenzofuran | 10 | 1 | |
| | | Diethylphthalate | 10 | 1 | |
| | | Dimethyl Phthalate | 10 | 1 | |
| | | Fluoranthene | 10 | 1 | |
| | | Fluorene | 10 | 1 | |
| | | Hexachlorobenzene | 10 | 1 | |
| | | Hexachlorobutadiene | 25 | 5 | |
| | | Hexachlorocyclopentadiene | 50 | 5 | |
| | | Hexachloroethane | 10 | 1 | |
| | | Indeno(1,2,3-cd)pyrene | 10 | 1 | |
| | | Isophorone | 25 | 5 | |
| | | n-Nitroso-dimethylamine | 40 | 5 | |
| | | n-Nitroso-di-n-Propylamine | 10 | 1 | |
| | | n-Nitrosodiphenylamine | 10 | 1 | |
| | | Naphthalene | 10 | 1 | |
| | | Nitrobenzene | 10 | 1 | |
| | | Pentachlorophenol | 50 | 2 | |
| | | Phenanthrene | 10 | 1 | |
| | | Phenol | 10 | 1 | |
| | | Pyrene | 10 | 1 | |

(Bold indicates SW8310 compounds)

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES
(Page 6 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) | |
|--|--------|---|--------------|--------------|--------------|-----|
| Dioxins/Furans (Preparation included in method) | SW8290 | Dioxins | | | TEF | |
| | | 2,3,7,8-TCDD | 20 pg/L | 2.0 pg/g | 1.0 | |
| | | 1,2,3,7,8-PeCDD | 50 pg/L | 5.0 pg/g | 0.5 | |
| | | 1,2,3,4,7,8-HxCDD | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 1,2,3,6,7,8-HxCDD | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 1,2,3,7,8,9-HxCDD | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 1,2,3,4,6,7,8-HpCDD | 50 pg/L | 5.0 pg/g | 0.01 | |
| | | OCDD | 100 pg/L | 10 pg/g | 0.001 | |
| | | Furans | | | | |
| | | 2,3,7,8-TCDF | 20 pg/L | 2.0 pg/g | 0.1 | |
| | | 1,2,3,7,8-PeCDF | 50 pg/L | 5.0 pg/g | 0.05 | |
| | | 2,3,4,7,8-PeCDF | 50 pg/L | 5.0 pg/g | 0.5 | |
| | | 1,2,3,4,7,8-HxCDF | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 1,2,3,6,7,8-HxCDF | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 1,2,3,7,8,9-HxCDF | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 2,3,4,6,7,8-HxCDF | 50 pg/L | 5.0 pg/g | 0.1 | |
| | | 1,2,3,4,6,7,8,-HpCDF | 50 pg/L | 5.0 pg/g | 0.01 | |
| | | 1,2,3,4,7,8,9-HpCDF | 50 pg/L | 5.0 pg/g | 0.01 | |
| | | OCDF | 100 pg/L | 10 pg/g | 0.001 | |
| | | PAHs SW3510C (Waters) SW3550B (Soils) SW3630C (Extracts) | SW8310 | Napthalene | 2.5 | 0.4 |
| Acenaphthylene | 5.0 | | | 0.4 | | |
| Acenaphthene | 2.5 | | | 0.4 | | |
| Fluorene | 0.5 | | | 0.04 | | |
| Phenanthrene | 0.6 | | | 0.12 | | |
| Anthracene | 0.7 | | | 0.14 | | |
| Fluoranthrene | 0.5 | | | 0.05 | | |
| Pyrene | 0.5 | | | 0.06 | | |
| Benzo(a)anthracene | 0.3 | | | 0.02 | | |
| Chrysene | 0.3 | | | 0.04 | | |
| Benzo(b)fluoranthene | 0.5 | | | 0.03 | | |
| Benzo(k)fluoranthene | 0.3 | | | 0.02 | | |
| Benzo(a)pyrene | 0.3 | | | 0.02 | | |
| Dibenzo(a,h)anthracene | 1.0 | | | 0.04 | | |
| Benzo(g,h,i)perylene | 0.5 | | | 0.02 | | |
| Indeno(1,2,3-c,d)pyrene | 0.5 | | | 0.04 | | |

TABLE 3.1-1. PRACTICAL QUANTITATION LIMITS FOR DEFINITIVE-LEVEL ANALYSES
(Page 7 of 7)

| Parameter & Preparation Method | Method | Analyte | Water (µg/L) | Soil (mg/kg) | TEF (SW8290) |
|--|------------------|--|--------------|--------------|--------------|
| Explosives (Preparation included in method) | SW8330 | HMX | 5.0 | 0.4 | |
| | | RDX | 5.0 | 0.4 | |
| | | 4-Amino-2,6-dinitrotoluene | 5.0 | 0.4 | |
| | | TNB | 5.0 | 0.4 | |
| | | 1,3-DNB | 5.0 | 0.4 | |
| | | Methyl-2,3,6-trinitrophenyl-nitramine (Tetryl) | 5.0 | 0.4 | |
| | | Nitrobenzene | 5.0 | 0.4 | |
| | | TNT | 5.0 | 0.4 | |
| | | 2,4-DNT | 5.0 | 0.4 | |
| | | 2,6-DNT | 5.0 | 0.4 | |
| | | o-Nitrotoluene | 5.0 | 0.4 | |
| | | m-Nitrotoluene | 5.0 | 0.4 | |
| | | p-Nitrotoluene | 5.0 | 0.4 | |
| | | Nitroglycerin | 25 | 0.5 | |
| PETN | 50 | 0.5/1.0 ^(a) | | | |
| Total Organic Carbon | SW9060 | TOC | N/A | 100 mg/kg | |
| | E415.1 | TOC | 1 mg/L | N/A | |
| Total Dissolved Solids | E160.1 | TDS | 10 mg/L | N/A | |
| Total Suspended Solids | E160.2 | TSS | 10 mg/L | N/A | |
| Common Anions | E300.0 | Chloride | 1.0 mg/L | 5.0 mg/kg | |
| | | Nitrate-N | 0.1 mg/L | 0.5 mg/kg | |
| | | Nitrite-N | 0.1 mg/L | 0.5 mg/kg | |
| | | Sulfate | 1.0 mg/L | 5.0 mg/kg | |
| Perchlorate | CADHS E300.0-Mod | Perchlorate | 4.0 µg/L | 0.5 mg/kg | |
| Total Phosphorous | E365.2/365.3 | Total Phosphorous | 1.0 mg/L | 2.0 mg/kg | |

The methods cited are from the following sources:

- "E" Methods Methods for Chemical Analysis of Water and Wastes, EPA Manual, 600/4-79-020 (USEPA, 1983--with additions)
- "SW" Methods Test methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (USEPA, 1986)
- "L" Methods Leaking Underground Fuel Tank Field Manual (State of California, 1989)

CADHS E300.0-Mod = Perchlorate by California Department of Health Services (CADHS) Sanitation and Radiation Laboratories Branch (SRLB) modification of EPA Method 300.0

All sample results will be reported down to the MDL (Refer to Section 3.2.4.2, last paragraph).

- W = Water
- S = Soil
- TEF = Toxicity Equivalence Factors
- NA = Not Analyzed

(a) 1.0 PQL may be reported for some samples not associated with the TNT Strips

Table 3.1-2. Recommended Sample Container, Preservation, and Holding Times for Selected Analytical Test Methods

| Parameter | Aqueous Sample Container ^(a) | Field Filter ^(a) | Volume Required | | Preservation ^(b) | | Maximum Holding Times ^{(c)**} |
|--|---|-----------------------------|-----------------|---------------|---|---|--|
| | | | Water (ml)* | Soil (g) | Water | Soil | |
| Metals (SW6010B) | P, G, T | X | 1000 | 250 | HNO ₃ to pH <2 | 4°C | 6 months |
| Mercury (SW7470A/SW7471A) | P, G, T | X | 1000 | 10 | HNO ₃ to pH <2 | 4°C | 28 days |
| Total Petroleum Hydrocarbons: TEPH Diesel, Kerosene, and Motor Oil (Mod SW8015 LUFT) | G, amber, T | | 1,000 | 250 | Cool 4°C | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Organochlorine Pesticides/PCBs (SW8081A/SW8082) | G, Teflon™ screw cap | | 1000 | 250 | Cool 4°C | 4°C | 7 days until extraction, 40 days after extraction |
| Volatile Organics (SW8260B) Preparation by SW5030 or SW5035 | G, Teflon™ lined septum, T | | 3 x 40 | 25 for SW5035 | Cool 4°C HCl to pH<2 (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C; and Na ₂ SO ₄ or Methanol for SW5035 | 14 days (7 days for waters if not pH adjusted); 48 hours for soils by SW5035 Encore™ sampler method if unpreserved |
| Semivolatile Organics (SW8270C) | G, Teflon™ screw cap, T | | 1000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Dioxins/Furans (SW8280A/SW8290) | G, Teflon™ screw cap | | 1000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) store in dark | 4°C | 7 days until extraction, 40 days after extraction |
| Polyaromatic Hydrocarbons (SW8310) | G, Teflon™ screw cap, T | | 1,000 | 250 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soil) until extraction, 40 days after extraction |
| Nitroaromatics & Nitroamines (SW8301); and Nitroglycerin/PETN (SW8330/8332) Collect Separate Water Containers for Nitroglycerin/PETN | G, Teflon™-screw cap | | 1000 | 50 | Cool 4°C (0.008% Na ₂ S ₂ O ₃ ^(d)) | 4°C | 7 days (water) and 14 days (soils) until extraction, 40 days after extraction |
| Residue, Filterable (160.1) (TDS) | P, G | | 100 | NA | Cool 4°C | NA | 7 days |
| Residue, Non-Filterable (160.2) (TSS) | P, G | | 100 | NA | Cool 4°C | NA | 7 days |
| Chloride, Sulfate (300.0) | P | | 100 | 50 | Cool 4°C | 4°C | 28 days |
| Nitrate-N, Nitrite-N, Orthophosphate-P (300.0) | P, G | | 100 | 50 | Cool 4°C | 4°C | 48 hours |
| Perchlorate (CADOHS 300.0-mod) | P | | 50 | 50 | Cool 4°C | 4°C | 28 days |
| Orthophosphate-P (365.2) | P | X | 50 | 50 | Cool 4°C | 4°C | 48 hours |

**Table 3.1-2. Recommended Sample Container, Preservation, and Holding Times
for Selected Analytical Test Methods**

| Parameter | Aqueous Sample Container ^(a) | Field Filter ^(e) | Volume Required | | Preservation ^(b) | | Maximum Holding Times ^{(c)**} |
|--|---|-----------------------------|-----------------|----------|--|------|--|
| | | | Water (ml)* | Soil (g) | Water | Soil | |
| Total Organic Carbon (415.1, SW9060) | P, G | | 1000 | 150 | Cool 4°C; H ₂ SO ₄ or HCl to pH <2 | 4°C | 28 days |
| Electrical Conductivity (120.1)(field) | P, G | | 100 | NA | None Required | NA | Analyze immediately |
| Hydrogen ion (pH) (150.1)(field) | P, G | | 50 | NA | None Required | NA | Analyze immediately |
| Temperature (170.1) (field) | P, G | | 1000 | NA | None Required | NA | Analyze immediately |
| Turbidity (180.1) (field) | P, G | | 100 | NA | None Required | NA | Analyze immediately |

Note: * Do not pre-wash bottle with samples.

** Extraction holding times are from date of sample collection; analysis times are from date of extraction.

Reference: This table includes the requirements of the U.S. Environmental Protection Agency, as published in the Code of Federal Regulations, Volume 49, Number 209, 40CFR 136, dated October 26, 1984, page 43260.

- (a) Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T). Soil samples may be collected in either glass jar or stainless steel liners with both ends sealed with Teflon™ paper and plastic caps.
- (b) Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed.
- (c) Samples should be analyzed as soon as possible after collection. The times listed are maximum times (in calendar days) that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the monitoring laboratory has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period given in the table. The monitoring laboratory is obligated to hold the sample for a shorter period if knowledge exists to show this is necessary to maintain sample stability.

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
(Page 1 of 23)

| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|------------------|-----------------------------|---|--|--|--|
| SW6010B (ICP) | Metals (Dissolved or Total) | Method Blank | 5% (one per batch of 20 or fewer samples) | <1/2 PQL ^(a) for all analytes | <ol style="list-style-type: none"> 1) If concentration in associated sample is <1/2 PQL or >5X the contamination, note the blank contamination in the case narrative and report sample result. Otherwise: <ol style="list-style-type: none"> 2) Reanalyze blank once 3) Determine source of contamination (analyze a system blank) 3a) If source is instrument, perform maintenance, reanalyze blank and samples 3b) If source is preparation, reprep and reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank. |
| | | Laboratory Duplicate Sample and Matrix Spike (Predigestion spike) (Matrix Spike Duplicate may be used if duplicate not run) | 5% (one per SDG of 20 or fewer samples) 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for precision (RPD) criteria. See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits). |
| | | Post Digestion Analytical Spike | As needed to confirm matrix effects | 75-125%R | <ol style="list-style-type: none"> 1) Report and flag data 2) Note in case narrative 3) No laboratory corrective action |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
(Page 2 of 23)

| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|------------------------|------------------|------------------------------------|--|---|---|
| SW6010B (Continued) | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See (b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis accepted, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | | ICP Serial Dilution (5X) | 5% (one per SDG of 20 or fewer samples) | 1-4 dilution must agree within 10% D for analytes with undiluted results >50X the IDL | <ol style="list-style-type: none"> 1) Report and flag data 2) Note in case narrative 3) No laboratory corrective action |
| | | Method of Standard Additions (MSA) | As needed for samples when an interference that is constant across the linear range is suspected | r>0.995 | <ol style="list-style-type: none"> 1) Report and flag data 2) Note in case narrative 3) No laboratory corrective action |
| | <u>Field QC:</u> | Equipment Blank | Once per day per sampling team for reusable equipment | <1/2 PQL ^(a) for all analytes | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
(Page 3 of 23)

| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|-------------------------|------------------------------|---|---|---|---|
| SW6010B (Continued) | | Unspiked Duplicate Samples | 10% (one per 10 samples) | ≤ 30 RPD - Waters ≤ 40 RPD - Soils | No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |
| | | Filter Blank | One of every ten filters per filter lot | < ½ PQL ^(a) for all analytes | No laboratory corrective action. Positive filter blank results will result in review of filters used. |
| SW7470A/7471A (CVAA) | Mercury (Dissolved or Total) | Method blank | 1 per batch of 20 samples or less | < ½ PQL ^(a) for all analytes | <p>1) If concentration in associated sample is < PQL or > 5X the contamination, note the blank contamination in the case narrative and report sample result. Otherwise:</p> <p>2) Reanalyze blank once</p> <p>3) Determine source of contamination (analyze a system blank)</p> <p>3a) If source is instrument, perform maintenance, reanalyze blank and samples</p> <p>3b) If source is preparation, reprep and reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank.</p> |
| | | Laboratory Duplicate Sample and | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for precision (RPD) criteria. | <p>1) Check calculations</p> <p>2) Evaluate the System. (instrument)</p> |
| | | Matrix Spike (Predigestion spike) (Matrix Spike Duplicate may be used if duplicate not run) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <p>3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits).</p> |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|------------------------------|-----------|------------------------------------|--|---|--|
| SW7470A/7471A (Continued) | | Post Digestion Analytical Spike | As needed to confirm matrix effects | 75-125%R | <ol style="list-style-type: none"> 1) Report and flag data 2) Note in case narrative 3) No laboratory corrective action |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See ^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis acceptable, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | | Serial Dilution (5X) | 1 per batch as needed if sample results exceed 25 times the MDL to test for interference in new and unusual matrices | 1:4 dilution must agree within 10% D for analytes with undiluted results >50X the IDL | <ol style="list-style-type: none"> 1) Report and flag data 2) Note in case narrative 3) No laboratory corrective action |
| | | Method of Standard Additions (MSA) | As needed for samples with suspected or confirmed matrix effects | r>0.995 | <ol style="list-style-type: none"> 1) Report and flag data 2) Note in case narrative 3) No laboratory corrective action |
| | | Equipment Blank | Once per day per sampling team for reusable equipment | <1/2 PQL ^(a) for all analytes | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. |

Field QC:

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|--------------------------------------|--|----------------------------|--|--|---|
| SW7470A/7471A (Continued) | | Unspiked Duplicate Samples | 10% (one per 10 samples) | ≤ 30 RPD - Waters ≤ 40 RPD - Soils | No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |
| | | Filter Blank | One of every ten filters per filter lot | $< \frac{1}{2}$ PQL ^(e) for all analytes | No laboratory corrective action. Positive filter blank results will result in review of filters used. |
| LUFT Mod SW8015B TEPH (GC/FID) | TEPH Diesel, Kerosene, and Motor Oil | Method blank | 1 per batch of 20 samples or less | $< \frac{1}{2}$ PQL ^(e) for all analytes | 1) If concentration in associated sample is $< \text{PQL}$ or $> 5X$ the contamination, note the blank contamination in the case narrative and report sample result. Otherwise: 2) Reanalyze blank once 3) Determine source of contamination (analyze a system blank) 3a) If source is instrument, perform maintenance, reanalyze blank and samples 3b) If source is preparation, reprep and reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank. |
| | | Surrogate spikes | Every sample, method blank, and standard | Refer to Table 3.2-4 Does not apply if more than 5X dilution for extractables | 1) Check calculations, standards and system 2) If surrogate is out, check instrument performance; if problem is found, correct and reanalyze sample, or proceed to 3. 3) (Continued Next Page) |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|---|-----------|--|--|---|--|
| LUFT Mod SW8015B TEPH (Continued) | | | | | 3) If still unacceptable and within holding time or if positive results detected, reextract and reanalyze sample, unless chromatogram indicates interference, in which case one reanalysis is acceptable. Report both sets of results. If beyond holding time, assess impact and qualify data. Discuss in case narrative. |
| | | Matrix Spike/Matrix Spike Duplicate (MS/MSD) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits). |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See ^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis acceptable, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC-Performed | Frequency | Acceptance Criteria | Corrective Action |
|---|---------------------------|---|---|--|---|
| LUFT Mod SW8015B TEPH (Continued) | Field QC: | Equipment Blank Unspiked Duplicate Samples | Once per day per sampling team for reusable equipment 10% (one per 10 samples) | <1/2 PQL ^(a) for all analytes ≤30 RPD -Waters ≤40 RPD - Soils | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |
| SW8081A (GC/ECD) | Organochlorine Pesticides | Method blank | 1 per batch of 20 samples or less | <1/2 PQL ^(a) for all analytes | 1) If concentration in associated sample is <PQL or >10X the contamination, note the blank contamination in the case narrative and report sample result. Otherwise: 2) Reanalyze blank once 3) Determine source of contamination (analyze a system blank) 3a) If source is instrument, perform maintenance, reanalyze blank and samples 3b) If source is preparation, prep and reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|------------------------|-----------|---|--|---|---|
| SW8081A (Continued) | | Surrogate spikes | Every sample, method blank, and standard | Refer to Table 3.2-4 Does not apply if more than 5X dilution | <ol style="list-style-type: none"> 1) Check calculations, standards and system if more than one surrogate is out, check instrument performance; if problem is found, correct and reanalyze sample, or proceed to 3. 2) If still unacceptable and within holding time or if positive results detected, reextract and reanalyze sample, unless chromatogram indicates interference, in which case one reanalysis is acceptable. Report both sets of results. If beyond holding time, assess impact and qualify data. Discuss in case narrative. |
| | | Matrix Spike/Matrix Spike Duplicate (MS/MSD) (must use EAFB sample) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits). |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|------------------------|-----------|--|--|---|--|
| SW8081A (Continued) | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See ^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis acceptable, reanalyze associated samples (other than those in 3) 5b) if still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | | Second Column Confirmation (excluding multicomponent analytes such as PCBs, toxaphene and chlordane) | 100% for all positive results | Results \pm 40% D | <ol style="list-style-type: none"> 1) If not confirmed (NC), report results as ND 2) If 2nd column confirms, summarize primary and confirmation results with %D, or report both sets of results |
| | Field QC: | Equipment Blank | Once per day per sampling team for reusable equipment | $< \frac{1}{2}$ PQL ^(e) for all analytes | No laboratory corrective action |
| | | Unspiked Duplicate (aqueous) or Replicate (soil) Samples | 10% (one per 10 samples) | \leq 30 RPD -Waters \leq 40 RPD - Soils | No laboratory corrective action |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|---------------------------------|-----------|------------------------------|---|--|---|
| SW8260B and SW8270C (Continued) | | Surrogate spikes (Continued) | | | 3) If still unacceptable and within holding time or if positive results detected, reextract and reanalyze sample, unless chromatogram indicates interference, in which case one reanalysis is acceptable. Report both sets of results. If beyond holding time, assess impact and qualify data. Discuss in case narrative. |
| | | Internal Standards - CCVs | Every 12 hour continuing calibration verification (CCV) standard check (and every sample, method blank, and standard - see below) | RT \pm 30 seconds from RT of the ICAL mid-point standard; EICP area within - 50% to +100% of ICAL mid-point standard | 1) Inspect GC and MS for malfunctions and check sensitivity of instrument 2) Corrections must be made (may require recalibration) 3) Reanalyze standard and all samples analyzed while system was malfunctioning |
| | | Internal Standards-Samples | Every sample, method blank, and standard | RT \pm 30 seconds from RT of the 12 hour CCV; EICP area within - 50% to +100% of the 12 hour CCV | 1) Check sensitivity of instrument 2) Reprep (SW5035) if required and reanalyze affected samples, blanks, and/or standards. Report both sets of results. 3) If still out, assess problem, report data, and note in the case narrative. If blanks/LCS and samples still out, further corrective action required |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|---------------------------------|------------------|--|---|---|---|
| SW8260B and SW8270C (Continued) | | Matrix Spike/Matrix Spike Duplicate (MS/MSD) (must use Project sample) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits). |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis accepted, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | <u>Field QC:</u> | Equipment Blank | Once per day per sampling team (soil); one of every ten bailers per disposable bailer lot (aqueous) | < 1/2 PQL ^(a) for all analytes | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. |
| | | Unspiked Duplicate (aqueous) or Replicate (soil) Samples | 10% (one per 10 samples) | ≤30 RPD - Waters ≤40 RPD - Soils | No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|---------------------|----------------|--|---|---|---|
| SW8290 (GC/HRMS) | Dioxins/Furans | Method blank | 1 per batch of 20 samples or less per matrix | Ratio of a given 2,3,7,8 substituted PCDD/PCDF isomer ≤ 5% of the appropriate internal standard. | <ol style="list-style-type: none"> 1) Reanalyze method blank. 2) If still exceeds and analyte conc. concentration in sample < CRQL or > 5X blank concentration, report results. 3) If noncompliant and analyte concentration in sample is between CRQL and 5X blank concentration, reextract/reanalyze affected samples. |
| | | Internal Standards (surrogates are used as internal standards) | Every sample, method blank, and LCS | Refer to Table 3.2-4 | <ol style="list-style-type: none"> 1) Check chromatogram for interference. If found, flag data. 2) Check instrument and reanalyze the extract if a problem is found and corrected. 3) Check S/N. If < 10:1, reextract. 4) Evaluate data usability and flag as appropriate. 5) Reextract and reanalyze adversely affected samples. |
| | | Matrix Spike/Matrix Spike Duplicate (MS/MSD) Laboratory Duplicate Sample | Not Required by the method, may be requested: 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Review data for usability. 2) Narrate outliers. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------|------------------|--|---|--|--|
| SW8290 (Continued) | | Laboratory Control Sample (include natives.) | At a frequency of 5% (1 per 20 samples analyzed.) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Review Internal Standards, as above. 2) Evaluate data for usability. 3) If sample results are ND and CRQLs are met, no action required. 4) If samples have positives, > CRQL, reextract and reanalyze analytes outside the acceptance criteria. |
| | <u>Field QC:</u> | Equipment Blank | Once per day per sampling team for reusable equipment | <1/2 PQL ^(a) for all analytes | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. |
| | | Unspiked Duplicate Samples | 10% (one per 10 samples) | ≤30 RPD - Waters ≤40 RPD - Soils | No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------|-----------|--|--|---|--|
| SW8310 (Continued) | | Matrix Spike/Matrix Spike Duplicate (MS/MSD) or MS and Laboratory Duplicate Sample | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits). |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See ^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis acceptable, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | | Second Column or Second Detector Confirmation | 100% for all positive results | Results \pm 50% D | <ol style="list-style-type: none"> 1) If not confirmed (NC), report results as ND 2) If 2nd column confirms, summarize primary and confirmation results with %D, or report both sets of results |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------|--|----------------------------|---|--|---|
| SW8310 (Continued) | Field QC: | Equipment Blank | Once per day per sampling team for reusable equipment | <1/2 PQL ^(a) for all analytes | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. |
| | | Unspiked Duplicate Samples | 10% (one per 10 samples) | ≤30 RPD - Waters ≤40 RPD - Soils | No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |
| SW8330 (HPLC/UV) | Explosives: Nitroaromatics and Nitroamines and Nitroglycerin/PETN | Method blank | 1 per batch of 20 samples or less | <1/2 PQL ^(a) for all analytes | <p>1) If concentration in associated sample is <PQL or >5X the contamination, note the blank contamination in the case narrative and report sample result. Otherwise:</p> <p>2) Reanalyze blank once</p> <p>3) Determine source of contamination (analyze a system blank)</p> <p>3a) If source is instrument, perform maintenance, reanalyze blank and samples</p> <p>3b) If source is preparation, reprep and reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank.</p> |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------|-----------|--|--|---|--|
| SW8330 (Continued) | | Surrogate spikes | Every sample, method blank, and standard | Refer to Table 3.2-4 Does not apply if more than 5X dilution | <ol style="list-style-type: none"> 1) Check calculations, standards and system 2) If surrogate is out, check instrument performance; if problem is found, correct and reanalyze sample, or proceed to 3. 3) If still unacceptable and within holding time or if positive results detected, reextract and reanalyze sample, unless chromatogram indicates interference (and for purgeables), in which case one reanalysis is acceptable. Report both sets of results. If beyond holding time, assess impact and qualify data. Discuss in case narrative. |
| | | Matrix Spike/Matrix Spike Duplicate (MS/MSD) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | <ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Re-extract/reanalyze. If recoveries are still not within QC limits, flag data and note in the case narrative as attributable to matrix effects (if LCS recoveries are within QC limits). |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See ^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case (Continued) |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------|------------------|---|---|---|--|
| SW8330 (Continued) | | LCS (Continued) | | | (Continued) narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis acceptable, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | | Second Column or Second Detector Confirmation | 100% for all positive results | Results $\pm 50\%$ D | 1) If not confirmed (NC), report results as ND 2) If 2nd column confirms, summarize primary and confirmation results with %D, or report both sets of results |
| | <u>Field QC:</u> | Equipment Blank | Once per day per sampling team for reusable equipment | $< \frac{1}{2}$ PQL ^(a) for all analytes | No laboratory corrective action. If equipment blank contamination is consistent and method blanks are acceptable, field decontamination procedures should be reviewed and corrective measures taken. |
| | | Unspiked Duplicate Samples | 10% (one per 10 samples) | ≤ 30 RPD - Waters ≤ 40 RPD - Soils | No laboratory corrective action. If field duplicate samples have poor precision, sample homogeneity will be reviewed and evaluated in data reports. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES

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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|--|--|--|---|---|--|
| General Inorganics (Spikeable): 300.0 | General Inorganics (Spikeable): Chloride Nitrate-N Nitrite-N Sulfate | Method Blank | 5% (one per batch of 20 or fewer samples) | <1/2 PQL ^(a) for all analytes | 1) If concentration in associated sample is <PQL or >5X the contamination, note the blank contamination in the case narrative and report sample result. Otherwise: 2) Reanalyze blank once 3) Determine source of contamination (analyze a system blank) 3a) if source is instrument, perform maintenance, reanalyze blank and samples 3b) If source is preparation, reprep and reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank. |
| CA DTSC 300.0-Mod 365.2/365.3 415.1 and SW9060 | Perchlorate Total Phosphorous Total Organic Carbon (TOC) | Matrix Spike/Matrix Spike Duplicate (MS/MSD) or MS and Laboratory Duplicate Sample (must use Project sample) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for accuracy (recovery) and precision (RPD) criteria. | 1) Check calculations 2) Evaluate the System. (instrument) 3) Check LCS: If recoveries are within QC limits, flag data and note in the case narrative as attributable to matrix effects. If LCS recoveries are not within QC limits, see below. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|--|--|--|---|--|--|
| General Inorganics, Spikeable (Continued) | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | <ol style="list-style-type: none"> 1) Evaluate the system (instrument). See ^(b) 2) Recheck calculations 3) If LCS is high and associated sample results ND, note in case narrative, report sample results 4) Reanalyze LCS if appropriate. 5a) If reanalysis accepted, reanalyze associated samples (other than those in 3) 5b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | <u>Field QC:</u> | Equipment Blank | Once per day per sampling team (soil); one of every ten bailers per disposable bailer lot (aqueous) | <½ PQL ^(a) for all analytes | No laboratory corrective action |
| | | Unspiked Duplicate (aqueous) or Replicate (soil) Samples | 10% (one per 10 samples) | See Tables 3.2-1 for precision (RPD) criteria. | No laboratory corrective action |
| General Inorganics (Unspikeable): 160.1 and 160.2 | General Inorganics (Unspikeable): TDS and TSS | Method Blank | 5% (one per batch of 20 or fewer samples) | <½ PQL ^(a) for all analytes | <ol style="list-style-type: none"> 1) If concentration in associated sample is <PQL or >5X the contamination, note the blank contamination in the case narrative and report sample result. Otherwise: 2) Reanalyze method blank and all samples (other than those in 1) associated with the contaminated blank. |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES

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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|--|------------------|--|---|--|---|
| General Inorganics (Unspikeable - Continued) | | Laboratory Duplicate Sample (must use Project sample) | 5% (one per SDG of 20 or fewer samples) | See Table 3.2-2 for precision (RPD) criteria. | 1) Check calculations 2) Check LCS: If recoveries are within QC limits, flag data and note in the case narrative as attributable to matrix effects. If LCS recoveries are not within QC limits, see below. |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | See Table 3.2-3 for accuracy (recovery) criteria | 1) Recheck calculations 2) If LCS is high and associated sample results ND, note in case narrative, report sample results 3) Reanalyze LCS if appropriate. 4a) If reanalysis acceptable, reanalyze associated samples (other than those in 3) 4b) If still out, reprep and reanalyze LCS and all associated samples (other than those in 3) |
| | <u>Field QC:</u> | Equipment Blank | Once per day per sampling team (soil); one of every ten bailers per disposable bailer lot (aqueous) | <1/2 PQL ^(a) for all analytes | No laboratory corrective action |
| | | Unspiked Duplicate (aqueous) or Replicate (soil) Samples | 10% (one per 10 samples) | See Tables Q.2-1 and Q.2-2 for precision (RPD) criteria. | No laboratory corrective action |

TABLE 3.2-1. SUMMARY OF FIELD AND LABORATORY QUALITY CONTROL PROCEDURES
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| Method | Parameter | QC Performed | Frequency | Acceptance Criteria | Corrective Action |
|---------------|------------------|---------------------------------|--|---------------------|---|
| SW9045C/150.1 | pH (soil) | Laboratory Duplicate Sample | 5% (one per SDG of 20 or fewer samples) | ± 0.3 pH units | Obtain third value |
| | | Laboratory Control Sample (LCS) | 1 per preparation batch (maximum batch size of 20 samples) | ± 0.3 pH units | 1) Check calibration 2) Reanalyze LCS and affected samples |
| | <u>Field QC:</u> | Replicate (soil) Samples | 10% (one per 10 samples) | ± 0.3 pH units | No laboratory corrective action |

Notes: (a) Practical Quantitation Limits (PQLs) listed in Table 3.1-1. Corrective action will be required at the PQL instead of 1/2 PQL for common laboratory contaminants for organic methods, for metals not on the CAM-17 metals list, and for inorganic analyses with PQLs not associated with DQOs (for example, chloride and sulfate).
(b) Laboratory batch control is based on preparation batches. Preparation batches use a Laboratory Control Sample (LCS) to determine batch acceptability.

The samples in the preparation batch will be considered out of control if any compound in the LCS is outside of the acceptance limits listed in Table 3.2-3. An out-of-control situation requires reanalysis and/or re-preparation and reanalysis of the samples with appropriate quality control, or an assessment of the data if reanalysis is not possible. If any of the spiked analytes are not within control, the following corrective action will be performed:

- 1) If the out-of-control analyses of the LCS exceed the upper control limit and the sample results are ND, no further action is required.
- 2) If the out-of-control analyses of the LCS are below the lower control limit or exceed the upper control limit and the sample results for the out-of-control analyte are detected, the LCS shall be reanalyzed. If the reanalysis is acceptable, the method blank and all associated samples including QC samples shall be reanalyzed and reported.
- 3) If the reanalysis is not acceptable and the holding time has not expired, all associated samples shall be re-prepared with appropriate QC and reanalyzed. If the holding time is expired, all associated samples shall be re-prepared with appropriate QC and reanalyzed if the potential results will provide estimated data versus rejected data, or if the results can be used to confirm the original analytical results, and the program QA manager should be contacted. If the reanalyses cannot be used for these purposes, the decision not to re-prepare and reanalyze can only be made with the knowledge and consent of the program QA manager.

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 1 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| SW6010B | Antimony | 75-125 | 75-125 | 20 | 35 |
| | Arsenic ** | 75-125 | 75-125 | 20 | 35 |
| | Barium | 75-125 | 75-125 | 20 | 35 |
| | Beryllium | 75-125 | 75-125 | 20 | 35 |
| | Cadmium | 75-125 | 75-125 | 20 | 35 |
| | Chromium | 75-125 | 75-125 | 20 | 35 |
| | Cobalt | 75-125 | 75-125 | 20 | 35 |
| | Copper | 75-125 | 75-125 | 20 | 35 |
| | Lead ** | 75-125 | 75-125 | 20 | 35 |
| | Molybdenum | 75-125 | 75-125 | 20 | 35 |
| | Nickel | 75-125 | 75-125 | 20 | 35 |
| | Selenium ** | 75-125 | 75-125 | 20 | 35 |
| | Silver | 75-125 | 75-125 | 20 | 35 |
| | Thallium ** | 75-125 | 75-125 | 20 | 35 |
| | Vanadium | 75-125 | 75-125 | 20 | 35 |
| | Zinc | 75-125 | 75-125 | 20 | 35 |
| | Aluminum | 75-125 | 75-125 | 20 | 35 |
| | Calcium | 75-125 | 75-125 | 20 | 35 |
| | Iron | 75-125 | 75-125 | 20 | 35 |
| | Manganese | 75-125 | 75-125 | 20 | 35 |
| | Magnesium | 75-125 | 75-125 | 20 | 35 |
| | Potassium | 75-125 | 75-125 | 20 | 35 |
| | Sodium | 75-125 | 75-125 | 20 | 35 |
| SW7470A | Mercury | 75-125 | 75-125 | 20 | 35 |
| SW7471A | Mercury | 75-125 | 75-125 | 20 | 35 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 2 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| LUFT Mod. | Diesel | 65-135 | 65-135 | 25 | 40 |
| SW8015 (6) | Kerosene | 65-135 | 65-135 | 25 | 40 |
| | Motor Oil | 60-117 | 60-135 | 35 | 50 |
| (4) | Aldrin | 30-140 | 30-140 | 35 | 35 |
| | alpha-BHC | 30-140 | 30-140 | 35 | 35 |
| | beta-BHC | 30-140 | 30-140 | 35 | 35 |
| | delta-BHC | 30-140 | 30-140 | 35 | 35 |
| | gamma-BHC (Lindane) | 30-140 | 30-140 | 35 | 35 |
| | alpha-Chlordane | 30-140 | 30-140 | 35 | 35 |
| | gamma-Chlordane | 30-140 | 30-140 | 35 | 35 |
| | 4,4'-DDD | 30-140 | 30-140 | 35 | 35 |
| | 4,4'-DDE | 30-140 | 30-140 | 35 | 35 |
| | 4,4'-DDT | 30-140 | 30-140 | 35 | 35 |
| | Dieldrin | 30-140 | 30-140 | 35 | 35 |
| | Endosulfan I | 30-140 | 30-140 | 35 | 35 |
| | Endosulfan II | 30-140 | 30-140 | 35 | 35 |
| | Endosulfan sulfate | 30-140 | 30-140 | 35 | 35 |
| (4) | Endrin | 30-140 | 30-140 | 35 | 35 |
| | Endrin aldehyde | 30-140 | 30-140 | 35 | 35 |
| | Endrin ketone | 30-140 | 30-140 | 35 | 35 |
| (4) | Heptachlor | 30-140 | 30-140 | 35 | 35 |
| | Heptachlor epoxide | 30-140 | 30-140 | 35 | 35 |
| | Methoxychlor | 30-140 | 30-140 | 35 | 35 |
| | Toxaphene | 30-140 | 30-140 | 35 | 35 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**
(Page 3 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|-------------------|--------------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| SW8260B (5) | 1,1-Dichloroethane | 65-135 | 65-135 | 25 | 40 |
| (4) | 1,1-Dichloroethene | 65-135 | 65-135 | 25 | 40 |
| | 1,1-Dichloropropene | 65-135 | 65-135 | 25 | 40 |
| | 1,1,1-Trichloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,1,2-Tetrachloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,2-Trichloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,2-Trichlorotrifluoroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,2,2-Tetrachloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dibromoethane | 65-135 | 65-135 | 25 | 40 |
| | 1,2,-Dibromo-3-Chloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dichloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,2,3-Trichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,2,3-Trichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,2,4-Trichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,2,4-Trimethylbenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,3-Dichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,3-Dichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,3,5-Trimethylbenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,4-Dichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 2-Butanone | 65-135 | 65-135 | 25 | 40 |
| | 2-Chloroethyl vinyl ether | 65-135 | 65-135 | 25 | 40 |
| | 2-Chlorotoluene | 65-135 | 65-135 | 25 | 40 |
| | 2-Hexanone | 65-135 | 65-135 | 25 | 40 |
| | 2,2-Dichloropropane | 65-135 | 65-135 | 25 | 40 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 4 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | | |
|-------------------------|------------------------|---------------------------|----------------|-----------------------------|----------------|----|
| | | Percent Recovery | | Relative Percent Difference | | |
| | | Water | Soil/Sediments | Water | Soil/Sediments | |
| (4) | 4-Chlorotoluene | 65-135 | 65-135 | 25 | 40 | |
| | 4-Methyl-2-pentanone | 65-135 | 65-135 | 25 | 40 | |
| | Acetone | 65-135 | 65-135 | 25 | 40 | |
| | Benzene | 65-135 | 65-135 | 25 | 40 | |
| | Bromobenzene | 65-135 | 65-135 | 25 | 40 | |
| | Bromochloromethane | 65-135 | 65-135 | 25 | 40 | |
| | Bromodichloromethane | 65-135 | 65-135 | 25 | 40 | |
| | Bromomethane | 65-135 | 65-135 | 25 | 40 | |
| | Bromoform | 65-135 | 65-135 | 25 | 40 | |
| | Carbon Disulfide | 65-135 | 65-135 | 25 | 40 | |
| | Carbon Tetrachloride | 65-135 | 65-135 | 25 | 40 | |
| | (4) | Chlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | | Chloroethane | 65-135 | 65-135 | 25 | 40 |
| | | Chloroform | 65-135 | 65-135 | 25 | 40 |
| Chloromethane | | 65-135 | 65-135 | 25 | 40 | |
| cis-1,2-Dichloroethene | | 65-135 | 65-135 | 25 | 40 | |
| cis-1,3-Dichloropropene | | 65-135 | 65-135 | 25 | 40 | |
| Dibromochloromethane | | 65-135 | 65-135 | 25 | 40 | |
| Dibromomethane | | 65-135 | 65-135 | 25 | 40 | |
| Dichlorodifluoromethane | | 65-135 | 65-135 | 25 | 40 | |
| Ethylbenzene | | 65-135 | 65-135 | 25 | 40 | |
| Hexachlorobutadiene | 65-135 | 65-135 | 25 | 40 | | |
| Isopropylbenzene | 65-135 | 65-135 | 25 | 40 | | |
| m & p-Xylene | 65-135 | 65-135 | 25 | 40 | | |
| Methyl(tert)butylether | 65-135 | 65-135 | 25 | 40 | | |
| Methylene Chloride | 65-135 | 65-135 | 25 | 40 | | |
| n-Butylbenzene | 65-135 | 65-135 | 25 | 40 | | |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 5 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|-------------------|---------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| | n-Propylbenzene | 65-135 | 65-135 | 25 | 40 |
| | Naphthalene | 65-135 | 65-135 | 25 | 40 |
| | o-Xylene | 65-135 | 65-135 | 25 | 40 |
| | p-Isopropyltoluene | 65-135 | 65-135 | 25 | 40 |
| | sec-Butylbenzene | 65-135 | 65-135 | 25 | 40 |
| | Styrene | 65-135 | 65-135 | 25 | 40 |
| | tert-Butylbenzene | 65-135 | 65-135 | 25 | 40 |
| | Tetrachloroethene | 65-135 | 65-135 | 25 | 40 |
| (4) | Toluene | 65-135 | 65-135 | 25 | 40 |
| | trans-1,2-Dichloroethene | 65-135 | 65-135 | 25 | 40 |
| | trans-1,3-Dichloropropene | 65-135 | 65-135 | 25 | 40 |
| (4) | Trichloroethene | 65-135 | 65-135 | 25 | 40 |
| | Trichlorofluoromethane | 65-135 | 65-135 | 25 | 40 |
| | Vinyl Acetate | 65-135 | 65-135 | 25 | 40 |
| | Vinyl Chloride | 65-135 | 65-135 | 25 | 40 |
| SW8270C (5,6) | 1,2-Dichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,2-Dinitrobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,2,4-Trichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,3-Dichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,3-Dinitrobenzene | 45-135 | 45-135 | 25 | 40 |
| (4) | 1,4-Dichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,4-Dinitrobenzene | 45-135 | 45-135 | 25 | 40 |
| | 2-Chloronaphthalene | 45-135 | 45-135 | 25 | 40 |
| (4) | 2-Chlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2-Methylnaphthalene | 45-135 | 45-135 | 25 | 40 |
| | 2-Methylphenol | 45-135 | 45-135 | 25 | 40 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 6 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|----------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| | 2-Nitroaniline | 45-135 | 45-135 | 25 | 40 |
| | 2-Nitrophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4-Dichlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4-Dimethylphenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4-Dinitrophenol | 45-135 | 45-135 | 25 | 40 |
| (4) | 2,4-Dinitrotoluene | 45-135 | 45-135 | 25 | 40 |
| | 2,4,5-Trichlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4,6-Trichlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,6-Dinitrotoluene | 45-135 | 45-135 | 25 | 40 |
| | 3-Nitroaniline | 45-135 | 45-135 | 25 | 40 |
| | 3,3'-Dichlorobenzidine | 45-135 | 45-135 | 25 | 40 |
| | 3,4-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| | 4-Bromophenyl-phenylether | 45-135 | 45-135 | 25 | 40 |
| (4) | 4-Chloro-3-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| | 4-Chloroaniline | 45-135 | 45-135 | 25 | 40 |
| | 4-Chlorophenyl-phenylether | 45-135 | 45-135 | 25 | 40 |
| | 4-Nitroaniline | 45-135 | 45-135 | 25 | 40 |
| (4) | 4-Nitrophenol | 45-135 | 45-135 | 25 | 40 |
| | 4,6-Dinitro-2-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| (4) | Acenaphthene | 45-135 | 45-135 | 25 | 40 |
| | Acenaphthylene | 45-135 | 45-135 | 25 | 40 |
| | Anthracene | 45-135 | 45-135 | 25 | 40 |
| | Aniline | 45-135 | 45-135 | 25 | 40 |
| | Benzidine | 45-135 | 45-135 | 25 | 40 |
| | Benzo(a)anthracene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(a)pyrene | 45-135 | 45-135 | 25 | 40 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**
(Page 7 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|----------------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| | Benzo(b)fluoranthene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(g,h,i)perylene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(k)fluoranthene | 45-135 | 45-135 | 25 | 40 |
| | Benzoic Acid | 45-135 | 45-135 | 25 | 40 |
| | Benzyl Alcohol | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Chloroethoxy) methane | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Chloroethyl)ether | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Chloroisopropyl)ether | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Ethylhexyl)phthalate | 45-135 | 45-135 | 25 | 40 |
| | Butylbenzylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Carbazole | 45-135 | 45-135 | 25 | 40 |
| | Chrysene | 45-135 | 45-135 | 25 | 40 |
| | Di-n-Butylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Di-n-Octylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Dibenzo(a,h)anthracene | 45-135 | 45-135 | 25 | 40 |
| | Dibenzofuran | 45-135 | 45-135 | 25 | 40 |
| | Diethylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Dimethyl Phthalate | 45-135 | 45-135 | 25 | 40 |
| | Fluoranthene | 45-135 | 45-135 | 25 | 40 |
| | Fluorene | 45-135 | 45-135 | 25 | 40 |
| | Hexachlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | Hexachlorobutadiene | 45-135 | 45-135 | 25 | 40 |
| | <i>Hexachlorocyclopentadiene</i> | 45-135 | 45-135 | 25 | 40 |
| | Hexachloroethane | 45-135 | 45-135 | 25 | 40 |
| | Indeno(1,2,3-cd)pyrene | 45-135 | 45-135 | 25 | 40 |
| | Isophorone | 45-135 | 45-135 | 25 | 40 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 8 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|--|----------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| (4) | n-Nitroso-dimethylamine | 45-135 | 45-135 | 25 | 40 |
| | n-Nitroso-di-n-propylamine | 45-135 | 45-135 | 25 | 40 |
| | n-Nitrosodiphenylamine | 45-135 | 45-135 | 25 | 40 |
| | Naphthalene | 45-135 | 45-135 | 25 | 40 |
| | Nitrobenzene | 45-135 | 45-135 | 25 | 40 |
| (4) | Pentachlorophenol | 45-135 | 45-135 | 25 | 40 |
| | Phenanthrene | 45-135 | 45-135 | 25 | 40 |
| (4) | Phenol | 45-135 | 45-135 | 25 | 40 |
| (4) | Pyrene | 45-135 | 45-135 | 25 | 40 |
| Bold indicates SW8310 compounds | | | | | |
| SW8290(1) | Matrix: | | | | |
| | 2,3,7,8-TCDD | 73-144 | 50-150 | 50 | 50 |
| | 2,3,7,8-TCDF | 70-135 | 50-150 | 50 | 50 |
| | 1,2,3,7,8-PeCDD | 85-131 | 50-150 | 50 | 50 |
| | 1,2,3,7,8-PeCDF | 79-136 | 50-150 | 50 | 50 |
| | 2,3,4,7,8-PeCDF | 56-154 | 50-150 | 50 | 50 |
| | 1,2,3,4,7,8-HxCDD | 58-146 | 50-150 | 50 | 50 |
| | 1,2,3,6,7,8-HxCDD | 80-131 | 50-150 | 50 | 50 |
| | 1,2,3,7,8,9-HxCDD | 60-154 | 50-150 | 50 | 50 |
| | 1,2,3,4,7,8-HxCDF | 77-124 | 50-150 | 50 | 50 |
| | 1,2,3,6,7,8-HxCDF | 69-135 | 50-150 | 50 | 50 |
| | 1,2,3,7,8,9-HxCDF | 58-141 | 50-150 | 50 | 50 |
| | 2,3,4,6,7,8-HxCDF | 58-140 | 50-150 | 50 | 50 |
| | 1,2,3,4,6,7,8-HpCDD | 78-134 | 50-150 | 50 | 50 |
| | 1,2,3,4,6,7,8-HpCDF | 80-115 | 50-150 | 50 | 50 |
| | 1,2,3,4,7,8,9-HpCDF | 68-151 | 50-150 | 50 | 50 |
| | OCDD | 73-144 | 50-150 | 50 | 50 |
| | OCDF | 64-152 | 50-150 | 50 | 50 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 9 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|-------------------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| (2)(3) | ¹³ C-2,3,7,8-TCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-2,3,7,8-TCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,7,8-PeCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,7,8-PeCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,6,7,8-HxCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,4,7,8-HxCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,4,6,7,8-HpCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,4,6,7,8-HpCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-OCDD | 40-135 | 40-135 | N/A | N/A |
| SW8310 (6) | Acenaphthene | 40-140 | 65-135 | 30 | 35 |
| | Acenaphthalene | 40-140 | 65-135 | 30 | 35 |
| | Anthracene | 40-140 | 65-135 | 30 | 35 |
| | Benzo(a)anthracene | 40-140 | 65-135 | 30 | 35 |
| (4) | Benzo(a)pyrene | 40-140 | 50-150 | 30 | 35 |
| | Benzo(b)fluoranthene | 40-140 | 65-135 | 30 | 35 |
| | Benzo(g,h,i)perylene | 40-140 | 65-135 | 30 | 35 |
| | Benzo(k)fluoranthene | 40-140 | 65-135 | 30 | 35 |
| | Chrysene | 40-140 | 65-135 | 30 | 35 |
| | Dibenzo(a,h)anthracene | 40-140 | 65-135 | 30 | 35 |
| | Fluoranthene | 40-140 | 65-135 | 30 | 35 |
| (4) | Fluorene | 40-140 | 50-150 | 30 | 35 |
| | Indeno(1,2,3-c,d)pyrene | 40-140 | 65-135 | 30 | 35 |
| | Naphthalene | 40-140 | 65-135 | 30 | 35 |
| | Phenanthrene | 40-140 | 65-135 | 30 | 35 |
| (4) | Pyrene | 40-140 | 6 | 30 | 35 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 10 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| SW8330 (4) | HMX | 65-135 | 65-135 | 20 | 35 |
| (4) | RDX | 65-135 | 65-135 | 20 | 35 |
| | 1,3,5-TNB | 65-135 | 65-135 | 20 | 35 |
| | 1,3-DNB | 65-135 | 65-135 | 20 | 35 |
| (4) | Tetryl | 50-150 | 50-150 | 20 | 35 |
| (4) | 2,4,6-TNT | 65-135 | 65-135 | 20 | 35 |
| | 2,4-DNT | 65-135 | 65-135 | 20 | 35 |
| | 2,6-DNT | 65-135 | 65-135 | 20 | 35 |
| | o-Nitrotoluene | 65-135 | 65-135 | 20 | 35 |
| | m-Nitrotoluene | 65-135 | 65-135 | 20 | 35 |
| | p-Nitrotoluene | 65-135 | 65-135 | 20 | 35 |
| | Nitrobenzene | 65-135 | 65-135 | 20 | 35 |
| SW8330/8332 | Nitroglycerin | 50-150 | 50-150 | 50 | 50 |
| | PETN | 50-150 | 50-150 | 50 | 50 |
| SW9060 | TOC | N/A | 75-125 | N/A | 35 |
| E415.1 | TOC | 75-125 | N/A | 20 | N/A |
| E160.1 | TDS | N/A | N/A | 20 | N/A |
| E160.2 | TSS | N/A | N/A | 20 | N/A |
| E300.0 | Chloride | 75-125 | 75-125 | 20 | 35 |
| | Nitrate-N | 75-125 | 75-125 | 20 | 35 |
| | Nitrite-N | 75-125 | 75-125 | 20 | 35 |
| | Sulfate | 75-125 | 75-125 | 20 | 35 |

**TABLE 3.2-2. CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATE,
AND LABORATORY (MATRIX) DUPLICATES**

(Page 11 of 11)

| Analytical Method | Spiking Compounds * | Laboratory Control Limits | | | |
|----------------------|------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| CADHS 300.0- Mod | Perchlorate | 75-125 | 75-125 | 20 | 35 |
| E365.2/365.3 | Total Phosphate | 75-125 | 75-125 | 20 | 35 |

* Final spiking concentrations should be in the expected range of detectable concentrations for samples (mid range). Spiking concentrations should be consistent for the MS/MSD and LCS for each analyte.

** For ICP trace analyses of arsenic, lead, selenium, and thallium, spike concentrations should be consistent with spikes used for graphite furnace, as the ICP spiking concentrations for ICP are generally at concentrations only applicable to ICP analyses without trace analyzers.

- (1) Native compound limits are COE default limits
- (2) Method default control limits. Signal-to-noise is also evaluated for data acceptability
- (3) The labeled analytes are spiked into all samples. RQD will be used to compare sample/duplicate IS recoveries.
- (4) These compounds will be used for laboratory control. The laboratory will not control on the other compounds, however, the control limits will be used for data validation.
- (5) For SW8260B and SW8270C, the laboratory may substitute CLP or laboratory specific control limits with prior approval by DTSC.
- (6) All surrogate or MS/MSD recoveries for samples undergoing silica gel or florasil cleanup will have a lower control limit of 30% recovery.

N/A = not applicable

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 1 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|-------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| SW6010B | Antimony | 80-120 | 80-120 | 20 | 35 |
| | Arsenic ^(b) | 80-120 | 80-120 | 20 | 35 |
| | Barium | 80-120 | 80-120 | 20 | 35 |
| | Beryllium | 80-120 | 80-120 | 20 | 35 |
| | Cadmium | 80-120 | 80-120 | 20 | 35 |
| | Chromium | 80-120 | 80-120 | 20 | 35 |
| | Cobalt | 80-120 | 80-120 | 20 | 35 |
| | Copper | 80-120 | 80-120 | 20 | 35 |
| | Lead ^(b) | 80-120 | 80-120 | 20 | 35 |
| | Molybdenum | 80-120 | 80-120 | 20 | 35 |
| | Nickel | 80-120 | 80-120 | 20 | 35 |
| | Selenium ^(b) | 80-120 | 80-120 | 20 | 35 |
| | Silver | 80-120 | 80-120 | 20 | 35 |
| | Thallium ^(b) | 80-120 | 80-120 | 20 | 35 |
| | Vanadium | 80-120 | 80-120 | 20 | 35 |
| | Zinc | 80-120 | 80-120 | 20 | 35 |
| | Aluminum | 80-120 | 80-120 | 20 | 35 |
| | Calcium | 80-120 | 80-120 | 20 | 35 |
| | Iron | 80-120 | 80-120 | 20 | 35 |
| | Manganese | 80-120 | 80-120 | 20 | 35 |
| Magnesium | 80-120 | 80-120 | 20 | 35 | |
| Potassium | 80-120 | 80-120 | 20 | 35 | |
| Sodium | 80-120 | 80-120 | 20 | 35 | |
| SW7470A | Mercury | 80-120 | 80-120 | 20 | 35 |
| SW7471A | Mercury | 80-120 | 80-120 | 20 | 35 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 2 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|-------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| LUFT Mod. | Diesel | 60-117 | 60-117 | 35 | 50 |
| SW8015 | Kerosene | 60-117 | 60-117 | 35 | 50 |
| | Motor Oil | 60-117 | 60-117 | 35 | 50 |
| SW8081A (4) | Aldrin | 30-140 | 30-140 | 35 | 35 |
| | alpha-BHC | 30-140 | 30-140 | 35 | 35 |
| | beta-BHC | 30-140 | 30-140 | 35 | 35 |
| | delta-BHC | 30-140 | 30-140 | 35 | 35 |
| | (4) gamma-BHC (Lindane) | 30-140 | 30-140 | 35 | 35 |
| | alpha-Chlordane | 30-140 | 30-140 | 35 | 35 |
| | gamma-Chlordane | 30-140 | 30-140 | 35 | 35 |
| | 4,4'-DDD | 30-140 | 30-140 | 35 | 35 |
| | 4,4'-DDE | 30-140 | 30-140 | 35 | 35 |
| | (4) 4,4'-DDT | 30-140 | 30-140 | 35 | 35 |
| (4) | Dieldrin | 30-140 | 30-140 | 35 | 35 |
| | Endosulfan I | 30-140 | 30-140 | 35 | 35 |
| | Endosulfan II | 30-140 | 30-140 | 35 | 35 |
| | Endosulfan sulfate | 30-140 | 30-140 | 35 | 35 |
| (4) | Endrin | 30-140 | 30-140 | 35 | 35 |
| | Endrin aldehyde | 30-140 | 30-140 | 35 | 35 |
| | Endrin ketone | 30-140 | 30-140 | 35 | 35 |
| (4) | Heptachlor | 30-140 | 30-140 | 35 | 35 |
| | Heptachlor epoxide | 30-140 | 30-140 | 35 | 35 |
| | Methoxychlor | 30-140 | 30-140 | 35 | 35 |
| | Toxaphene | 30-140 | 30-140 | 35 | 35 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 3 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|--------------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| SW8260B (5) | 1,1-Dichloroethane | 65-135 | 65-135 | 25 | 40 |
| (4) | 1,1-Dichloroethene | 65-135 | 65-135 | 25 | 40 |
| | 1,1-Dichloropropene | 65-135 | 65-135 | 25 | 40 |
| | 1,1,1-Trichloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,1,2-Tetrachloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,2-Trichloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,2-Trichlorotrifluoroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,1,2,2-Tetrachloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dibromoethane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dibromo-3-Chloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dichloroethane | 65-135 | 65-135 | 25 | 40 |
| | 1,2-Dichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,2,3-Trichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,2,3-Trichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,2,4-Trichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,2,4-Trimethylbenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,3-Dichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,3-Dichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 1,3,5-Trimethylbenzene | 65-135 | 65-135 | 25 | 40 |
| | 1,4-Dichlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | 2-Butanone | 65-135 | 65-135 | 25 | 40 |
| | 2-Chloroethyl vinyl ether | 65-135 | 65-135 | 25 | 40 |
| | 2-Chlorotoluene | 65-135 | 65-135 | 25 | 40 |
| | 2-Hexanone | 65-135 | 65-135 | 25 | 40 |
| | 2,2-Dichloropropane | 65-135 | 65-135 | 25 | 40 |
| | 4-Chlorotoluene | 65-135 | 65-135 | 25 | 40 |
| | 4-Methyl-2-pentanone | 65-135 | 65-135 | 25 | 40 |
| | Acetone | 65-135 | 65-135 | 25 | 40 |
| (4) | Benzene | 65-135 | 65-135 | 25 | 40 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 4 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|-------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| (4) | Bromobenzene | 65-135 | 65-135 | 25 | 40 |
| | Bromochloromethane | 65-135 | 65-135 | 25 | 40 |
| | Bromodichloromethane | 65-135 | 65-135 | 25 | 40 |
| | Bromomethane | 65-135 | 65-135 | 25 | 40 |
| | Bromoform | 65-135 | 65-135 | 25 | 40 |
| | Carbon Disulfide | 65-135 | 65-135 | 25 | 40 |
| | Carbon Tetrachloride | 65-135 | 65-135 | 25 | 40 |
| | Chlorobenzene | 65-135 | 65-135 | 25 | 40 |
| | Chloroethane | 65-135 | 65-135 | 25 | 40 |
| | Chloroform | 65-135 | 65-135 | 25 | 40 |
| | Chloromethane | 65-135 | 65-135 | 25 | 40 |
| | cis-1,2-Dichloroethene | 65-135 | 65-135 | 25 | 40 |
| | cis-1,3-Dichloropropene | 65-135 | 65-135 | 25 | 40 |
| | Dibromochloromethane | 65-135 | 65-135 | 25 | 40 |
| | Dibromomethane | 65-135 | 65-135 | 25 | 40 |
| | Dichlorodifluoromethane | 65-135 | 65-135 | 25 | 40 |
| | Ethylbenzene | 65-135 | 65-135 | 25 | 40 |
| | Hexachlorobutadiene | 65-135 | 65-135 | 25 | 40 |
| | Isopropylbenzene | 65-135 | 65-135 | 25 | 40 |
| | m & p-Xylene | 65-135 | 65-135 | 25 | 40 |
| | Methyl(tert)butylether | 65-135 | 65-135 | 25 | 40 |
| | Methylene Chloride | 65-135 | 65-135 | 25 | 40 |
| | n-Butylbenzene | 65-135 | 65-135 | 25 | 40 |
| | n-Propylbenzene | 65-135 | 65-135 | 25 | 40 |
| | Naphthalene | 65-135 | 65-135 | 25 | 40 |
| | o-Xylene | 65-135 | 65-135 | 25 | 40 |
| | p-Isopropyltoluene | 65-135 | 65-135 | 25 | 40 |
| | sec-Butylbenzene | 65-135 | 65-135 | 25 | 40 |
| | Styrene | 65-135 | 65-135 | 25 | 40 |
| | tert-Butylbenzene | 65-135 | 65-135 | 25 | 40 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 5 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|---------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| (4) | Tetrachloroethene | 65-135 | 65-135 | 25 | 40 |
| | Toluene | 65-135 | 65-135 | 25 | 40 |
| | trans-1,2-Dichloroethene | 65-135 | 65-135 | 25 | 40 |
| | trans-1,3-Dichloropropene | 65-135 | 65-135 | 25 | 40 |
| | Trichloroethene | 65-135 | 65-135 | 25 | 40 |
| | Trichlorofluoromethane | 65-135 | 65-135 | 25 | 40 |
| | Vinyl Chloride | 65-135 | 65-135 | 25 | 40 |
| SW8270C (5) | 1,2-Dichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,2-Dinitrobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,2,4-Trichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,3-Dichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,3-Dinitrobenzene | 45-135 | 45-135 | 25 | 40 |
| | (4) 1,4-Dichlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | 1,4-Dinitrobenzene | 45-135 | 45-135 | 25 | 40 |
| | 2-Chloronaphthalene | 45-135 | 45-135 | 25 | 40 |
| | (4) 2-Chlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2-Methylnaphthalene | 45-135 | 45-135 | 25 | 40 |
| (4) | 2-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| | 2-Nitroaniline | 45-135 | 45-135 | 25 | 40 |
| | 2-Nitrophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4-Dichlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4-Dimethylphenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4-Dinitrophenol | 45-135 | 45-135 | 25 | 40 |
| | (4) 2,4-Dinitrotoluene | 45-135 | 45-135 | 25 | 40 |
| | 2,4,5-Trichlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,4,6-Trichlorophenol | 45-135 | 45-135 | 25 | 40 |
| | 2,6-Dinitrotoluene | 45-135 | 45-135 | 25 | 40 |
| (4) | 3-Nitroaniline | 45-135 | 45-135 | 25 | 40 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 6 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|-----------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| | 3,3'-Dichlorobenzidine | 45-135 | 45-135 | 25 | 40 |
| | 3,4-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| | 4-Bromophenyl-phenylether | 45-135 | 45-135 | 25 | 40 |
| (4) | 4-Chloro-3-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| | 4-Chloroaniline | 45-135 | 45-135 | 25 | 40 |
| | 4-Chlorophenyl-phenylether | 45-135 | 45-135 | 25 | 40 |
| | 4-Nitroaniline | 45-135 | 45-135 | 25 | 40 |
| (4) | 4-Nitrophenol | 45-135 | 45-135 | 25 | 40 |
| | 4,6-Dinitro-2-Methylphenol | 45-135 | 45-135 | 25 | 40 |
| (4) | Acenaphthene | 45-135 | 45-135 | 25 | 40 |
| | Acenaphthylene | 45-135 | 45-135 | 25 | 40 |
| | Anthracene | 45-135 | 45-135 | 25 | 40 |
| | Aniline | 45-135 | 45-135 | 25 | 40 |
| | Benzidine | 45-135 | 45-135 | 25 | 40 |
| | Benzo(a)anthracene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(a)pyrene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(b)fluoranthene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(g,h,i)perylene | 45-135 | 45-135 | 25 | 40 |
| | Benzo(k)fluoranthene | 45-135 | 45-135 | 25 | 40 |
| | Benzoic Acid | 45-135 | 45-135 | 25 | 40 |
| | Benzyl Alcohol | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Chloroethoxy)methane | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Chloroethyl)ether | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Chloroisopropyl)ether | 45-135 | 45-135 | 25 | 40 |
| | bis(2-Ethylhexyl)phthalate | 45-135 | 45-135 | 25 | 40 |
| | Butylbenzylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Carbazole | 45-135 | 45-135 | 25 | 40 |
| | Chrysene | 45-135 | 45-135 | 25 | 40 |
| | Di-n-Butylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Di-n-Octylphthalate | 45-135 | 45-135 | 25 | 40 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 7 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|--|-------------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| | Dibenzo(a,h)anthracene | 45-135 | 45-135 | 25 | 40 |
| | Dibenzofuran | 45-135 | 45-135 | 25 | 40 |
| | Diethylphthalate | 45-135 | 45-135 | 25 | 40 |
| | Dimethyl Phthalate | 45-135 | 45-135 | 25 | 40 |
| | Fluoranthene | 45-135 | 45-135 | 25 | 40 |
| | Fluorene | 45-135 | 45-135 | 25 | 40 |
| | Hexachlorobenzene | 45-135 | 45-135 | 25 | 40 |
| | Hexachlorobutadiene | 45-135 | 45-135 | 25 | 40 |
| | Hexachlorocyclopentadiene | 45-135 | 45-135 | 25 | 40 |
| | Hexachloroethane | 45-135 | 45-135 | 25 | 40 |
| | Indeno(1,2,3-cd)pyrene | 45-135 | 45-135 | 25 | 40 |
| | Isophorone | 45-135 | 45-135 | 25 | 40 |
| | n-Nitroso-dimethylamine | 45-135 | 45-135 | 25 | 40 |
| (4) | n-Nitroso-di-n-propylamine | 45-135 | 45-135 | 25 | 40 |
| | n-Nitrosodiphenylamine | 45-135 | 45-135 | 25 | 40 |
| | Naphthalene | 45-135 | 45-135 | 25 | 40 |
| | Nitrobenzene | 45-135 | 45-135 | 25 | 40 |
| (4) | Pentachlorophenol | 45-135 | 45-135 | 25 | 40 |
| | Phenanthrene | 45-135 | 45-135 | 25 | 40 |
| (4) | Phenol | 45-135 | 45-135 | 25 | 40 |
| (4) | Pyrene | 45-135 | 45-135 | 25 | 40 |
| Bold indicates SW8310 compounds | | | | | |
| SW8290 (1) | Matrix: | | | | |
| | 2,3,7,8-TCDD | 73-144 | 50-150 | 50 | 50 |
| | 2,3,7,8-TCDF | 70-135 | 50-150 | 50 | 50 |
| | 1,2,3,7,8-PeCDD | 85-131 | 50-150 | 50 | 50 |
| | 1,2,3,7,8-PeCDF | 79-136 | 50-150 | 50 | 50 |
| | 2,3,4,7,8-PeCDF | 56-154 | 50-150 | 50 | 50 |
| | 1,2,3,4,7,8-HxCDD | 58-146 | 50-150 | 50 | 50 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 8 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|-------------------|-------------------------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| | 1,2,3,6,7,8-HxCDD | 80-131 | 50-150 | 50 | 50 |
| | 1,2,3,7,8,9-HxCDD | 60-154 | 50-150 | 50 | 50 |
| | 1,2,3,4,7,8-HxCDF | 77-124 | 50-150 | 50 | 50 |
| | 1,2,3,6,7,8-HxCDF | 69-135 | 50-150 | 50 | 50 |
| | 1,2,3,7,8,9-HxCDF | 58-141 | 50-150 | 50 | 50 |
| | 2,3,4,6,7,8-HxCDF | 58-140 | 50-150 | 50 | 50 |
| | 1,2,3,4,6,7,8-HpCDD | 78-134 | 50-150 | 50 | 50 |
| | 1,2,3,4,6,7,8-HpCDF | 80-115 | 50-150 | 50 | 50 |
| | 1,2,3,4,7,8,9-HpCDF | 68-151 | 50-150 | 50 | 50 |
| | OCDD | 73-144 | 50-150 | 50 | 50 |
| | OCDF | 64-152 | 50-150 | 50 | 50 |
| (2)(3) | ¹³ C-2,3,7,8-TCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-2,3,7,8-TCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,7,8-PeCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,7,8-PeCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,6,7,8-HxCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,4,7,8-HxCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,4,6,7,8-HpCDD | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-1,2,3,4,6,7,8-HpCDF | 40-135 | 40-135 | N/A | N/A |
| (2)(3) | ¹³ C-OCDD | 40-135 | 40-135 | N/A | N/A |
| SW8310 | Acenaphthene | 55-135 | 65-135 | 30 | 35 |
| | Acenaphthalene | 55-135 | 65-135 | 30 | 35 |
| | Anthracene | 55-135 | 65-135 | 30 | 35 |
| | Benzo(a)anthracene | 55-135 | 65-135 | 30 | 35 |
| (4) | Benzo(a)pyrene | 55-135 | 50-150 | 30 | 35 |
| | Benzo(b)fluoranthene | 55-135 | 65-135 | 30 | 35 |
| | Benzo(g,h,i)perylene | 55-135 | 65-135 | 30 | 35 |
| | Benzo(k)fluoranthene | 55-135 | 65-135 | 30 | 35 |
| | Chrysene | 55-135 | 65-135 | 30 | 35 |
| | Dibenzo(a,h)anthracene | 55-135 | 65-135 | 30 | 35 |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 9 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | | |
|-------------------|-------------------------|---------------------------|----------------|-----------------------------|----------------|----|
| | | Percent Recovery | | Relative Percent Difference | | |
| | | Water | Soil/Sediments | Water | Soil/Sediments | |
| (4) | Fluoranthene | 55-135 | 65-135 | 30 | 35 | |
| | Fluorene | 40-135 | 50-150 | 30 | 35 | |
| | Indeno(1,2,3-c,d)pyrene | 55-135 | 65-135 | 30 | 35 | |
| | Naphthalene | 55-135 | 65-135 | 30 | 35 | |
| | Phenanthrene | 55-135 | 65-135 | 30 | 35 | |
| (4) | Pyrene | 55-135 | 50-150 | 30 | 35 | |
| SW8330 (4) | HMX | 65-135 | 65-135 | 20 | 35 | |
| (4) | RDX | 65-135 | 65-135 | 20 | 35 | |
| (4) | 1,3,5-TNB | 65-135 | 65-135 | 20 | 35 | |
| | 1,3-DNB | 65-135 | 65-135 | 20 | 35 | |
| | Tetryl | 50-150 | 50-150 | 20 | 35 | |
| | 2,4,6-TNT | 65-135 | 65-135 | 20 | 35 | |
| | 2,4-DNT | 65-135 | 65-135 | 20 | 35 | |
| | 2,6-DNT | 65-135 | 65-135 | 20 | 35 | |
| | o-Nitrotoluene | 65-135 | 65-135 | 20 | 35 | |
| | m-Nitrotoluene | 65-135 | 65-135 | 20 | 35 | |
| | p-Nitrotoluene | 65-135 | 65-135 | 20 | 35 | |
| | Nitrobenzene | 65-135 | 65-135 | 20 | 35 | |
| | SW8330/8332 | Nitroglycerin | 50-150 | 50-150 | 50 | 50 |
| | | PETN | 50-150 | 50-150 | 50 | 50 |
| | SW9060 | TOC | N/A | 80-120 | N/A | 35 |
| E415.1 | TOC | 80-120 | N/A | 20 | N/A | |
| E160.1 | TDS | 80-120 | N/A | 20 | N/A | |
| E160.2 | TSS | 80-120 | N/A | 20 | N/A | |

TABLE 3.2-3. CONTROL LIMITS FOR LABORATORY CONTROL SAMPLES

(Page 10 of 10)

| Analytical Method | Spiking Compounds* | Laboratory Control Limits | | | |
|--------------------|--------------------|---------------------------|----------------|-----------------------------|----------------|
| | | Percent Recovery | | Relative Percent Difference | |
| | | Water | Soil/Sediments | Water | Soil/Sediments |
| E300.0 | Chloride | 80-120 | 80-120 | 20 | 35 |
| | Nitrate-N | 80-120 | 80-120 | 20 | 35 |
| | Nitrite-N | 80-120 | 80-120 | 20 | 35 |
| | Sulfate | 80-120 | 80-120 | 20 | 35 |
| CADHS 300.0-Mod | Perchlorate | 80-120 | 80-120 | 20 | 35 |
| E365.2/365.3 | Total Phosphate | 80-120 | 80-120 | 20 | 35 |

- Notes: (a) Final spiking concentrations should be in the expected range of detectable concentrations for samples (mid range). Spiking concentrations should be consistent for the MS/MSD and LCS for each analyte.
- (b) For ICP trace analyses of arsenic, lead, selenium, and thallium, spike concentrations should be consistent with spikes used for graphite furnace, as the ICP spiking concentrations for ICP are generally at concentrations only applicable to ICP analyses without trace analyzers.
- (1) Native compound limits are COE default limits.
- (2) Method default control limits. Signal-to-noise is also evaluated for data acceptability.
- (3) The labeled analytes are spiked into all samples. RQD will be used to compare sample/duplicate IS recoveries.
- (4) These compounds will be used for laboratory control. The laboratory will not control on the other compounds, however, the control limits will be used for data validation.
- (5) For SW8260B and SW8270C, the laboratory may substitute CLP or laboratory specific control limits with prior approval by DTSC.
- N/A = not applicable

TABLE 3.2-4. CONTROL LIMITS FOR SURROGATE SPIKES

| Analytical Method | Anticipated Spiking Compounds (Surrogates) | Laboratory Control Limits | | | |
|---|--|---------------------------|--------|----------------|--------|
| | | Percent Recovery | | | |
| | | Samples | | Blanks and LCS | |
| | | Water | Solids | Water | Solids |
| LUFT/Mod SW8015 TEPH (2) | o-Terphenyl or | 50-110 | 60-120 | 50-110 | 60-120 |
| | Benzo(a)pyrene | 60-140 | 65-135 | 60-140 | 65-135 |
| SW8081A (2) | 2,4,5,6-Tetrachloro-m-xylene | 40-140 | 40-140 | 50-130 | 50-130 |
| | Decachlorobiphenyl (3) | 10-140* | 40-140 | 30-130* | 50-130 |
| SW8260B (1) | Toluene-d8 | 70-130 | 70-130 | 80-125 | 75-125 |
| | 4-Bromofluorobenzene | 70-130 | 70-130 | 80-125 | 75-125 |
| | 1,2-Dichloroethane-d ₄ | 70-130 | 70-130 | 80-125 | 75-125 |
| SW8270C (1,2) | Nitrobenzene-d5 | 45-135 | 45-135 | 45-135 | 45-135 |
| | 2-Fluorobiphenyl | 45-135 | 45-135 | 45-135 | 45-135 |
| | Terphenyl-d14 | 45-135 | 45-135 | 45-135 | 45-135 |
| | Phenol-d5 | 35-135 | 35-140 | 35-135 | 35-140 |
| | 2-Fluorophenol | 35-135 | 35-140 | 35-135 | 35-140 |
| | 2,4,6-Tribromophenol | 35-140 | 35-140 | 35-140 | 35-140 |
| SW8310 (2) | o-Terphenyl | 40-140 | 65-135 | 40-140 | 65-135 |
| SW8330 (Explosives) | 2,4-Dinitrofluorobenzene or 1,2-Dinitrobenzene or 3,4-dinitrotoluene | 50-135 | 65-135 | 50-135 | 65-135 |
| SW8330 and SW8330/8332 (PETN and Nitroglycerin) | 2,4-Dinitrofluorobenzene or 1,2-Dinitrobenzene or 3,4-dinitrotoluene | 50-150 | 50-150 | 50-150 | 50-150 |
| SW8290 | ¹³ C ₁₂ -2,3,7,8-TCDD | 40-135 | 40-135 | RPD | RPD |
| | ¹³ C ₁₂ -1,2,3,7,8-TCDF | 40-135 | 40-135 | 50 | 50 |
| | ¹³ C ₁₂ -1,2,3,7,8-PeCDD | 40-135 | 40-135 | 50 | 50 |
| | ¹³ C ₁₂ -1,2,3,7,8-PeCDF | 40-135 | 40-135 | 50 | 50 |
| | ¹³ C ₁₂ -1,2,3,6,7,8-HxCDD | 40-135 | 40-135 | 50 | 50 |
| | ¹³ C ₁₂ -1,2,3,4,7,8-HxCDF | 40-135 | 40-135 | 50 | 50 |
| | ¹³ C ₁₂ -1,2,3,4,6,7,8-HpCDD | 40-135 | 40-135 | 50 | 50 |
| | ¹³ C ₁₂ -1,2,3,4,6,7,8-HpCDF | 40-135 | 40-135 | 50 | 50 |
| ¹³ C ₁₂ -OCDD | 40-135 | 40-135 | 50 | 50 | |

Notes: Surrogates are to be spiked into and used to control all standards, samples (including environmental samples, LCSs, and field QC samples) and blanks.
 Surrogate control limits are to be established based on historical data. In the absence of sufficient historical data, control limits are estimated, and will be established once historical data is available.
 (1) For SW8260B and SW8270C, the laboratory may substitute CLP or laboratory specific control limits with prior approval by DTSC.
 (2) All surrogate or MS/MSD recoveries for samples undergoing silica gel or florisil cleanup will have a lower control limit of 30% recovery.
 (3) Decachlorobiphenyl will not be used for qualification of pesticide results as this compound is related to polychlorinated biphenyls (PCBs) and is not chemically similar to the chlorinated pesticides.
 NA = not analyzed
 TBD = To be determined.

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 1 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|------------------|------------------------------|--|--|--|--|
| SW6010B (ICP) | Metals (Total and Dissolved) | Initial Calibration: High calibration standard and a blank with a PQL standard check for all analytes; or three standards and a blank. | Before initial sample analysis or every 24 hours; after major system modifications; or if ICV/CCVC criteria are not met. | %RSD <5% | <ol style="list-style-type: none"> 1) Reanalyze the standard(s) 2) Prepare and analyze new standard(s) 3) Recalibrate following system maintenance. |
| | | Instrumental Precision: %RSD minimum of 2 integrations (exposures) | Each initial and continuing calibration verification standard (ICV/CCV) | %RSD < 5%. If not performed, must provide alternate documentation of instrument precision. | <ol style="list-style-type: none"> 1) Reanalyze ICV or CCV and all associated samples. 2) Repeat Initial Calibration. |
| | | Initial calibration verification (ICV) (instrument check std) | After initial calibration | 90-110% of expected value | <ol style="list-style-type: none"> 1) Reanalyze ICV. 2) Repeat Initial Calibration. |
| | | Initial calibration blank (ICB) | After every ICV | <1/2 PQL ^(a) for each analyte | <ol style="list-style-type: none"> 1) Repeat Initial Calibration blank. |
| | | ICP interference check standards (ICS): ICS-A - interferents only ICS-B - interferents and target analytes | Run at beginning of daily run | 80-120% of true value for ICS interferents elements; review for false positives and negatives for other elements | <ol style="list-style-type: none"> 1) Verify calibration as necessary 2) Verify ICS and update as necessary 3) Recalibrate |
| | | Continuing calibration verification (CCV) | Every 10 samples and at the end of the analytical run. | 90-110% of expected value | <ol style="list-style-type: none"> 1) Reanalyze CCV. If acceptable, Reanalyze all samples since last acceptable CCV. 2) Repeat Initial Calibration. Reanalyze all samples since last acceptable CCV. |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 2 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|-------------------------------|---|--|--|---|--|
| SW7470A SW7471A | Mercury | Continuing calibration blank (CCB) | After every CCV and at the end of the analytical run. | <1/2 PQL ^(a) for each analyte | 1) Reanalyze CCB. 2) Rerun affected samples ^(b) back to last acceptable CCB. |
| | | Multipoint calibration (minimum three points, five for mercury) Instrumental Precision: %RSD 2 integrations (exposures) Initial calibration verification (ICV) | Daily prior to analyses Initial calibration and initial and continuing calibration verification standards (ICV/CCVs) After calibration | $r > 0.995$ %RSD < 10%. If not provided, alternate documentation of instrument precision must be provided. $\pm 20\%$ | Recalibrate 1) Reanalyze ICV or CCV and all associated samples. 2) Repeat Initial Calibration. 1) Rerun 2) Clean system 3) Rerun affected samples ^(b) back to last acceptable CCB. |
| LUFT Modified SW8015 (GC/FID) | Total Extractable Petroleum Hydrocarbons: Diesel, Kerosene, and Motor Oil | Initial calibration blank (ICB) | After initial calibration verification | <1/2 PQL ^(a) for each analyte | 1) Reanalyze standard 2) Recalibrate |
| | | Continuing calibration verification (CCV) | 10%, plus end of run | Same as initial calibration check | 1) Reanalyze standard 2) Recalibrate 3) Reanalyze affected samples |
| | | Continuing calibration blanks (CCBs) | After each continuing calibration verification | <1/2 PQL ^(a) for each analyte | 1) Reanalyze standard 2) Recalibrate |
| | | Multipoint calibration (minimum five points) for diesel, kerosene, and motor oil | Initially and as required | RSD $\leq 20\%$ or $r > 0.995^{(c)}$ | 1) Evaluate system 2) Recalibrate |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 3 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|-------------------------|--------------------------------|---|--|---|--|
| SW8081A/SW8082 (GC/ECD) | Organochlorine Pesticides/PCBs | Initial and continuing calibration verification standards for diesel, kerosene, and motor oil Multipoint calibration (minimum five points) Initial calibration verification check standard (ICV) Continuing calibration verification standard (CCV). Recommended that high and low concentration CCVs alternate. DDT/Endrin breakdown | After initial calibration, daily (before samples) after every 10 samples, and at end of run, specified fuels may alternate Initially and as required Daily, before sample analyses Every 10 samples and end of analyses sequence Daily | ± 15% Difference $r > 0.995$ or average % RSD for RF $\leq 20\%$ (e) with maximum allowable 40%D $\pm 15\%$ D for each compound; average must be $\leq 15\%$ D for all compounds, with maximum allowable 30%D, or corrective action is required <15% | 1) Evaluate system 2) Repeat calibration check 3) Recalibrate 4) Reanalyze affected samples 1) Evaluate system 2) Recalibrate 1) Evaluate system 2) Repeat calibration check 3) Recalibrate if still out 4) Reanalyze affected samples 1) Evaluate system 2) Recalibrate 3) Reanalyze affected samples |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 4 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|-----------------------------------|-----------------------|---|---|--|--|
| SW8260B (GC/MS) (Cap. col.) | Volatile Organics | Check of mass spectral ion intensities using BFB | Every 12 hours | All relative ion abundances within criteria. Refer to Footnote (D) | 1) Retune instrument 2) Repeat BFB analysis |
| | | Multipoint calibration (minimum five points) | Initially and as required | % RSD for CCCs \leq 30% Avg. RF \geq 0.10 (0.30 for chlorobenzene and 1,1,2,2-PCA) for SPCCs If average of all RSDs \leq 15%, quantitate with RFs. If RSD > 15%, r^2 must be \geq 0.990 | 1) Evaluate system 2) Recalibrate |
| SW8270C (GC/MS) | Semivolatile Organics | Continuing calibration check standard | Daily and every 12 hours | RF \geq 0.10 (0.30 for chlorobenzene and 1,1,2,2-PCA) for SPCCs; % D \leq 20% for CCCs % D \leq 50% for all analytes, with allowance for up to 6 non-critical compounds to exceed 50%D | 1) Evaluate system 2) Repeat calibration check 3) Recalibrate 4) Reanalyze affected samples |
| | | Check of instrument tuning criteria using DFTPP Multipoint calibration (minimum five points) | Daily and every 12 hours Initially and as required | All relative ion abundances within criteria. Refer to Footnote (E) % RSD for CCCs \leq 30% Avg. RF \leq 0.050 for SPCCs. If average of all RSDs \leq 15%, quantitate with RFs. If RSD > 15%, r^2 must be 0.990 | 1) Retune instrument 2) Repeat DFTPP analysis 1) Evaluate system 2) Recalibrate |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 5 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|------------------------|----------------|--|---|--|--|
| SW8270C (Continued) | | Continuing calibration check standard | Daily and every 12 hours | RF ≥ 0.050 for SPCCs % Difference $\leq 20\%$ for CCCs | 1) Evaluate system 2) Repeat calibration check 3) Recalibrate 4) Reanalyze affected samples |
| SW8290 (GC/MS) | Dioxins/Furans | Tune using PFK Window defining mix (WDM) Column Performance Check Solution (CPSM) Multipoint calibration (5 points, ICAL) for all analytes | Once per 12 hours, prior to sample analysis Prior to ICAL, once per 12 hours prior to sample analysis Initially and as required | Resolving power $\geq 10,000$ at $m/z=304.9824$ & $m/z=380.9760 + 5$ ppm of expected mass Used to set retention times. CPSM must have $\leq 25\%$ valley resolution for 2378-TCDD Int. std %RSD $\leq 30\%$ Natives %RSD $\leq 20\%$ Retention time must be within -1 to +3 seconds of labeled IS or 0.005 RRT units. Ion ratios within Table A limits. S/N ≥ 2.5 | 1) Retune instrument. 2) Reanalyze PFK. 1) Readjust windows. 2) Evaluate system. 3) Perform maintenance. 4) Reanalyze WDM/CPSM. 1) Evaluate system. 2) Recalibrate. |
| | | Daily continuing calibration standard (CCAL). | At the beginning of a 12 hour sequence, prior to sample analysis and to close 12 hours of sample analysis | %D of IS $\leq 30\%$ from avg RRF (ICAL). %D of natives $\leq 20\%$ from avg RRF (ICAL). RT must be within -1 to +3 seconds of labeled IS or 0.005 RRT units. Ion ratios are within limits (see Footnote F) | 1) Evaluate system. 2) Reanalyze CCAL. 3) Recalibrate for beginning CCAL as necessary. 4) Assess impact on data for ending CCAL |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 6 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|---------------------|-------------------------------|---|--|---|--|
| SW8310 (HPLC/UV) | PAHs | Multipoint calibration (minimum five points) for all analytes | Initially and as required. Use RF with area closest to sample area. | $r \geq 0.995$ or average % RSD for RF $\leq 20\%$ ^(e) | Recalibrate |
| | | Initial calibration (second source) verification standard (ICV) | Immediately after initial calibration, Prior to analysis | $\pm 15\%$ | Repeat calibration |
| | PAHs | Continuing calibration verification (CCV) | Every 10 samples (excluding CCVs and instrument blanks) and at end of sequence | $\pm 15\%$ | 1) Reanalyze standard 2) Recalibrate 3) Reanalyze affected samples |
| | | Retention time window calculated for each analyte | Each initial calibration and calibration verification | ± 3 standard deviation from 72-hour study | 1) Perform maintenance if necessary and recalibrate 2) Reanalyze all samples analyzed since the last retention time check |
| SW8330 (HPLC/UV) | Nitroaromatics and Nitramines | Multipoint calibration (minimum five points) for all analytes | Initially and as required | $r \geq 0.995$ or average % RSD for RF $\leq 20\%$ ^(e) | 1) Evaluate system 2) Recalibrate |
| | | Initial calibration (second source) verification standard (ICV) | Immediately after initial calibration, Prior to analysis | Average RF $\pm 15\%$ D from expected concentration | 1) Evaluate system 2) Repeat calibration check 3) Recalibrate if still out 4) Reanalyze affected samples |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 7 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|------------------------------|-----------------------------|---|--|--|---|
| SW8330 (Continued) | | Calibration check standard (CCV) | Daily before sample analysis, every 10 samples (excluding CCVs and instrument blanks) and at end of sequence | $\pm 15\%$ D for each compound; average must be $\leq 15\%$ D for all compounds, or corrective action required | <ol style="list-style-type: none"> 1) Evaluate system 2) If $> 15\%$ and samples ND, report data and evaluate standards for trends 3) Reanalyze samples subsequent to last acceptable CCV 4) Perform new ICV as needed 5) Recalibrate as necessary |
| | | Retention time window calculated for each analyte | Each initial calibration and calibration verification | ± 3 standard deviation from 72-hour study | <ol style="list-style-type: none"> 1) Perform maintenance if necessary and recalibrate 2) Reanalyze all samples analyzed since the last retention time check |
| SW9060 | Total Organic Carbon (Soil) | Single point calibration forcing through zero | Weekly, prior to analysis, and as required | $\pm 20\%$ of true value | Repeat calibration |
| | | Initial calibration verification | Immediately after initial calibration | $\pm 10\%$ | Repeat calibration |
| | | Continuing calibration verification | 10% and at end of run | $\pm 10\%$ | <ol style="list-style-type: none"> 1) Reanalyze 2) Recalibrate 3) Reanalyze affected samples |
| 160.1/160.2 (Gravimetric) | Total Dissolved Solids | Calibration check of analytical balance | Prior to analysis of samples | $\pm 0.5\%$ of expected value | <ol style="list-style-type: none"> 1) Recalibrate balance 2) Repeat Calibration check unit criteria is met |

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 8 of 9)

| Method | Parameter | Calibration | Frequency | Acceptance Criteria | Corrective Action |
|--------------------------------|--|---|---|---|--|
| 300.0 (IC) and CADHS 300.0-Mod | Chloride Nitrate-N Nitrite-N Sulfate Perchlorate | Multipoint calibration (minimum three points) Continuing calibration check standard Calibration blank | Initially and as required Daily, every 20 samples and at the end of the run Daily and after each continuing calibration check | $r > 0.995$ $\pm 10\%$ $< 1/2 \text{ PQL}^{(a)}$ for each analyte | 1) Check calculations 2) Recalibrate 1) Check calculations 2) Recalibrate 3) Rerun affected samples 1) Rerun 2) Clean system 3) Rerun affected samples ^(b) back to last acceptable blank |
| and 365.2/365.3 (Colorimetric) | Total Phosphorous | | | | |
| 415.1 (Waters) | Total Organic Carbon | Multipoint calibration (minimum three points); or: Single point calibration forcing through zero, and multipoint linearity verification (minimum three points) Calibration verification | Daily, prior to analyses 10% and at end of run | $\pm 20\%$ of true value $\pm 20\%$ of true value | Recalibrate 1) Recalibrate 2) Reanalyze affected samples |
| SW9045C | pH | Two-point calibration | Prior to analysis | Measured value within ± 0.1 pH unit | 1) Recalibrate 2) See instrument manual |

Notes: (a) Practical Quantitation Limits (PQLs) listed in Table 3-1. Corrective action will be required at the PQL instead of $1/2$ PQL for common laboratory contaminants for organic methods, for metals not on the CAM-17 metals list, and for inorganic analyses with PQLs not associated with DQOs (for example, chloride and sulfate).
 (b) Affected samples are samples with detected results for the analyte in question $< 5X$ the blank contamination (5X for common laboratory contaminants).
 (c) If the average %RSD for all compounds $> 20\%$ for GC or $> 15\%$ for GC/MS, must use r or r^2 for all compounds. The use of r^2 or % RSD is calibration specific. This acceptance criteria cannot be used interchangeably for a single calibration event.
 (d) The acceptance criteria for BFB ion abundance are given below.

TABLE 3.2-5. SUMMARY OF CALIBRATION PROCEDURES
(Page 9 of 9)

BFB KEY IONS AND ION ABUNDANCE CRITERIA

| Mass | Ion Abundance Criteria | Mass | Ion Abundance Criteria |
|------|------------------------------------|------|-----------------------------|
| 50 | 15% to 40% of mass 95 | 174 | >50% of mass 95 |
| 75 | 30% to 60% of mass 95 | 175 | 5% to 9% of mass 174 |
| 95 | Base peak, 100% relative abundance | 176 | >95% but < 101% of mass 174 |
| 96 | 5% to 9% of mass 95 | 177 | 5% to 9% of mass 176 |
| 173 | <2% of mass 174 | | |

(e)

The acceptance criteria for DFTPP ion abundance are given below:

DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

| Mass | Ion Abundance Criteria | Mass | Ion Abundance Criteria |
|------|------------------------------------|------|--------------------------------|
| 51 | 30% to 60% of mass 198 | 199 | 5% to 9% of mass 198 |
| 68 | <2% of mass 69 | 275 | 10% to 30% of mass 198 |
| 69 | (reference only) | 365 | >1% of mass 198 |
| 70 | <2% of mass 69 | 441 | Present but less than mass 443 |
| 127 | 40% to 60% of mass 198 | 442 | >40% of mass 198 |
| 197 | <1% of mass 198 | 443 | 17% to 23% of mass 442 |
| 198 | Base peak, 100% relative abundance | | |

1.

The acceptance criteria for spectral ion intensities are given below:

| PCDDs | Selected Relative Ions (m/z) | Intensity | PCDFs | Selected Ions (m/z) | Relative Intensity |
|-------|------------------------------|-----------|-------|---------------------|--------------------|
| Tetra | 320/322 | 0.65-0.89 | Tetra | 304/306 | 0.65-0.89 |
| Penta | 356/358 | 1.24-1.86 | Penta | 340/342 | 1.24-1.86 |
| Hexa | 390/392 | 1.05-1.43 | Hexa | 374/376 | 1.05-1.43 |
| Hepta | 424/426 | 0.88-1.20 | Hepta | 408/410 | 0.88-1.20 |
| Octa | 458/460 | 0.76-1.02 | Octa | 442/444 | 0.767-1.02 |

Internal Standards

| Standards | Recovery |
|-----------------------|-----------|
| ¹³ C-TCDF | 065-089 |
| ¹³ C-TCDD | 0.65-0.89 |
| ¹³ C-HxCDD | 1.04-1.43 |
| ¹³ C-HpCDF | 0.88-1.20 |
| ¹³ C-OCDD | 0.76-1.02 |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

FOR METALS ANALYSES: SW6010B, SW7470A, & SW7471A

| Metals Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|---|---------------------|--------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Holding Times | 1) Holding time exceeded by 2 times or less | J | J- | UJ | Sample |
| | 2) Holding time exceeded by greater than 2 times | J | J- | R | |
| Initial Calibration | 1) $r < 0.995$ | J | J | UJ | All samples associated with initial calibration (Run Batch) |
| Initial Calibration Verification (ICV) | % Recovery > 110% but $\leq 125\%$ (Hg, % Recovery > 120% but $\leq 135\%$) | J | J+ | No qual. | All samples associated with initial calibration verification (Run Batch) |
| | % Recovery > 125% (Hg, % Recovery > 135%) | R | R | No qual. | |
| | % Recovery < 90% but $\geq 75\%$ (Hg, % Recovery < 80% but $\geq 65\%$) | J | J- | UJ | |
| | % Recovery < 75% (Hg, % Recovery < 65%) | J | J- | R | |
| Continuing Calibration Verification (CCV) | 1) % Recovery > 110% but $\leq 125\%$ (Hg, % Recovery > 120% but $\leq 135\%$) | J | J+ | No qual. | All samples associated with continuing calibration (Analysis Batch) |
| | % Recovery > 125% (Hg, % Recovery > 135%) | R | R | No qual. | |
| | % Recovery < 90% but $\geq 75\%$ (Hg, % Recovery < 80% but $\geq 65\%$) | J | J- | UJ | |
| | % Recovery < 75% (Hg, % Recovery < 65%) | J | J- | R | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| Metals Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|---|---------------------|---------------------|---------------------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Method Blank (MB) and Continuing Calibration Blank (CCB) Contamination | Detected sample results less than or equal to 5 times the blank contamination | UJ | UJ | No qual. | All samples in the same Preparation Batch (MB) or in the same Analytical Run (CCB) |
| Matrix Spike (MS)/Matrix Spike Duplicate (MSD) Recovery and Laboratory (Matrix) Duplicate Results | 1) If Original Sample Result >4X Spike Concentration, MS/MSD Not Evaluated 2) % Recovery < CL but ≥ 30% 3) % Recovery <30% 4) % Recovery > CL 5) RPD > CL | J J J J | J- J- J+ J | UJ R No qual. UJ | All samples in the same Method Batch |
| Laboratory Control Sample Recovery | 1) % Recovery < CL but ≥ 50% 2) % Recovery <50% 3) % Recovery > CL 4) RPD > CL | J J J J | J- J- J+ J | UJ R No qual. UJ | All samples in the same Preparation Batch |
| Reporting Limits | Reporting limits not matching the project specified limits Reported result less than the project reporting detection limit. | No qual. J | No qual. J | No qual. No qual. | Sample (noted in outlier report) Sample |
| Field Duplicates | 1) RPD > CL if ≥5X PQL or if results <5X PQL: 2) Difference >1X PQL(W) 3) Difference >2X PQL (S) | No qual. | No qual. | No qual. | Non-compliant results listed in the ADR outlier report |
| Field Blanks Equipment Blanks | Detected sample results within 5 times blank contamination | UJ | UJ | No qual. | All samples in the same sampling event |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

FOR GC ANALYSES: CALUFT MODIFIED SW8015 AND SW8081A

| GC Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|--|---------------------|----------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Holding Times (Extraction/Analysis) | 1) Holding time exceeded by 2 times or less | J | J- | UJ | Sample |
| | 2) Holding time exceeded by greater than 2 times | J | J- | R | |
| Cooler Temperature | 1) > 6 and ≤20 degrees Centigrade | J | J- | UJ | All samples shipped in the affected cooler. (Shipping Batch) |
| | 2) >20 degrees Centigrade | J | J- | R | |
| | 3) < 2 degrees Centigrade | No qual. | No qual. | No qual. | |
| Initial Calibration | 1) %RSD > 20% | J | J | UJ | All samples associated with initial calibration (Run Batch) |
| | 2) r < 0.995 | J | J | UJ | |
| Continuing Calibration (CCV) | 1) % Difference > +15% | J | J+ | No qual. | All samples associated with continuing calibration (Analysis Batch) |
| | 2) % Difference < -15% and > -50% | J | J- | UJ | |
| | 3) % Difference < -50% | J | J- | R | |
| Method Blank Contamination | 1) Common lab contaminant results less than or equal to 10 times the blank contamination | UJ | UJ | No qual. | All samples in the same Preparation Batch |
| | 2) Other compound results less than or equal to 5 times the blank contamination | UJ | UJ | No qual. | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|-------------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Surrogate Recovery | 1) % Recovery < CL but > 10% | J | J- | UJ | Sample |
| | 2) % Recovery <10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | No qual. | |
| Matrix Spike/matrix Spike Duplicate (MS/MSD) Recovery | 1) If Original Sample Result >4X Spike Concentration, MS/MSD Not Evaluated | | | | Parent Sample |
| | 2) % Recovery < CL but ≥ 30% | J | J- | UJ | |
| | 3) % Recovery <30% | J | J- | R | |
| | 4) % Recovery > CL | J | J+ | No qual. | |
| | 5) RPD > CL | J | J | UJ | |
| Laboratory Control Sample Recovery | 1) % Recovery < CL but ≥ 10% | J | J- | UJ | All samples in the same Preparation Batch |
| | 2) % Recovery <10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | No qual. | |
| | 4) RPD > CL | J | J | UJ | |
| Reporting Limits | Reporting limits not matching the project specified limits. | No qual. | No qual. | No qual. | Sample (noted in outlier report) |
| | Results reported below the project reporting detection limit. | J | J | No qual. | Sample |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|--|---------------------|----------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Field Duplicates | 1) RPD > CL if $\geq 5X$ PQL or If results $< 5X$ PQL: 2) Difference $> 1X$ PQL (W) 3) Difference $> 2X$ PQL (S) | No qual. | No qual. | no qual. | Non-compliant results listed in the ADR outlier report |
| Field Blanks Equipment Blanks | 1) Common lab contaminant results within 10 times blank contamination 2) Other lab contaminant results within 5 times blank contamination | UJ | UJ | No qual. | All samples in the same sampling event |
| | | UJ | UJ | No qual. | |
| Trip Blanks | 1) Common lab contaminant results within 10 times blank contamination 2) Other lab contaminant results within 5 times blank contamination | UJ | UJ | No qual. | All samples in the same Shipping Batch |
| | | UJ | UJ | No qual. | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

FOR GC/MS ANALYSES: SW8260B and SW8270C

| GC/MS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|----------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Holding Times (Extraction/Analysis) | 1) Holding time exceeded by 2 times or less | J | J- | UJ | Sample |
| | 2) Holding time exceeded by greater than 2 times | J | J- | R | |
| Cooler Temperature | 1) > 6 and ≤20 degrees Centigrade | J | J- | UJ | All samples shipped in the affected cooler (Shipping Batch) |
| | 2) >20 degrees Centigrade | J | J- | R | |
| | 3) < 2 degrees Centigrade | No qual. | No qual. | No qual. | |
| Instrument Tuning | 1) Ion abundance criteria not met | JN | JN | R | All samples associated to an initial calibration (Run Batch), if tune is associated to an initial calibration; or all samples associated to a continuing calibration (Analysis Batch), if tune is associated to a continuing calibration. |
| Initial Calibration | 1) Average RRF < 0.05 | J | J | R | All samples associated to the initial calibration (Run Batch) |
| | 2) %RSD > 30% | J | J | UJ | |
| | 3) r < 0.995 | J | J | UJ | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC/MS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|--|---------------------|--------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV) | 1) Average RRF < 0.05 | J | J | R | All samples associated to the ICV (Run Batch) or All samples associated to the CCV (Analysis Batch) |
| | 2) % Difference > +25% | J | J+ | no qual. | |
| | 3) % Difference < -25% and ≥ -50% | J | J- | UJ | |
| | 4) % Difference < -50% | J | J- | R | |
| Method Blank Contamination | 1) Common lab contaminant and tentatively identified compound (TIC) results less than or equal to 10 times blank contamination | UJ | UJ | No qual. | All samples in the same Preparation Batch as the method blank |
| | 2) Other compound results less than or equal to 5 times blank contamination | UJ | UJ | No qual. | |
| Surrogate Recovery | 1) % Recovery < CL but ≥ 10% | J | J- | UJ | Sample |
| | 2) % Recovery < 10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | no qual. | |
| | Note: For semivolatile analysis, two or more surrogates in a fraction must be out of criteria for qualification unless recovery < 10%. | | | | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC/MS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|---|---------------------|----------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Matrix Spike/matrix Spike Duplicate (MS/MSD) Recovery | 1) If Original Sample Result >4X Spike Concentration, MS/MSD Not Evaluated | | | | Parent Sample |
| | 2) % Recovery < CL but ≥ 10% | J | J- | UJ | |
| | 3) % Recovery <10% | J | J- | R | |
| | 4) % Recovery > CL | J | J+ | no qual. | |
| | 5) RPD > CL | J | J | UJ | |
| Laboratory Control Sample Recovery | 1) % Recovery < CL but ≥ 10% | J | J- | UJ | All samples in the same Preparation Batch the LCS |
| | 2) % Recovery <10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | no qual. | |
| | 4) RPD > CL | J | J | UJ | |
| Reporting Limits | Reporting limits not matching the project specified limits. | No qual. | No qual. | No qual. | Sample (noted on outlier report) |
| | Results reported below the project reporting detection limit. | J | J | No qual. | |
| Field Duplicates | 1) RPD > CL if ≥5X PQL or If results <5X PQL: 2) Difference >1X PQL (W) 3) Difference >2X PQL (S) | No qual. | No qual. | no qual. | Noted in outlier report |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC/MS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|--------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non- Biased | Biased | | |
| Field Blanks Equipment Blanks | 1) Common lab contaminants and tentatively identified compound (TIC) results within 10 times blank contamination | UJ | UJ | No qual. | All samples in the same sampling event |
| | 2) Other lab contaminant results within 5 times blank contamination | UJ | UJ | No qual. | |
| Trip Blanks | 1) Common lab contaminant and tentatively identified compound (TIC) results within 10 times blank contamination | UJ | UJ | No qual. | All samples in the same Shipping Batch as the trip blank |
| | 2) Other lab contaminant results within 5 times blank contamination | UJ | UJ | No qual. | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

FOR GC/HRMS ANALYSES: SW8290

| GC/HRMS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|----------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Holding Times (Extraction/Analysis) | 1) Holding time exceeded by 2 times or less | J | J- | UJ | Sample |
| | 2) Holding time exceeded by greater than 2 times | J | J- | R | |
| Cooler Temperature | 1) > 6 and ≤20 degrees Centigrade | J | J- | UJ | All samples shipped in the affected cooler (Shipping Batch) |
| | 2) >20 degrees Centigrade | J | J- | R | |
| | 3) < 2 degrees Centigrade | No qual. | No qual. | No qual. | |
| Instrument Tuning, Window Defining Mix | 1) Resolution criteria not met | JN | JN | R | All samples associated to an initial calibration (Run Batch), if tune is associated to an initial calibration; or all samples associated to a continuing calibration (Analysis Batch), if tune is associated to a continuing calibration. |
| | 2) Valley resolution criteria not met | JN | JN | R | |
| Initial Calibration | 1) Internal standard %RSD > 30% | J | J | UJ | All samples associated to the initial calibration (Run Batch) |
| | 2) Natives %RSD > 20% | J | J | UJ | |
| | 3) Ion ratios within limits, and S/N <2.5 | JN | JN | UJ | |
| | 4) RRTs within criteria | JN | JN | UJ | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC/HRMS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|---|---------------------|--------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV) | 1) Internal standard %D > 30% of avg ICAL RRF | J | J | R | All samples associated to the ICV (Run Batch) or All samples associated to the CCV (Analysis Batch) |
| | 2) Natives %D > 20% of avg ICAL RRF | J | J+ | no qual. | |
| | 3) Ion ratios within limits | J | J- | UJ | |
| | 4) RRTs within criteria | J | J- | R | |
| Method Blank Contamination | 1) Compound results less than or equal to 5 times blank contamination | UJ | UJ | No qual. | All samples in the same Preparation Batch as the method blank |
| Internal Standard (Surrogate) Recovery | 1) % Recovery < CL but ≥ 10% | J | J- | UJ | Sample |
| | 2) % Recovery < 10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | no qual. | |
| | 4) S/N ratios < 10:1 | JN | JN | Evaluate | |
| Matrix Spike/matrix Spike Duplicate (MS/MSD) (Optional) | 1) If Original Sample Result > 4X Spike Concentration, MS/MSD Not Evaluated | | | | Parent Sample |
| | 2) % Recovery < CL but ≥ 10% | J | J- | UJ | |
| | 3) % Recovery < 10% | J | J- | R | |
| | 4) % Recovery > CL | J | J+ | no qual. | |
| | 5) RPD > CL | J | J | UJ | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| GC/HRMS Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|-------------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Laboratory Control Sample Recovery | 1) % Recovery < CL but ≥ 10% | J | J- | UJ | All samples in the same Preparation Batch as the LCS |
| | 2) % Recovery < 10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | no qual. | |
| | 4) RPD > CL | J | J | UJ | |
| Reporting Limits | Reporting limits not matching the project specified limits. | No qual. | No qual. | No qual. | Sample (noted on outlier report) |
| | Results reported below the project reporting detection limit. | J | J | No qual. | |
| Field Duplicates | 1) RPD > CL if ≥ 5X PQL or If results < 5X PQL: 2) Difference > 1X PQL (W) 3) Difference > 2X PQL (S) | No qual. | No qual. | no qual. | Noted in outlier report |
| Field Blanks Equipment Blanks | 1) Compound results within 5 times blank contamination | UJ | UJ | No qual. | All samples in the same sampling event |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

FOR HPLC ANALYSES: SW8310 & SW8330

| HPLC Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|----------|-------------|---|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Holding Times (Extraction/Analysis) | 1) Holding time exceeded by 2 times or less | J | J- | UJ | Sample |
| | 2) Holding time exceeded by greater than 2 times | J | J- | R | |
| Cooler Temperature | 1) > 6 and ≤20 degrees Centigrade | J | J- | UJ | All samples shipped in the affected cooler. (Shipping Batch) |
| | 2) >20 degrees Centigrade | J | J- | R | |
| | 3) < 2 degrees Centigrade | No qual. | No qual. | No qual. | |
| Initial Calibration | 1) %RSD > 20% | J | J | UJ | All samples associated with initial calibration (Run Batch) |
| | 2) r < 0.995 | J | J | UJ | |
| Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV) | 1) % Difference > +15% | J | J+ | No qual. | All samples associated with initial calibration verification (Run Batch) or All samples associated with continuing calibration (Analysis Batch) |
| | 2) % Difference < -15% and ≥ -50% | J | J- | UJ | |
| | 3) % Difference < -50% | J | J- | R | |
| Method Blank Contamination | 1) Sample results less than or equal to 5 times the blank contamination. | UJ | UJ | No qual. | All samples in the same Preparation Batch |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| HPLC Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|--|---------------------|----------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Surrogate Recovery | 1) % Recovery < CL but > 10% | J | J- | UJ | Sample |
| | 2) % Recovery <10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | No qual. | |
| Matrix Spike Recovery | 1) If Original Sample Result >4X Spike Concentration, MS/MSD Not Evaluated | J | J- | UJ | Parent Sample |
| | 2) % Recovery < CL but > 10% | J | J- | R | |
| | 3) % Recovery <10% | J | J+ | No qual. | |
| | 4) % Recovery > CL | J | J | UJ | |
| | 5) RPD > CL | | | | |
| Laboratory Control Sample Recovery | 1) % Recovery < CL but ≥ 10% | J | J- | UJ | All samples in the same Preparation Batch |
| | 2) % Recovery <10% | J | J- | R | |
| | 3) % Recovery > CL | J | J+ | No qual. | |
| | 4) RPD > CL | J | J | UJ | |
| Reporting Limits | Reporting limits not matching the project specified limits. | No qual. | No qual. | No qual. | Sample (noted in outlier report) |
| | Results reported below the project reporting detection limit. | J | J | No qual. | Sample |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| HPLC Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|--|--|---------------------|----------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Field Duplicates | 1) RPD > CL if $\geq 5X$ PQL or If results <5X PQL: 2) Difference >1X PQL (W) 3) Difference >2X PQL (S) | No qual. | No qual. | No qual. | Non-compliant results listed in the ADR outlier report |
| Field Blanks Equipment Blanks | 1) Compound results within 5 times blank contamination | UJ | UJ | No qual. | All samples in the same sampling event |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

**FOR NON-METALS INORGANIC ANALYSES:
E160.1, E160.2, E300.0, CADHS 300.0-Mod, E365.2/365.3, E415.1, AND SW9060**

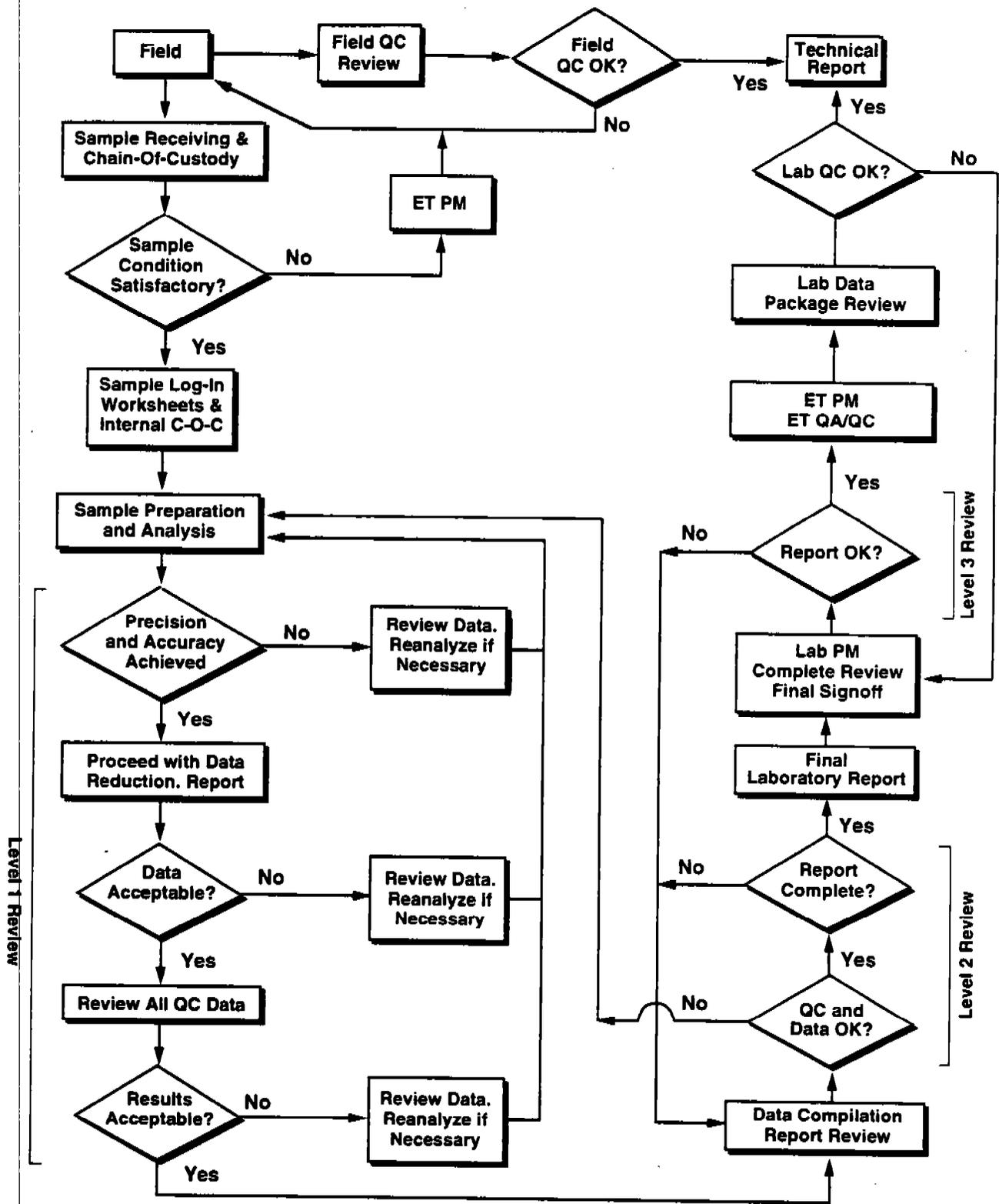
| Non-metals Inorganic Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|--|---------------------|----------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Holding Times | 1) Holding time exceeded by 2 times or less | J | J- | UJ | Sample |
| | 2) Holding time exceeded by greater than 2 times | J | J- | R | |
| Cooler Temperature | 1) > 6 degrees Centigrade 2) < 2 degrees Centigrade | No qual. | No qual. | No Qual | Noted on outlier report for samples shipped in affected cooler |
| Initial Calibration | 1) %RSD > 20% | J | J | UJ | All samples associated with initial calibration (Run Batch) |
| | 2) $r < 0.995$ | J | J | UJ | |
| Initial Calibration Verification (ICV) | 1) % Difference > +10% | J | J+ | No qual. | All samples associated with initial calibration verification (Run Batch) |
| | 2) % Difference < -10% and \geq -50% | J | J- | UJ | |
| | 3) % Difference < -50% | J | J- | R | |
| Calibration Verification | 1) % Difference > +10% | J | J+ | No qual | All samples associated with continuing calibration (Analysis Batch) |
| | 2) % Difference < -10% and \geq -50% | J | J- | UJ | |
| | 3) % Difference < -50% | J | J- | R | |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| Non-metals Inorganic Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|---|------------------------------|-----------------------------|---------------------------------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Blank Contamination | Sample results less than or equal to 5 times the blank contamination | UJ | UJ | No qual. | All samples in the same Preparation Batch |
| Matrix Spike Recovery | 1) If Original Sample Result >4X Spike Concentration, MS/MSD Not Evaluated 2) % Recovery < CL but > 10% 3) % Recovery <10% 4) % Recovery > CL 5) RPD > CL | J J J J | J- J- J+ J | UJ R No qual. UJ | All samples in the same Method Batch |
| Laboratory Control Sample Recovery | 1) % Recovery < CL but ≥ 10% 2) % Recovery <10% 3) % Recovery > CL 4) RPD > CL | J J J J | J- J- J+ J | UJ R No qual. UJ | All samples in the same Preparation Batch |
| Reporting Limits | Reporting limits not matching the project specified limits. Results reported below the project reporting detection limit. | No qual. J | No qual. J | No qual. | Sample (noted in outlier report) Sample |

TABLE 3.4-1. DATA VALIDATION FLAGGING CONVENTIONS

| Non-metals Inorganic Analyses Quality Control Item | Evaluation | Data Qualifier Flag | | | Sample(s) Qualified |
|---|---|---------------------|----------|-------------|--|
| | | Detects | | Non-detects | |
| | | Non-Biased | Biased | | |
| Field Duplicates | 1) RPD > CL if $\geq 5X$ PQL or If results < $5X$ PQL: 2) Difference > $1X$ PQL (W) 3) Difference > $2X$ PQL (S) | No qual. | No qual. | No qual. | Non-compliant results listed in the ADR outlier report |
| Field Blanks | 1) Compound results | UJ | UJ | No qual. | All samples in the same |



QA/QC Data Flowchart

Figure 3.2-1

Nonconformance Report (NCR)

NCR No. _____

Project _____ Project No. _____

Activity _____ Location _____

Part A
Description of non-conformance

Personnel reporting non-conformance _____ Date _____

Part B
Evaluation of non-conformance

| | Work stoppage required | | Significant condition adverse to quality | | Impacts previous data/reports | |
|---------------|------------------------|----|--|----|-------------------------------|----|
| | Yes | No | Yes | No | Yes | No |
| Remarks _____ | | | | | | |

Evaluated by _____ Date _____ Title _____

Approved by _____ Date _____

Project Manager Program QA/QC officer

Part C
Recommended corrective action/disposal

Evaluated by _____ Date _____ Title _____

Approved by _____ Date _____

Project Manager Program QA/QC officer

Part D
Corrective action

Completed by _____ Date _____

Remarks _____

Corrective action approved and NCR closed by:

_____ Date _____

Project Manager Program QA/QC officer

Nonconformance Report Form
Figure 3.3-1

Figure 3.4-1 Data Validation Summary Sheet

Project _____ Lab _____ Job No _____ Validation Level _____
 Matrix _____ No. of Samples _____ DUP _____ TB _____ EB _____ AB _____ Sampling Date _____
 Reviewer _____ Date _____ Validator _____ Date _____
 Final Reviewer _____ Date _____ Final Validator _____ Date _____
 Report Needs Revision Yes No Revision Received Final Date final _____

| Qualifiers are Needed <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | | | | | | |
|--|--------|--|---|--|---|-----------------------------|-----------------------------|------------|--|
| Q | Method | Blanks | <input type="checkbox"/> LMB Sample No. | <input type="checkbox"/> TB | <input type="checkbox"/> AB | <input type="checkbox"/> EB | <input type="checkbox"/> FB | | |
| | | <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | | | Analyte(s) | |
| | | Hold Time <input type="checkbox"/> Yes <input type="checkbox"/> No | Sample No. | | | | | Qualifier | |
| | | Confirmation <input type="checkbox"/> Yes <input type="checkbox"/> No;N/A | Sample No. | | | | | | |
| | | Surrogates <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A | Sample No. | | | | | Qualifier | |
| | | QC Samples <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> MS/MSD Sample No. | <input type="checkbox"/> LCS Analyte(s) | <input type="checkbox"/> DUP Qualifier | | | | |
| | | Field Duplicates <input type="checkbox"/> Yes <input type="checkbox"/> No;N/A | Sample No. | | | | | Analyte(s) | |
| | | Preservation <input type="checkbox"/> Yes <input type="checkbox"/> No;N/A | Sample No. | | | | | Problem | |
| | | Other Problems (Chain of Custody, Analysis not Performed per Request, Tuning, Calibration, Internal Standards, etc.) | | | | | | | |

Figure 3.4-2

QC Level _____

Chain-of-Custody Documentation

Project _____ Lab _____ Job No. _____

Matrix _____ No. of Samples _____ DUP _____ TB _____ EB _____ AB _____ Sampling Date (s) _____

Shipment No. _____

Chain of Custody Record

- 1. Project Name Yes No
- 2. Project No. Yes No
- 3. Shipment No. Yes No
- 4. Airbill No. Yes No NA
- 5. Cooler No. Yes No
- 6. Samplers' Signature Yes No
- 7. Field Sample ID Yes No
- 8. Matrix Yes No
- 9. Sample Depth Interval Yes No NA
- 10. Sampling Date Yes No
- 11. Sampling Time Yes No
- 12. Type/Size of Container Yes No
- 13. Preservation Yes No
- 14. Filtered/Unfiltered Yes No
- 15. No. of Containers Yes No
- 16. Analysis Required Yes No
- 17. MS/MSD Yes No NA
- 18. Relinquished By/Received By Yes No
- 19. Relinquished/Received Date and Time Yes No
- 20. Special Requirements Yes No NA

Field Sample Identifier/Code Reference Sheet

- 21. Project Charge No. Yes No COC Match? Y N
- 22. Shipping Date Yes No COC Match? Y N
- 23. Shipment No. Yes No COC Match? Y N
- 24. Field Sample ID/Base/Location/Extension Yes No COC Match? Y N
- 25. Sample Type Yes No
- 26. Matrix Yes No COC Match? Y N
- 27. Sampling Depth/Begin/End Yes No COC Match? Y N
- 28. Sample Date Yes No COC Match? Y N
- 29. Sample Time Yes No COC Match? Y N

If all information is complete and correct, check "yes".

If not, check "no", and enter item number in comments and explain.

Comments:

Were changes made to COC or Cross Reference Sheet? Yes _____ No _____

Changes:

Figure 3.4-5 Calibration and Instrument Information - Organics Review Sheet

Project _____ Lab _____ Lab Job No. _____

Method _____ Matrix _____ Batch No. _____

GC Analyses: Instrument ID _____

| | DATE | TIME | FREQUENCY | ACCEPT CRITERIA | RESULTS | RAW DATA CHECK |
|--------------------------|------|------|------------|-----------------------------------|---------|----------------|
| INITIAL CALIBRATION | | | | $r \geq 0.995$ $RSD \leq 20\%$ | | |
| CONTINUING CALIBRATION | | | Daily | $\pm 15\% D$ | | |
| CALIBRATION CHECK (CCV) | | | 10% End | $\pm 15\% D$ | | |
| SYSTEM PERFORMANCE CHECK | | | Daily | | | |

COMMENTS _____

GCMS Analyses: Instrument ID _____

| | DATE | TIME | FREQUENCY | ACCEPT CRITERIA | RESULTS | RAW DATA CHECK |
|---|------|------|--------------|-----------------|---------|----------------|
| BFB/DFTPP TUNING I.C. | | | Before I.C. | | | |
| | | | Every 12 hrs | | | |
| INITIAL CALIBRATION | | | | | | |
| CONTINUING CALIBRATION | | | Every 12 hrs | | | |
| INTERNAL STANDARDS IN CALIBRATION CHECK | | | Every 12 hrs | | | |

COMMENTS _____

Figure 3.4-6 Calibration and Instrument Information - Inorganics Review Sheet

Project _____ Lab _____ Lab Job No. _____

Method _____ Matrix _____ Batch No. _____

Metals Analyses: Instrument ID _____

| | Date | Time | Frequency | Accept Criteria | Results | Raw Data Check |
|---------------------|------|------|---------------------------|-----------------|---------|----------------|
| INITIAL CALIBRATION | | | Daily | | | |
| ICP HIGH STANDARD | | | | | | |
| ICV | | | After initial calibration | | | |
| CCV | | | 10% End | | | |
| ICB | | | After initial calibration | | | |
| CCB | | | 10% End | | | |
| ICS | | | Beginning End | ± 20% ± 20% | | |
| ICP SER. DIL. | | | | | | |
| MSA | | | | | | |

Inorganic Analyses: Instrument ID _____

| | Date | Time | Frequency | Accept Criteria | Results | Raw Data Check |
|-------------------------------|------|------|---------------------|-----------------|---------|----------------|
| INITIAL CALIBRATION | | | | | | |
| CONTINUING CALIBRATION OR ICV | | | Daily or after I.C. | | | |
| CCV | | | 10% End | | | |
| ICB | | | After I.C. | | | |
| CCB | | | 10% End | | | |

Comments _____

4.0 FEASIBILITY STUDY APPROACH

The scope of the work for the FS at the Project Site will be conducted in accordance with the objectives and procedures presented in this Work Plan. The purpose of the FS is to evaluate site characteristics, cleanup goals, and the performance of remedial technologies in order to select the most cost-effective alternative for each area of interest.

Existing data and data collected during the RI will be used to identify areas exceeding clean-up goals based on the intended clean closure of the Project Site. Areas of interest where no further action is considered appropriate will be identified, but will not be evaluated in the FS process. Areas of interest where further action is required will be addressed in a focused FS, as clean closure is the approach being taken at the Project Site. The areas of interest to be addressed in the focused FS include:

- Sites with detected contaminants of interest above the established background concentrations for the Project Site (developed during the site characterization)

The overall FS process includes three phases to select appropriate remedial actions:

- The development of alternatives
- The screening of alternatives
- The detailed analysis of alternatives.

The following sections present the approach to conducting each phase of the focused FS and a description of the governing criteria.

4.1 DEVELOPMENT OF ALTERNATIVES

4.1.1 Development of Remedial Action Objectives

Medium-specific or site-specific remedial action objectives to protect human health and the environment will be developed based on existing information and information collected during the RI. The objectives will specify the contaminants and media of interest, the exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (e.g., nondetect and established background concentrations for clean closure).

In addition, action-specific ARARs will be identified. These will include federal requirements, and California requirements that are either more stringent than federal ARARs or that specify requirements where no federal ARARs exist.

4.1.2 Development of General Response Actions

General response actions that will satisfy the remedial action objectives will be developed for each area of interest. For example, based on existing data and clean closure requirements, the general response actions for contaminated soils are likely to include excavation, treatment (if necessary), and off-site disposal. The No Action response will be included as it is always considered as a baseline for comparison with other remedial alternatives in accordance with the National Contingency Plan (NCP).

The volume of contaminated media to be remediated at each area of interest will be estimated based on the clean-up goals, site conditions, and the nature and extent of contamination. In general, areas and volumes of media to be remediated will be estimated on the bases of contaminant concentrations and distribution exceeding the clean-up goals.

4.1.3 Identification and Screening of Remedial Technologies and Process Options

For the general response actions developed for each area of interest, waste treatment technologies and process options will be identified. For example, TNT-contaminated soil treatment may be accomplished by technologies such as bioremediation and thermal destruction; process options for thermal destruction may include such technologies as incineration and thermal desorption.

Technology types and process options will be identified based on a literature search to identify accepted, demonstrated, and emerging remedial approaches for water and soil. Sources to be included in the literature search include EPA's Superfund Innovative Technology Evaluation (SITE) Program, EPA publications, journals, and trade publications. The performance information gathered in the literature search will be evaluated to identify technologies that have been proven successful at sites with similar conditions.

The technology types will then be screened on the basis of technical feasibility to ensure that only those applicable to the detected contaminants, their physical matrix, and other site characteristics are considered.

4.1.4 Evaluation of Process Options

The process options will be evaluated using effectiveness, implementability, and cost criteria to select one or more representative processes for each technology type retained. The selected options will then be carried forward into alternative development.

Evaluation of the effectiveness of each of the process options will focus on the following: potential effectiveness in handling the estimated areas or volumes of media and meeting the remediation goals; potential impacts on human health and

the environment during the construction and implementation phase; and the proven reliability of the process with respect to the contaminants and conditions at the Project Site. For example, a treatment process that generates a hazardous degradation product may not be effective in meeting the clean closure remediation goal for the Project Site.

The implementability evaluation will assess both the technical and administrative feasibility of implementing the process options. As technical implementability was used as the screening tool for technology types in the previous step, this evaluation will focus on the institutional aspects of implementability such as the following: the ability to obtain necessary permits for off-site actions; the availability of treatment, storage, and disposal services; and the availability of equipment and skilled workers to implement the option. For example, TNT-contaminated soil may require treatment to render it nonreactive prior to transport and landfill disposal.

The cost evaluation of the process options will be based on relative capital and operations and maintenance (O&M) costs. The cost analysis will be made on the basis of engineering judgment of whether costs are high, medium, or low relative to other process options in the same technology type. For example, costs for disposal at a Class I, II, and III landfill will be high, medium, and low, respectively.

4.2 IDENTIFICATION AND SCREENING OF ALTERNATIVES

The potential technologies and process options will be combined into media-specific or area of interest-specific alternatives. For example, an alternative for TNT-contaminated soils may be excavation/windrow composting/Class II landfill disposal. The developed alternatives will be defined with respect to size and configuration of the representative process options, the time frame for remediation, the rates of treatment, spatial requirements for implementation, distances for disposal technologies, and required permits for off-site actions and imposed limitations such as emissions control requirements.

In this phase, the entire alternative, in contrast to a specific technology or process option, as in the previous phase, will be screened on a general basis against the short- and long-term aspects of the effectiveness, implementability, and cost criteria.

Each alternative will be evaluated to assess its effectiveness in providing protection of human health and the environment, and to assess the reductions in toxicity, mobility, or volume that it will achieve.

The implementability evaluation of each alternative will also consider technical and administrative feasibility. Technical feasibility refers to the ability to construct, reliably operate, maintain, and monitor process options. Administrative feasibility refers to the ability to obtain approvals from regulatory agencies, the availability of treatment, storage, and disposal services and capacity, and the availability of required equipment and skilled workers.

The bases for the screening cost estimates may include generic unit costs, vendor information, conventional cost-estimating guides, and cost estimates for similar projects at similar locations. Costs common to all alternatives and indirect costs (e.g., engineering, contingencies) will not be considered during the screening effort unless an alternative involves substantially higher or lower indirect costs than other alternatives.

4.2.1 Treatability Studies

For well demonstrated remedial technologies, the area of interest-specific information collected during the RI may be sufficient to evaluate the performance and cost of these alternatives without conducting treatability studies. For technologies that have not been sufficiently demonstrated, or when site characterization alone is not sufficient to predict treatment performance or to estimate equipment sizes or costs, a treatability study may be desirable.

Treatability studies may be conducted at the bench- or pilot-scale as part of the site characterization. The decision of whether to conduct bench- or pilot-scale treatability studies is generally governed by the level of development of a particular technology. Bench-scale studies, which are typically performed in a laboratory, are often adequate to confirm the anticipated effectiveness of a demonstrated technology on new wastes. Innovative technologies generally require pilot-scale testing since cost and performance data are not readily available. Bench-scale studies would probably be conducted for an innovative technology prior to conducting a pilot-scale treatability study in order to establish a range of optimal conditions and to determine whether the technology is capable of achieving the clean-up goals.

If treatability studies are necessary, a treatability study work plan will be developed to execute the tests. The work plan will include the following: a waste sampling plan; waste characterization; treatment goals; data requirements for estimating the cost of the technology being evaluated; and information needed for procurement of equipment and analytical services. The results of the treatability studies will be included in the FS report, and will be used to support detailed analysis of remedial alternatives and full-scale design efforts, if appropriate. Treatability studies, if necessary, will be conducted in accordance with the *Guide for Conducting Treatability Studies under CERCLA* (Environmental Protection Agency, 1989) and with EPA guidance on treatability studies for specific technologies.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The detailed analysis of remedial alternatives will consist of an individual analysis of each alternative against a set of evaluation criteria, and a comparative analysis of all options against the evaluation criteria with respect to one another.

The individual analysis will include the following: a technical description of each alternative that outlines the waste management strategy involved and identifies the significant ARARs associated with each alternative; and an assessment of the performance of each alternative with respect to each of the evaluation criteria.

EPA has developed nine evaluation criteria for detailed analysis of remedial alternatives as codified in the NCP (40 CFR 300.430). These criteria include:

Overall Protection of Human Health and the Environment. The assessment of this criterion addresses how the remedial alternative, as a whole, achieves and maintains protection of human health and the environment. This evaluation describes how site risks posed through each migration pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with ARARs. This evaluation criterion is used to determine whether each alternative will meet all ARARs identified in the RI/FS process, and/or provides the justification for a waiver as allowed under CERCLA.

Long-Term Effectiveness and Permanence. This criterion is used to evaluate the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. The evaluation will address the magnitude of residual risk as well as the adequacy of associated controls (i.e., engineering or institutional).

Reduction of Toxicity, Mobility, or Volume Through Treatment. This evaluation criterion addresses the statutory preference for remedial alternatives capable of permanently and significantly reducing toxicity, mobility, or volume of the hazardous substances through treatment. This assessment will describe specific requirements and limitations of the treatment process and both the quantities and characteristics of the treatment residuals or byproducts.

Short-Term Effectiveness. This evaluation criterion addresses the time period needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation phase until the clean-up goals are achieved.

Implementability. This evaluation criterion addresses the technical and administrative feasibility of a remedial alternative, including the availability of services and materials required during implementation.

Costs. This evaluation criterion requires the development of estimated capital (direct and indirect) and annual O&M costs, and a present-worth analysis to evaluate the total costs of a remedial action alternative, including the post-closure period.

5.0 PROJECT ORGANIZATION AND SCHEDULE

5.1 PROJECT ORGANIZATION

The organizational structure for this project is shown on Figure 5.1-1. This organizational structure provides the PM with a dedicated project team, including project engineers, technical and administrative support staff, and subcontracting managers. A detailed description of Project Team member responsibilities is presented in this chapter.

This project organization is designed to provide a clear line of management responsibility and authority; facilitate delegation of authority to the management level responsible for completing the RI/FS and related work products; and maintain appropriate cost, schedule, and quality control. The organization reflects strong technical and management leadership and provides a direct line of communication between Earth Tech managers and Granite's representative, Russell Resources, Inc. Lines of communication from Earth Tech to the DTSC and the CESPCK are through Russell Resources, Inc.

Project Coordinator - The Project Coordinator's primary responsibility is for the overall coordination of the project with the DTSC. Additional responsibilities include receiving all notices, comments, approvals, and other communication from the DTSC. The Project Coordinator works closely with the Project Engineer and all other Project Team members to ensure that project goals and objectives, including the project schedule, are met. Lines of authority for the Project Coordinator flow directly from the responsible parties named in the Order. The Project Coordinator serves as the primary point of contact for the Project Engineer.

Program Management Responsibilities. It is the responsibility of all management personnel who may affect the quality of the RI/FS, studies, operations, or other quality-related functions to be aware of and implement the policies and practices set forth in this document, which includes the FSP, the QAPP, and the SSHP. The Project Engineer may delegate authority to appropriate personnel to assure activities are conducted in a compliant, cost-effective, and timely manner. However, responsibility for the project will remain with the Project Engineer. A summary of the responsibilities of project management personnel is provided as follows:

Project Engineer. The Project Engineer, who is responsible for the overall direction, coordination, technical consistency, and review of the RI/FS, will monitor the performance of all project staff through the PM. The Project Engineer will have the authority to select or dismiss staff; select or terminate major subcontractors; approve or disapprove budgets and schedules; stop work; and communicate with Russell Resources, Inc., and the City of Benicia, as

necessary, to evaluate the progress on any task and ensure the early resolution of any problem. Communication with DTSC and the CESPCK will be coordinated with Russell Resources, Inc. The Project Engineer is responsible for overall direction, coordination, technical consistency, and review of the entire contract. Specific responsibilities include:

- Final approval and review of project plans, all project deliverables, schedules, contract changes, and manpower allocations for each task
- Approval of budgets and schedules, and changes in budgets or schedules
- Designation of a PM for the RI/FS
- Ensuring availability of key personnel assigned to the project for the duration of the project
- Overseeing coordination among management, field teams, and support personnel to ensure consistency of performance
- Communicating, as necessary, with the City of Benicia Program Manager to evaluate the progress of the program and to facilitate the early resolution of any potential problem.

Project Manager. The PM, who will report directly to the Project Engineer, will be fully responsible and accountable for all project activities, and will serve as the focal point and main channel of communication between Russell Resources, Inc., and the project team regarding technical and scheduling matters. The PM will establish and interpret project policies; monitor schedule and cost; coordinate all reporting and other forms of communications; ensure necessary resources are made available; prepare RI/FS project plans; identify and resolve potential problems or conflicts; and provide for safe performance and quality of the work. Other duties, as appropriate, will include:

- Allocating work assignment, budgets, and schedules to members of the project team, and orienting the staff to the goals and objectives of the RI/FS
- Evaluating the qualifications of project staff and critical subcontractor personnel, and identifying individuals who need additional training
- Assigning project field managers to direct specific field activities and providing them with the necessary resources
- Tracking the performance of the RI/FS

- Reviewing, approving, and consistently implementing the project planning documents (e.g., this Work Plan) and procedures including approval of monitoring well site locations, chemical analysis parameters, geophysical techniques, schedules, and manpower allocations
- Addressing specific tasks for compliance with federal, state, and local regulations/laws, and directives
- Providing overall technical, quality, and performance consistency throughout the RI/FS
- Identifying procurement needs (e.g., materials, services, subcontracts) and coordinating project procurement with the subcontract administrator
- Identifying, documenting, and notifying the PE, the QCSM, the Health and Safety Officer (HSO), the OE Safety Manager (OESM), and project staff of changes in project scope
- Reviewing procurement documents, sampling logs, laboratory reports, and final reports
- Interacting with regulatory or public agencies at the request of Russell Resources, Inc., and preparing progress reports
- Disseminating project-related information from Russell Resources, Inc.
- Preparing the RI/FS Report and related presentations at progress meetings between the project team and Russell Resources, Inc.
- Reporting any significant conditions adverse to quality and obtaining concurrence by the QCSM on proposed resolutions
- Reviewing quality assurance audit reports and any resulting corrective action disposition.

Quality Control Systems Manager. The QCSM will be appointed by the PM to be principally responsible for execution of all QC operations. The QCSM will be directly responsible to the PM.

The QCSM, or her/his designee, will interface with the client and regulatory agencies on the quality functions of the project and will coordinate activities with the PM. In addition, he/she will, as necessary, perform audits, surveillance, document reviews, and other quality functions as required to determine the

continued effectiveness of the QAPP. The QCSM will, as necessary, audit compliance with the QAPP, and will perform QC review of selected project tasks. The QCSM will work closely with the Project Chemist, who is responsible for all aspects of the investigation that may affect data quality. Other responsibilities of the QCSM will include, but will not be limited to:

- Reporting regularly to the PM on the status of QAPP implementation
- Providing quality orientation training and disseminating applicable quality information to the project staff
- Maintaining the authority to stop work that is not in compliance with the project
- Coordinating all QC functions on the project
- Identifying the need for corrective actions, and initiating, recommending, and coordinating solutions for project-wide issues; maintaining a formal corrective actions tracking system
- Reviewing project-generated procurement documents to assure that applicable quality requirements are adequately stipulated and followed
- Performing periodic quality inspections of project records
- Coordinating submittal of all quality-related reports.

Project Chemist. The Project Chemist will have knowledge of environmental analytical chemistry methodologies as described in EPA SW-846, and quality control procedures as applicable to environmental analytical chemistry. The Project Chemist will report directly to the Project Manager and will have a direct line of communication to both the Analytical Laboratory and the QCSM. The Project Chemist will have, as a minimum, the following qualifications:

A minimum of a 4-year college degree in chemistry from an accredited post-secondary institution. Also required is a minimum of 4 years of combined professional experience at the level of a commercial environmental analytical laboratory and employment as a part of a Contractor project management team, of which a minimum of 1-2 years must be directly related to environmental investigations and/or remedial actions as a part of a project management team (i.e. not primarily employed at a laboratory).

The Project Chemist will have a "hands on" role in management of project tasks associated with sampling and analysis including preparation of the QAPP, preparation of the FSP, instruction of field personnel in sampling and

preservation requirements, general oversight of field personnel involved in sampling activities, coordination with the analytical laboratory to insure readiness to implement project specific requirements, review of analytical data as it becomes available to ensure conformance with quality standards, implementation of corrective actions in accordance with these specifications when review of data uncovers deficiencies, and service as a point of contact for the responsible parties for issues related to environmental chemistry. Other responsibilities will include, but not be limited to:

- Oversight of all on-site analytical testing including field-screening tests and Quality Assurance testing that verifies the chemical data.
- Review and verification of all chemical data for hazardous waste manifests. The Chemist shall also prepare all data validation reports or review for accuracy all data validation reports prepared by subcontractors.
- Verification that the laboratory audit requirements in Section 3.3.2.3 have been fulfilled, including carrying follow-on audits while project samples are in house.

Health and Safety Officer. The HSO will be principally responsible for execution of all health and safety operations for field activities. The HSO will have knowledge of the Occupational Safety and Health Administration (OSHA) requirements and corporate health and safety requirements.

The HSO is responsible for the implementation of the SSHP and will provide overall direction of the health and safety function for field activities. The HSO, or her/his designee, will administer health and safety functions of the project and will coordinate activities with the PM. In addition, the HSO will perform any necessary audits, surveillance, document reviews, and other health and safety functions as required to determine the continued effectiveness of the SSHP. Other responsibilities will include, but will not be limited to:

- Coordinating the Program Certified Industrial Hygienist (CIH) review of the SSHP and obtaining the CIH certification of the SSHP
- Ensuring regulatory and operational compliance with OSHA requirements, the SSHP, and Earth Tech corporate health and safety requirements
- Reviewing health and safety training and medical monitoring

- Working with the PM and the FTL to ensure that all health and safety requirements outlined in the SSHP are implemented in the field
- Performing document reviews, and other health and safety functions as required to determine the continued effectiveness of the SSHP
- Performing random health and safety assessments in the field, implementing corrective measures for site-specific health and safety deficiencies, and verifying resolution of any resulting corrective actions
- Oversight of a SSC, who will monitor the labeling, shipping, and control of hazardous or potentially hazardous samples and materials, and brief all field personnel concerning health and safety requirements.

Ordnance and Explosives Safety Manager. The OESM will be appointed by the PM to be principally responsible for execution of all OE operations for field activities. The OESM should have an adequate understanding of the Department of Defense Explosive Safety Board Guidelines and be recognized by the USACE as capable of performing the necessary OE work required under the order. The OESM will have knowledge of all requirements mandated by OSHA, USACE, U.S. EPA, 8 CCR, and the Earth Tech Corporate Health and Safety Program. The OESM will be directly responsible to the PM.

The OESM is responsible for the implementation of the OE avoidance procedures specified in the SSHP and will provide overall direction of the project OE escort and avoidance functions for field activities. The OESM, or his/her designee, will interface with the Field Team Leader (FTL) on OE safety functions of the project and will coordinate activities with the PM. In addition, he/she will, as necessary, perform audits, surveillance, document reviews, and other OE safety functions as required to determine the continued effectiveness of the SSHP. The OESM will, as necessary, audit compliance with the SSHP, and will perform OE safety reviews of selected project tasks. Other responsibilities will include, but will not be limited to:

- Performing and documenting regular and frequent OE site hazard inspections and observing employees at work
- Stopping work when necessary to prevent injury or illness associated with OE and to ensure personal and environmental health and safety
- Investigating all injuries and illnesses resulting from OE-related incidents

- Implementing OE avoidance procedures to eliminate or mitigate hazards
- Providing the OE safety portions of training sessions or briefings for site and visitor personnel.

Field Team Leader. The FTL reports to the PM and is responsible for project setup in the field, including identifying and scheduling personnel resources, materials, and equipment. The FTL is assigned to oversee and control all field activities, and is responsible for field cost tracking through administrators and project billing. The FTL will also conduct project control assessments and provide purchasing support for small purchases necessary to initiate the project. The FTL will provide site level implementation of environmental protection, fire protection, occupational safety and health requirements, and permitting for this project. The FTL has the organizational freedom and authority to implement changes to work practices; identify problems and proposed solutions; and if necessary, stop work activities that could pose a threat to personnel or the environment. The FTL will coordinate activities with the PM and other project personnel as appropriate. Duties of the FTL include, but are not limited to:

- Initiating the non-OE investigation field activities with the required resources, materials, and equipment
- Directing all field activities, supervising field staff and any subcontractors, and ensuring that field procedures described in the FSP/SSHP are implemented
- Maintaining daily records of work performed, personnel on site, and any work stoppages or communications with other agencies pertaining to the project
- Managing equipment preventive maintenance, decontamination, and calibration programs
- Assisting the QCSM with instruction of field personnel in the sample management techniques included in the QAPP
- Ensuring that the samples taken meet the sampling requirements
- Ensuring the collection of equipment rinsate samples
- Assisting the QCSM in ensuring preventive maintenance is conducted on instruments used for sampling and analysis
- Using a correction tracking system in order to ensure correction of field work and laboratory deficiencies.

Site Safety Coordinator. The FTL will also serve as the SSC for this Project. The SSC is responsible for performing the routine duties for health and safety, and will coordinate any necessary assistance from the designated HSO. The SSC will administer the SSHP and the applicable site-specific safety guidance document. Additional SSC responsibilities include:

- Reading and becoming familiar with the SSHP
- Enforcing the requirements of the SSHP and other applicable safety requirements
- Stopping work, if necessary, to prevent injury or illness and ensure personal and environmental health and safety
- Determining excavation routes, and establishing/posting local emergency contact telephone numbers
- Ensuring that all applicable site personnel and visitors have received the proper training and medical monitoring before entering any controlled areas
- Presiding over any tailgate safety meeting and maintaining appropriate training documentation/attendance records
- Implementing air monitoring according to directives in the SSHP
- Implementing changes in health and safety procedures as directed by the HSO and/or approved addenda to the SSHP.

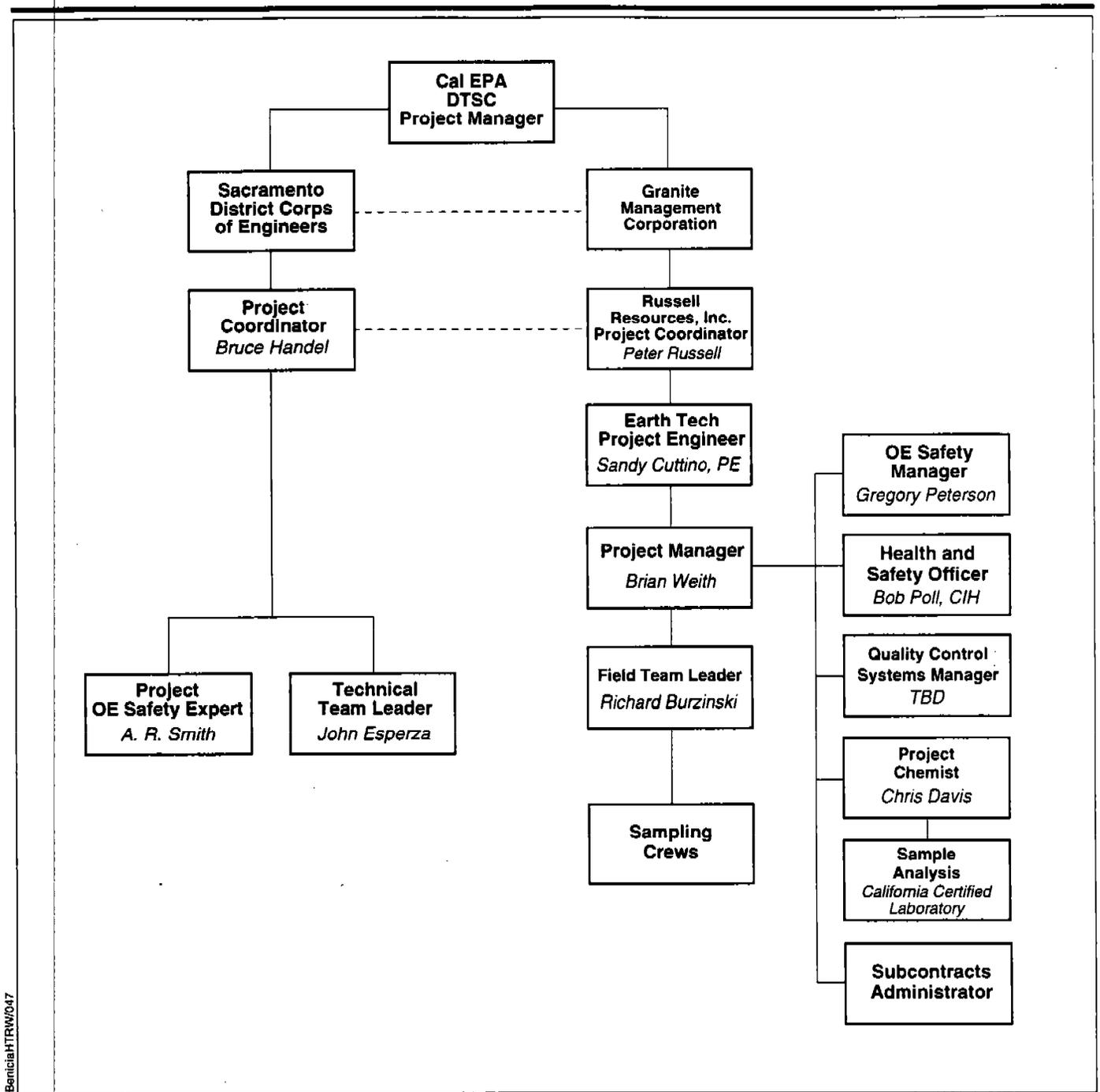
5.2 Project Schedule

The RI/FS includes development of this Work Plan, the field investigation, and an RI report documenting the results of the field investigation. Several follow-on documents, including the RAP, Remedial Design Plan, and California Environmental Quality Act documents, will also be prepared as part of the overall project investigation and remediation. A schedule of the activities associated with the Non-OE RI/FS activities is provided in Table 5.2-1.

Table 5.2-1. RI/FS Schedule of Activities

| Activity | Start Date | Completion Date |
|--|-------------------|------------------------|
| Issue Revised Draft RI/FS Work Plan | - | November 9, 1999 |
| Issue Draft Final RI/FS Work Plan | - | November 16, 1999 |
| Agency Interim Approval of Draft Final RI/FS Work Plan | November 22, 1999 | November 23, 1999 |
| Field Work | December 1, 1999 | December 24, 1999 |
| Prepare Internal Draft RI/FS Report | December 24, 1999 | TBD |
| Issue Administrative Draft RI/FS Report | - | TBD |
| Issue Draft RI/FS Report | - | TBD |
| Issue Final RI/FS Report | - | TBD |

RI/FS = Remedial Investigation/Feasibility Study



Bernicia HTRW/047

Project Organization Chart

Figure 5.2-1

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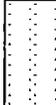
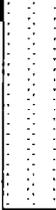
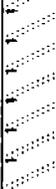
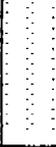
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APPENDIX A
ENGEO GEOTECHNICAL LOGS

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 13, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|------------------------------|---------------|---|---|--|--|--------------------------------|--------------------------------------|
| | | | SURFACE ELEVATION: Approx. 380.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | |  | Dark brown silty CLAY, stiff, moist. | | | | |
| | |  | Brown silty CLAY, stiff, moist. | | | | |
| | |  | Grey fine SANDSTONE, hard, dry. | | | | |
| 5 | 1-1 |  | Easier drilling. Brown SANDSTONE, damp, moist, completely weathered, highly jointed with some iron oxide stains. | 37* | | 116.4 | 13.6 |
| 10 | 1-2 |  | | 46* | | | |
| 15 | |  | Grey fine SANDSTONE or shale, HARD, DRY. | | | | |
| | |  | Brown CLAYSTONE, highly fractured, highly weathered with oxide staining, moist. | | | | |
| 20 | 1-3 |  | | 28* | | 113.1 | 17.7 |
| 25 | |  | | | | | |
| 30 | 1-4 |  | Grey fine grained SANDSTONE, hard, dry, moderately fractured, moderately weathered. | 70* | | | |
| ENGEO INCORPORATED | | | Southampton-Units D-1 through D-7 Benicia, California | BORING NO.: 1 DATE: February 1990 JOB NO.: N9-1736-M12 | | FIGURE NO. 2 | |

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 13, 1989 | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|------------------------------|---------------|----------------------------------|--|--|--|--------------------------------|-----------------------------------|
| | | | SURFACE ELEVATION: Approx. 380.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST CONTE % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 30 | 1-5 | | | 50* | | | |
| 35 | | | Bottom of boring at approximately 33.5 feet. No free water encountered. | | | | |
| 40 | | | | | | | |
| 45 | | | | | | | |
| 50 | | | | | | | |
| 55 | | | | | | | |
| 60 | | | | | | | |
| ENGEO INCORPORATED | | | Southampton-Units D-1 through D-7 Benicia, California | BORING NO.: 1 DATE: February 1990 JOB NO.: N9-1736-M12 | FIGURE NO. 2 | | |

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 13, 1989 | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|---|--|--|--------------------------------|--------------------------------------|
| | | | SURFACE ELEVATION: Approx. 200.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Dark brown silty CLAY, soft, wet. | | | | |
| | | | Brown silty CLAY, soft, wet. | | | | |
| | | | Dark brown silty CLAY, very stiff, moist. | | | | |
| 5 | 2-1 | | Brown sandy silty CLAY, stiff to very stiff, moist with occasional rounded gravel. | 20* | | 112.3 | 15.7 |
| 10 | 2-2 | | ▽ Brown silty CLAY with some fine rounded gravel, medium stiff to stiff, moist, lost sample. | 9* | | | |
| 15 | 2-3 | | Orange brown CLAYSTONE and interbedded grey shale, highly fractured and jointed, highly weathered, moist. | 25* | | | |
| 20 | 2-4 | | Grey fine SANDSTONE, moderately fractured, moderately weathered, damp. (Very shale like) | 50/3"* | | | |
| 25 | 2-5 | | Grey CLAYSTONE, thinly bedded, slightly weathered, moderately hard. | 50/3"* | | | |
| 30 | | | Bottom of boring at approximately 25.25 feet. | | | | |

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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 2
DATE: February 1990
JOB NO.: NS-1736-M12

FIGURE NO.
3

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 13, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|------------------------------|---------------|----------------------------------|--|--|--|--------------------------------|---------------------------------------|
| | | | SURFACE ELEVATION: Approx. 205.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST CONT. % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Dark brown silty CLAY, soft, wet. | | | | |
| | | | Brown silty CLAY, stiff, moist. | | | | |
| 5 | 3-1 | | Brown CLAYSTONE, completely weathered, highly fractured, moist. | 38* | | 116.6 | 14.8 |
| 10 | 3-2 | | | 23/3"* | | | 13.5 |
| 15 | | | Grey CLAYSTONE, moderately weathered, moderately fractured, dry, hard. | | | | |
| 20 | 3-3 | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |
| ENGEO INCORPORATED | | | Southampton-Units D-1 through D-7 Benicia, California | BORING NO.: 3 DATE: February 1990 JOB NO.: N9-1736-M12 | FIGURE NO. 4 | | |

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 13, 1989 | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | | | |
|------------------------------|---------------|----------------------------------|--|--|--|--|-----------------------------|-----------------------|-------------------|
| | | | SURFACE ELEVATION: Approx. 205.0 feet | | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | DRY UNIT WEIGHT | MOIST. CONTENT |
| | | | DESCRIPTION | | | | | (PCF) | % DRY WEIGHT |
| 30 | 3-4 | | | | | | | | |
| 35 | | | Bottom of boring at approximately 30.5 feet. No free water encountered. | | | | | | |
| 40 | | | | | | | | | |
| 45 | | | | | | | | | |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |
| 60 | | | | | | | | | |
| ENGEO INCORPORATED | | | Southampton-Units D-1 through D-7 Benicia, California | BORING NO.: 3 DATE: February 1990 JOB NO.: N9-1736-M12 | FIGURE NO. 4 | | | | |

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 14, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|--|-------------------------|--|--|-----------------------------|
| | | | SURFACE ELEVATION: Approx. 250.0 feet | | | DRY UNIT WEIGHT | MOIST CONTENT |
| | | | DESCRIPTION | | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. |
| 0 | | | Dark brown silty CLAY, soft. Becoming moist, hard. | | | | |
| 5 | 4-1 |  | | 18* | | 114.0 | 15.6 |
| 10 | 4-2 |  | Brown sandy SILT to siltstone, completely weathered, weak, damp, highly fractured. | 24* | | | |
| 15 | 4-3 |  | Grey brown CLAYSTONE, completely weathered, closely fracture, damp to moist. | 52 | | | |
| 20 | 4-4 |  | Grey-light grey CLAYSTONE, moderately weathered, moderately fractured, hard, dry. | 62 | | | 10.3 |
| 25 | | | Bottom of boring at approximately 21 feet. No free water encountered. | | | | |
| 30 | | | | | | | |

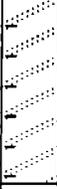
ENGEO
INCORPORATED

Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 4
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE
NO.
5

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 14, 1989 | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|------------------------------|---------------|----------------------------------|--|--|--|--------------------------------|--|
| | | | SURFACE ELEVATION: Approx. 170.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Brown silty CLAY, stiff, moist to wet. | | | | |
| | | | Orange brown silty CLAY, stiff, moist. | | | | |
| 5 | 5-1 | | Tan sandy silty CLAY, stiff, moist. | 22* | | 96.9 | 16.6 |
| | | | Tan silty SAND, to silty sandstone, moist, dense, weak, highly weathered with abundant, caliche deposit (to 50 percent). | | | | |
| 10 | 5-2 | | Interbedded grey CLAYSTONE and brown SANDSTONE, moderately bedded, moderately weathered, moderately strong. | 50* | | | |
| 15 | 5-3 | | | 64 | | | |
| 20 | 5-4 | | Interbedded sandy SILTSTONE and CLAYSTONE, very weathered, very fractured, moderately weathered. | 34 | | | 35.7 |
| 25 | | | Bottom of boring at approximately 21.5 feet. No free water encountered. | | | | |
| 30 | | | | | | | |
| ENGEO INCORPORATED | | | Southampton-Units D-1 through D-7 Benicia, California | BORING NO.: 5 DATE: February 1988 JOB NO.: NS-1736-M12 | FIGURE NO. 6 | | |

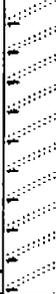
| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 14, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|--|--|--|--------------------------------|---|
| | | | SURFACE ELEVATION: Approx. 145.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Brown-dark brown silty CLAY, medium stiff, moist to wet. | | | | |
| 5 | 6-1 |  | Red brown sandy silty CLAY, hard, moist with approximately 1 percent fine rounded gravel. | 26* | | 113.2 | 16.6 |
| 10 | 6-2 |  | Grey brown CLAYSTONE with some interbedded brown fine SANDSTONE, highly to moderately weathered, highly fracture, moderately hard, damp. | 26* | | 105.5 | 19.2 |
| 15 | 6-3 |  | Grey CLAYSTONE, highly fractured, moderately to slightly weathered, moderately hard, damp. | 38 | | | |
| 20 | 6-4 | | Bottom of boring at approximately 20 feet. No free water encountered. | 55 | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |

ENGE O
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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 6
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE
NO.
7

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 14, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|--|--|--|--------------------------------|--|
| | | | SURFACE ELEVATION: Approx. 200.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | |  | Brown to dark brown silty CLAY, stiff, moist. | | | | |
| 5 | 7-1 |  | Brown SANDSTONE, moderately weathered, moderately fractured, hard, dry. | 50* | | | |
| 10 | |  | Grey-brown CLAYSTONE with interbedded brown sandstone, moderately fractured, moderately weathered, dry to damp, moderately hard to hard. | | | | |
| 15 | 7-2 | | Bottom of boring at approximately 15.5 feet. No free water encountered. | 55/6" | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 36 | | | | | | | |

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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 7
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE NO.
8

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 14, 1989 | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|---|--|--|--------------------------------|---|
| | | | SURFACE ELEVATION: Approx. 170.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Dark brown to black silty CLAY, soft, wet. | | | | |
| 5 | 8-1 | | Dark brown to grey silty CLAY, stiff to very stiff, moist. | 21* | | 104.6 | 23.6 |
| 10 | 8-2 | | Dark brown to grey silty CLAY, stiff to very stiff, moist. | 18* | | 105.0 | 23.7 |
| 15 | 8-3 | | Dark brown to grey silty CLAY, stiff to very stiff, moist. | 15* | | 109.7 | 22.5 |
| 20 | | | Grey brown CLAYSTONE and SANDSTONE, moderately fractured, very weathered. | | | | |
| 30 | | | Bottom of boring at approximately 30 feet. | | | | |

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Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 8

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE
NO.

9

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 17, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|--|--|--|--------------------------------|--------------------------------------|
| | | | SURFACE ELEVATION: Approx. 150.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Dark brown silty CLAY, medium stiff to stiff, moist. | | | | |
| 5 | 9-1 | | ▼ | 14* | | 94.9 | 26.2 |
| 10 | 9-2 | | ▼ Brown silty CLAY, medium stiff, wet. | 17* | | 99.2 | 26.0 |
| 15 | 9-3 | | | 21* | | 98.3 | 28.4 |
| 25 | 9-4 | | Greyish brown SANDSTONE, highly weathered, very fractured, moderately hard, saturated along all joints. Very hard drilling. | 50/5"* | | 121.6 | 15.9 |
| 30 | 9-5 | | Bottom of boring at approximately 28 feet. | 50/1" | | | |

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INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 9

DATE: February 1990

JOB NO.: NS-1736-M12

FIGURE
NO.

10

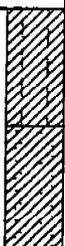
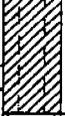
| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 17, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | | |
|--------------|---------------|---|---|--|--|--------------------------------|--|--|
| | | | SURFACE ELEVATION: Approx. 185.0 feet | | | DRY UNIT WEIGHT (PCF) | MOISTURE CONTENT % DRY WEIGHT | |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | | |
| 0 | |  | Brown to dark brown silty CLAY, hard, dry at surface, moist and medium stiff at 1 foot. | | | | | |
| | | | Brown silty CLAY, very stiff to hard, damp. | | | | | |
| 5 | 10-1 | | Orange brown sandy CLAY, hard, damp to moist, (residual soil). | 50/4"* | | | | |
| 10 | 10-2 |  | Grey brown CLAYSTONE, hard, dry to damp, moderately weathered, moderately fractured. | 50/6"* | | | | |
| 15 | 10-3 |  | | 72 | | | | |
| | | | Bottom of boring at approximately 15.5 feet. No free water encountered. | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |

ENGEO
INCORPORATED

Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 10
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE NO.
11

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 17, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|--|--|--|--------------------------------|--------------------------------------|
| | | | SURFACE ELEVATION: Approx. 175.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | 11-1 |  | Red brown silty CLAY, moist, stiff. | 33* | | 115.1 | 15.5 |
| 5 | | | Red brown sandy CLAY, hard, damp. | | | | |
| 10 | 11-2 |  | Brown silty CLAY with occasional gravel, fine, hard, moist, (residual soil). | 58 | | | |
| 15 | 11-3 |  | Grey CLAYSTONE, highly weathered, moderately fractured, moderately hard, damp. | 106 | | | |
| 20 | | | Bottom of boring at approximately 18 feet. No free water encountered. | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |

ENGEO
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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 11
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE NO.
12

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 17, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|--|--|--|--------------------------------|-------------------------------------|
| | | | SURFACE ELEVATION: Approx. 100.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Brown silty CLAY, stiff, moist. | | | | |
| 0 | 12-1 | | Red brown sandy silty CLAY, very stiff to hard, damp. | 40* | | 117.6 | 14.9 |
| 10 | 12-2 | | Brown silty CLAY, hard, damp, (residual soil). | 38 | | | |
| 15 | 12-3 | | Brown clayey SILTSTONE, highly weathered, moderately fractured, weak, moist. | 27 | | | |
| 20 | 12-4 | | | 32 | | | |
| 20 | | | Bottom of boring at approximately 19.5 feet. No free water encountered. | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |

ENGEO
INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 12

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE
NO.

13

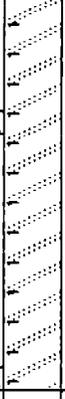
| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 17, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|---|-----------------------------|--|--------------------------------|--|
| | | | SURFACE ELEVATION: Approx. 105.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| DESCRIPTION | | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | | |
| 0 | |  | Red brown silty CLAY, moist, stiff. Grading to damp. | | | | |
| 5 | 13-1 |  | Brown clayey SAND to sandy CLAY, dry, hard with occasional rounded pebbles. | 28* | | 123.0 | 13.3 |
| | 13-2 |  | CLAYSTONE, completely weathered, highly fracture, dry, moderately hard. | 61 | | | 10.9 |
| 10 | | | Bottom of boring at approximately 9 feet. No free water encountered. | | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |

ENGE O
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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 13
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE
NO.
14

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 20, 1989 | | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|--|--|-------------------------|--|------------------------------------|--|
| | | | SURFACE ELEVATION: Approx. 105.0 feet | | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTE % DRY WEIGHT |
| | | | DESCRIPTION | | | | | |
| 0 | | | Brown silty CLAY, moist, very stiff. | | | | | |
| 5 | 14-1 |  | | | 23* | | 111.7 | 17.8 |
| 10 | 14-2 |  | | | 24* | | 109.5 | 19.8 |
| 15 | 14-3 |  | Grey brown CLAYSTONE, completely weathered, very fractured, moderately weak. | | 71/11" | | | |
| 20 | 14-4 |  | | | 84 | | | |
| 25 | | | Bottom of boring at approximately 21.5 feet. No free water encountered. | | | | | |
| 30 | | | | | | | | |
| 35 | | | | | | | | |
| 38 | | | | | | | | |

ENGEO
INCORPORATED

Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 14
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE NO.
15

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 20, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|--|--|--|--------------------------------|--------------------------------------|
| | | | SURFACE ELEVATION: Approx. 130.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Brown silty CLAY, moist, very stiff. | | | | |
| 5 | 15-1 | | | 20* | | 108.9 | 18.0 |
| 10 | 15-2 | | Color change to lighter brown. | 39* | | 100.0 | 24.8 |
| 15 | 15-3 | | Brown, completely weathered silty SANDSTONE, moderately fractured, weak, damp. | 93/10" | | | |
| 20 | | | Grey CLAYSTONE, moderately weathered, very fractured, hard, dry to damp. | | | | |
| 25 | 15-4 | | Bottom of boring at approximately 21 feet. No free water encountered. | 94/11" | | | |
| 30 | | | | | | | |

ENGEO
INCORPORATED

Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 15
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE
NO.
16

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 20, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|---|--|--|------------------------------------|---|
| | | | SURFACE ELEVATION: Approx. 140.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Brown silty CLAY, stiff, moist, with some gravel sized angular rock. | | | | |
| 5 | 16-1 | | | 30* | | 118.8 | 15.8 |
| 10 | 16-2 | | Grey brown to brown CLAYSTONE, completely weathered, to a brown silty CLAY, very fractured, dry, moderately weak. | 33* | | | 14.6 |
| 15 | 16-3 | | | 40 | | | 13.8 |
| 20 | | | Grey CLAYSTONE, moderately weathered, moderately fractured, hard, damp. | | | | |
| 25 | 16-4 | | | 50/6" | | | |
| | | | Bottom of boring at approximately 25.5 feet. No free water encountered. | | | | |
| 30 | | | | | | | |

| | | | |
|------------------------------|-----------------------------------|----------------------|----------------------------|
| ENGEO INCORPORATED | Southampton-Units D-1 through D-7 | BORING NO.: 16 | FIGURE NO. 17 |
| | Benicia, California | DATE: February 1990 | |
| | | JOB NO.: N9-1736-M12 | |

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 20, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|----------------------------------|--|--|--|--------------------------------|--|
| | | | SURFACE ELEVATION: Approx. 135.0 feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Brown to dark brown silty CLAY, soft to medium stiff, wet. | | | | |
| 5 | 17-1 | | Brown sandy silty CLAY with ample angular rock fragments, very stiff, damp. | 34* | | 101.3 | 23.5 |
| 10 | 17-2 | | Grey brown CLAYSTONE very highly weathered, highly fractured, much discoloration, moderately weak. | 30* | | | |
| 15 | 17-3 | | Grey CLAYSTONE, moderately weathered, very fractured, dry, hard. | 67 | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | Bottom of boring at approximately 25 feet. No free water encountered. | | | | |

ENGEO
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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 17
DATE: February 1990
JOB NO.: N9-1736-M12

FIGURE
NO.
18

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 20, 1989 | | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|---|---|--|--|--|------------------------------------|---------------------------------------|
| | | | SURFACE ELEVATION: Approx. 155.0 feet | | | | DRY UNIT WEIGHT (PCF) | MOIST CONTE % DRY WEIGHT |
| | | | DESCRIPTION | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | |  | 8 inch asphalt pavement section. | | | | | |
| | |  | Grey to grey silty CLAY, medium stiff, moist, to wet. (FILL) | | | | | |
| 5 | 18-1 |  | Brown to dark brown silty CLAY, medium stiff, moist. | | 16* | | 100.1 | 24.7 |
| 10 | 18-2 |  | Grey-brown CLAYSTONE, moderately weathered, moderately fractured, moderately hard, dry. | | 40* | | | |
| 15 | | | | | | | | |
| 20 | 18-3 |  | Bottom of boring at approximately 21.5 feet. | | 56 | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |

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Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 18
DATE: February 1998
JOB NO.: NS-1736-M12

FIGURE
NO.
19

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: February 20, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | | |
|--------------|---------------|---|--|-------------------------|--|--|-----------------------------|--------------------------------|
| | | | SURFACE ELEVATION: Approx. 160.0 feet | | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | DRY UNIT WEIGHT (PCF) |
| | | | DESCRIPTION | | | | | |
| 0 | |  | Brown silty CLAY, stiff, moist. | | | | | |
| 5 | 19-1 |  | Brown grey CLAYSTONE, weathered to an orange silty CLAY, hard, damp, very fractured. | 39* | | | | |
| 10 | 19-2 |  | Grey CLAYSTONE, moderately weathered, very fractured, hard. | 78 | | | | |
| 15 | | | | | | | | |
| 20 | 19-3 |  | | 50/6" | | | | |
| 25 | | | | | | | | |
| 30 | | | Bottom of boring at approximately 30 feet. No free water encountered. | | | | | |

ENGEO
INCORPORATED

Southampton-Units D-1 through D-7
Benicia, California

BORING NO.: 19
DATE: February 1990
JOB NO.: NS-1736-M12

FIGURE NO.
20

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: October 12, 1989 | | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|------------------------------|---------------|----------------------------------|--|--|--|--|------------------------------------|---------------------------------------|
| | | | SURFACE ELEVATION: Approx. feet | | | | DRY UNIT WEIGHT (PCF) | MOIST CONTE % DRY WEIGHT |
| | | | DESCRIPTION | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | Dark brown silty CLAY with some gravel, slightly moist. | | | | | |
| 5 | 20-1 | | Light olive clayey SILT with some sand and gravel, hard, slightly moist. | | 50/9"* | 4.5+* | 126.3 | 9.3 |
| 10 | 20-2 | | Light olive fine SILTSTONE with rust stains, hard, slightly moist. | | 50/6"* | 4.5+* | 113.1 | 10.3 |
| 15 | 20-3 | | Mottled olive SILTSTONE, with rust stains, hard, moist. | | 68 | 4.5+* | | |
| | | | Bottom of boring at approximately 14.5 feet. | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| ENGEO INCORPORATED | | | Southampton Units D1 through D7 Benicia, California | | BORING NO.: 20 DATE: January 1990 JOB NO.: N9-1736-M12 | | FIGURE NO. 21 | |

| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: October 12, 1989 | N S.P.T. BLOWS/FT | QU UNCON. COMP. STRENGTH (TSF) | IN PLACE | | |
|------------------------------|---------------|----------------------------------|--|--|--|--|-----------------------------|--------------------------------|
| | | | SURFACE ELEVATION: Approx. feet | | | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | DRY UNIT WEIGHT (PCF) |
| | | | DESCRIPTION | | | | | |
| 0 | | | Dark brown silty CLAY, moist. | | | | | |
| 21-1 | | | Brown silty CLAY with gravel, with rust stain, moist, stiff. | 30* | | 109.6 | 15.7 | |
| 21-2 | | | Olive sandy SILT with gravel, moist, hard. | 50/6"* | | | | |
| 21-3 | | | Olive SILTSTONE. Olive sandy SILTSTONE with rust stains, moist, hard. | 74 | 4.5+* | | | |
| 10 | | | Bottom of boring at approximately 9.5 feet. | | | | | |
| 15 | | | | | | | | |
| 20 | | | | | | | | |
| 25 | | | | | | | | |
| 30 | | | | | | | | |
| ENGEO INCORPORATED | | | Southampton Units D1 through D7 Benicia, California | BORING NO.: 21 DATE: January 1990 JOB NO.: NS-1736-M12 | FIGURE NO. 22 | | | |

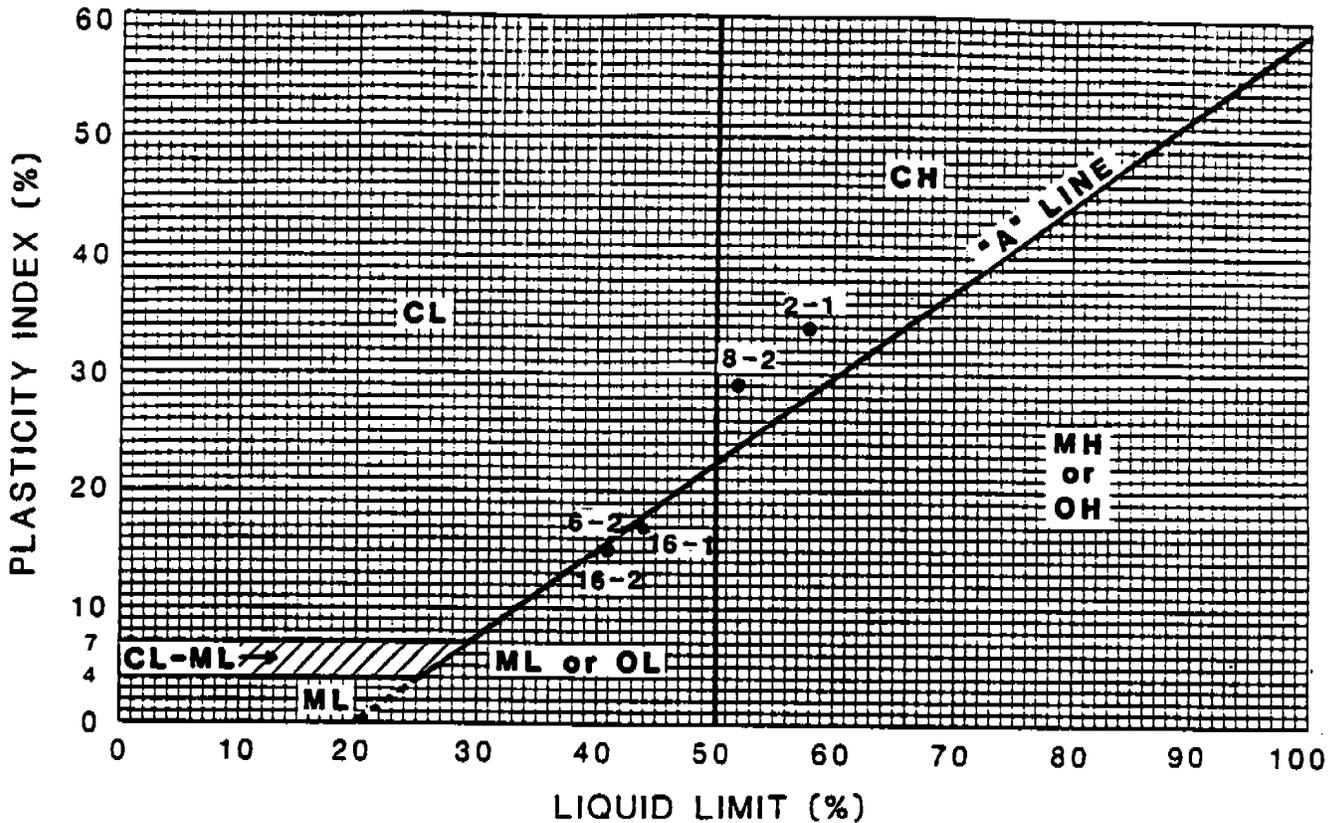
| DEPTH (FEET) | SAMPLE NUMBER | LOG, LOCATION AND TYPE OF SAMPLE | DATE OF BORING: October 12, 1989 | N S.P.T. BLOWS/FT | qu UNCON. COMP. STRENGTH (TSF) | IN PLACE | |
|--------------|---------------|--|---|--|--|------------------------------------|--|
| | | | SURFACE ELEVATION: Approx. feet | | | DRY UNIT WEIGHT (PCF) | MOIST. CONTENT % DRY WEIGHT |
| | | | DESCRIPTION | *MODIFIED FOR 3" O.D. SAMPLER | *FIELD PENET. APPROX. | | |
| 0 | | | | | | | |
| 22-1 | |  | Dark brown silty CLAY with gravel and sand, moist, very stiff. | 28* | 4.5+* | 108.0 | 15.9 |
| 22-2 | |  | Olive SILTSTONE with carbonate veining, hard, slightly moist. | 50/ 7.5"* | 4.5+* | 112.4 | 12.2 |
| 22-3 | |  | Olive SILTSTONE with carbonate veining and rust stains, hard, slightly moist. | 50/3" | 4.5+* | | |
| | | | Bottom of boring at approximately 11.5 feet. | | | | |
| 5 | | | | | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |

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Southampton Units D1 through D7
Benicia, California

BORING NO.: 22
DATE: January 1990
JOB NO.: N9-1736-M12

FIGURE
NO.
23



| NO. | SAMPLE DEPTH (FEET) | NATURAL WATER CONTENT % | ATTERBERG LIMITS | | | PERCENT PASSING NO. 200 SIEVE | UNIFIED SOIL CLASSIFICATION SYMBOL |
|-----|---------------------|-------------------------|------------------|-----------------|--------------------|-------------------------------|------------------------------------|
| | | | LIQUID LIMIT % | PLASTIC LIMIT % | PLASTICITY INDEX % | | |
| 2-1 | 6½ | 15.7 | 58 | 24 | 34 | -- | CH |
| 6-2 | 11 | 19.2 | 41 | 26 | 15 | -- | ML-CL |
| 8-2 | 11½ | 23.7 | 52 | 23 | 29 | -- | CH |

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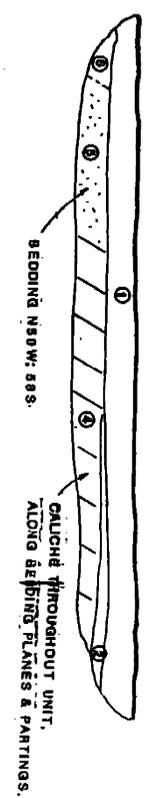
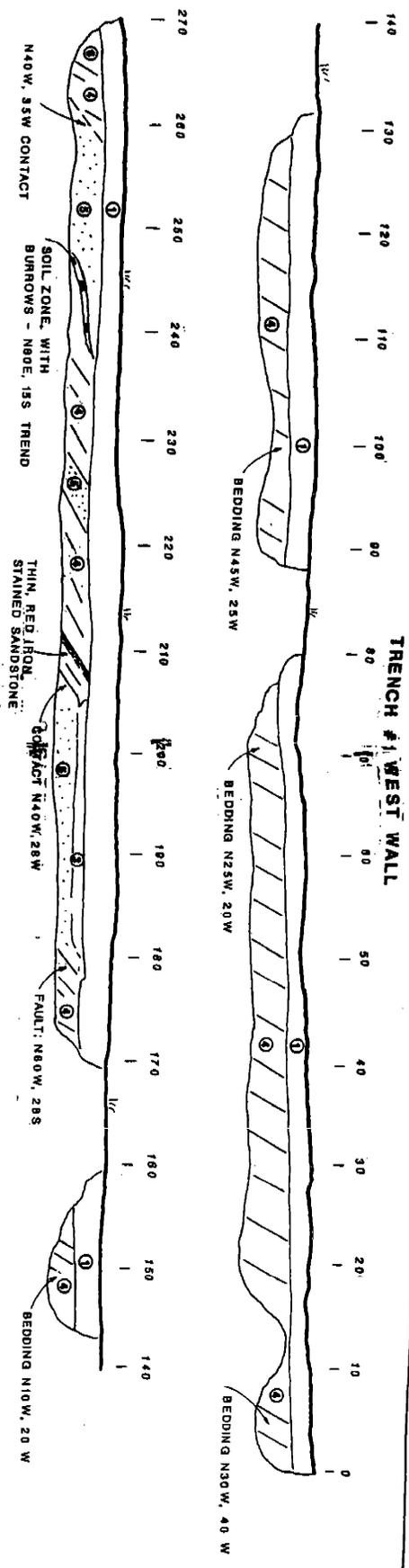
ATTERBERG LIMITS
SOUTHAMPTON UNITS D-1 THROUGH D-7
BENICIA, CALIFORNIA

FIGURE NO.

24

SCALE --
DATE December 1989

JOB NO. N9-1736-M12



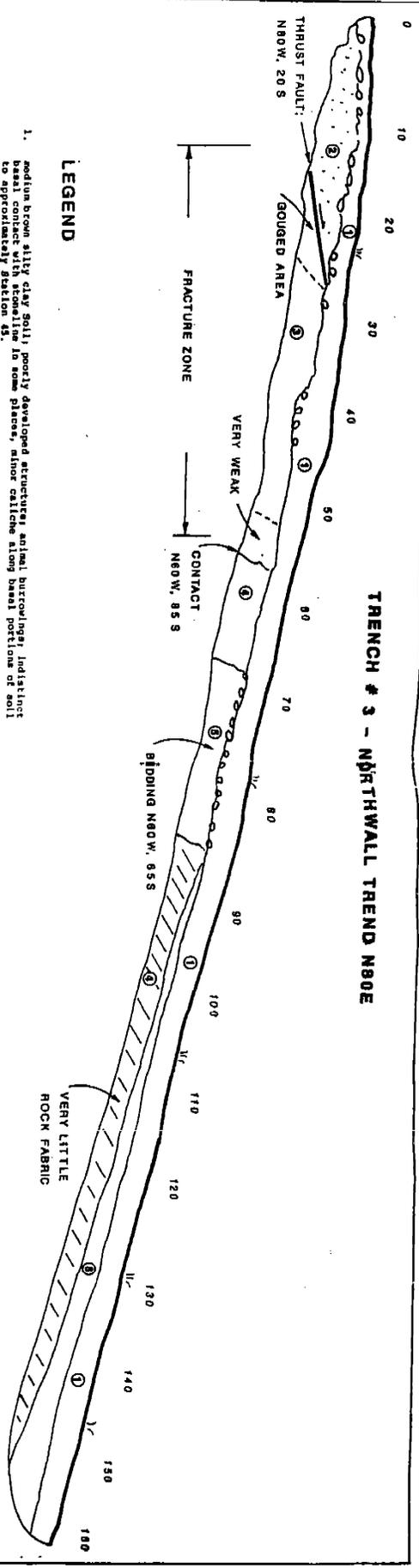
TRENCH #2 WEST WALL

LEGEND

1. Gray brown to dark brown silty clay soil with minor gravel; prismatic structure; molar, fine to very compact at depth.
2. medium brown silty clay soil, minor gravel, damp, compact.
3. weathered sandstone "cc" soil horizons; yellow highly weathered rock fragments in a matrix of brown sandy clay.
4. Shale/Claystone; gray but moderately weathered to red brown in most places, finely bedded, damp.
5. Sandstone; yellow to red oxidized surfaces, generally very hard and well cemented; grains moderately sorted and rounded, or quartz or plagioclase; fine to medium grained.
6. siltstone; yellow, weathered, highly fractured.

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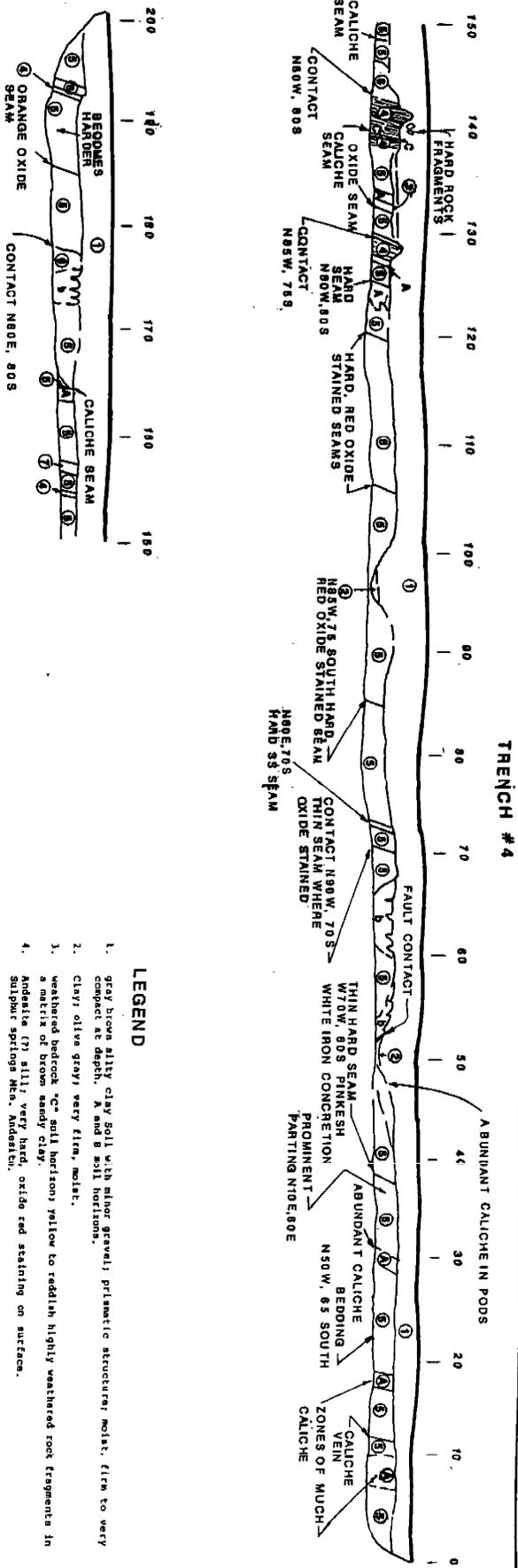
SOUTHAMPTON TRENCH LOGS
SOUTHAMPTON
BENICIA, CALIFORNIA
SCALE: 1"=10'
DATE: JANUARY 1988
JOB NO. NB-1738-MID
FIGURE NO. 3



LEGEND

1. medium brown silty clay soil; poorly developed structures; animal burrowings; indistinct basal contact with siltstone in some places, sharp caliche along basal portions of soil to approximately station 45.
2. Sandstone; yellow oxidized surfaces; light green/gray where fresh, very hard, well cemented very fine grained, moderate to moderately severe weathering, fractured.
3. weathered siltstone/claystone; small areas of olive to dark greenish gray compact but closely fractured rock surrounded by extensive areas severely weathered to light olive brown and dusky yellow; soft to moderately hard; very intensely closely fractured; much catclay common.
4. siltstone/claystone; light olive to dark greenish gray; moderately hard; slight to moderate weathering; fractured.
5. siltstone; light olive brown with reddish and orange staining; moderate to moderately severe weathering; closely fractured; atom-line present at contact with overlying soil.
6. silty clay calicheum with gravel; damp, medium brown to reddish brown, stiff, well developed prismatic soil structure.

| | | |
|---|--|---------------------------------------|
| <p>ENG GEO INCORPORATED</p> <p><small>ENGINEERS AND GEOLOGISTS CONSULTANTS IN THE APPLIED EARTH SCIENCES</small></p> | <p>SOUTHAMPTON TRENCH LOGS</p> <p>SOUTHAMPTON BENICIA, CALIFORNIA</p> | <p>FIGURE NO. 4</p> |
| | <p>SCALE: 1" = 1'</p> <p>DATE: JANUARY 1982</p> <p>JOB NO. NS-1736-M10</p> | |



LEGEND

1. gray brown silty clay soil with minor gravel; prismatic structure; moist, firm to very compact at depth. A and B soil horizons.
2. Clay; olive gray; very firm, moist.
3. weathered bedrock (ca soil horizon) yellow to reddish highly weathered rock fragments in a matrix of brown sandy clay.
4. Andesite (?) silty, very hard, oxide red staining on surface. Sulphur springs Nka. Andesite.
5. Shale, dark gray, damp, finely bedded, moderately weathered to brownish in places, calcium carbonate "caliche" abundant on weathered surfaces.
 - A. zones containing >50% caliche disseminated throughout weathered rock.
 - B. light gray, highly flaking fat clay with abundant scattered caliche interfingers with soil above (benctonal).
 - C. zones with red "baked" appearances.
6. Siltstone; yellow weathered, abundant scattered carbonate.
7. Sandstone; orange oxidized surface; moderately weathered friable.

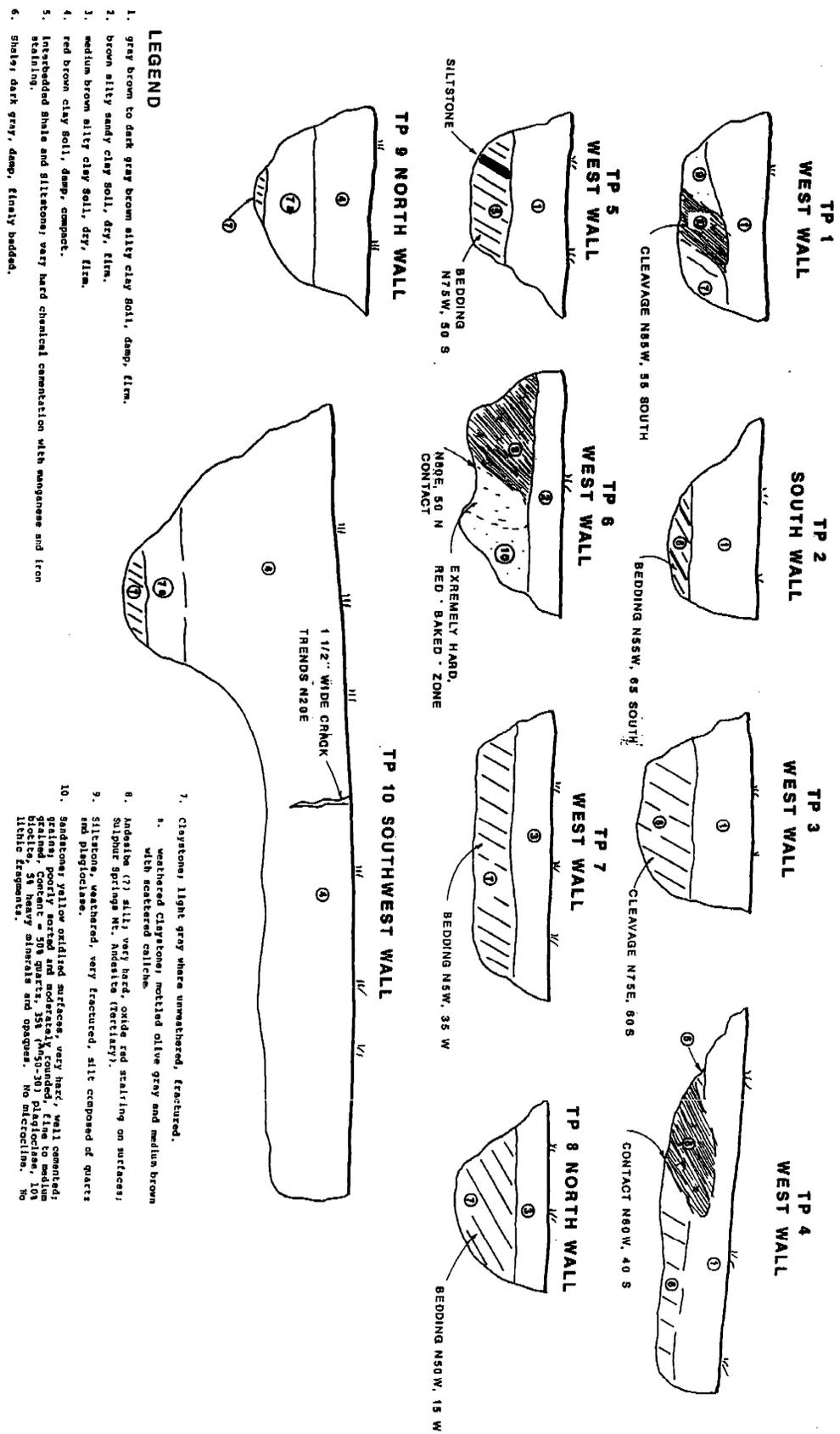
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SOUTHAMPTON TRENCH LOGS
SOUTHAMPTON
BENICIA, CALIFORNIA

SCALE: 1"=10'
DATE: JANUARY 1989

JOB NO. NS-1736-M10

FIGURE NO. 5



LEGEND

1. gray brown to dark gray brown silty clay soil, damp, firm.
2. brown silty sandy clay soil, dry, firm.
3. medium brown silty clay soil, dry, firm.
4. red brown clay soil, damp, compact.
5. interbedded shale and siltstone; very hard chemical cementation with manganese and iron staining.
6. shales dark gray, damp, finely bedded.
7. claystone; light gray where unweathered, fractured.
8. weathered claystone; mottled olive gray and medium brown with scattered calcite.
9. Andalusite (?) silt; very hard, oxide red staining on surfaces; Sulphur Springs Mt. Andalusite (tertiary?).
10. siltstone, weathered, very fractured, silt composed of quartz and plagioclase.
11. sandstone; yellow oxidized surfaces, very hard, well cemented, grains poorly sorted and moderately rounded, fine to medium grained, 50% quartz, 35% (m50-30) plagioclase, 10% calcite, 5% silicates and opal. No microfossils. No lithic fragments.

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SOUTHAMPTON TRENCH LOGS
 SOUTHAMPTON
 BENICIA CALIFORNIA

SCALE: 1"=5'
 DATE: JANUARY 1963

JOB NO. N9-1738-M10

FIGURE NO. 6

APPENDIX B

EARTH TECH TEST PIT LOGS

PROJECT NAME: Tourtelot Proper dy

PROJECT NO.: 35734 / 04.02

CLIENT: ~~State Dept of Education~~

DRILLING CONTRACTOR: LEE'S BACKHOE

DRILLING EQUIPMENT: Backhoe

DRILLER: LEE

SAMPLING METHOD: N.A.

TOTAL DEPTH: 8'

START DATE: 5-5-99

COMPLETION DATE: 5-5-99

LOGGED BY: R. Burginski

APPROVED BY: RAB R.G. #5674

LOCATION:

SURFACE ELEVATION:

| DEPTH | RECOVERY / % RCD | BLOW COUNT | SAMPLE NO. | MODE | SOIL CLASS / GRAPHIC LOG | DESCRIPTION | PID READING (PPM) | REMARKS |
|-------|---------------------|---------------|------------|------|-----------------------------|---|----------------------|---|
| 0'-8' | | | | | CL | silty clay (cl): dark brown (7.5 YR 3/3); damp; firm. Increasing rock fragments with depth. → Slightly weath. | | advanced test pit with JD450-D Encoder Backhoe with 3' shovel. |
| | | | | | | BOH = 8' : Bedrock: SHALE; olive gray; moderately ^{moderately} weathered; ab. ^{ab.} hard. | | moderately ^{moderately} some |
| | | | | | | T D H = 8' | | |

PROJECT NAME: Tourtelot Property

PROJECT NO.: 35734/04.02

CLIENT: ~~Brick & Mortar~~

DRILLING CONTRACTOR: LEE'S BACKHOE

DRILLING EQUIPMENT: Backhoe

DRILLER: LEE

SAMPLING METHOD: N.A.

TOTAL DEPTH: 9'

START DATE: 5-5-99

COMPLETION DATE: 5-5-99

LOGGED BY: R. Burginski

APPROVED BY: RAB RG. #5674

LOCATION:

SURFACE ELEVATION:

| DEPTH | RECOVERY / ROD | BLOW COUNT | SAMPLE NO. | MODE | SOIL CLASS / GRAPHIC LOG | DESCRIPTION | PID READING (PPM) | REMARKS |
|-----------|----------------|------------|------------|------|--------------------------|---|-------------------|----------------------|
| 0-9' | | | | | CL | Silty Clay (CL): dark brown (7.5 YR 3/3); damp; firm. Occasional rock fragments of SANDSTONE and SILTSTONE. | | moderately weathered |
| at 9' BOH | | | | | | BEDROCK: SHALE: gray; moderately weathered; hard | | hard |
| | | | | | | TDH = 9' | | |

PROJECT NAME: Tourtelot Property

PROJECT NO.: 35734/04.02

CLIENT: ~~Bobas~~ ~~Walt~~ ~~Edson~~

DRILLING CONTRACTOR: LEE'S BACKHOE

DRILLING EQUIPMENT: Backhoe

DRILLER: LEE

SAMPLING METHOD: N.A.

TOTAL DEPTH: 10'

START DATE: 5-5-99

COMPLETION DATE: 5-5-99

LOGGED BY: R. Burzinski

APPROVED BY: RAB R.G. #5674

LOCATION:

SURFACE ELEVATION:

| DEPTH | RECOVERY / ROD | BLOW COUNT | SAMPLE NO. | MODE | SOIL CLASS / GRAPHIC LOG | DESCRIPTION | PID READING (PPHM) | REMARKS |
|--------|----------------|------------|------------|------|--------------------------|--|--------------------|-----------------------|
| 0'-2' | | | | | CL | Silty Clay (CL): dark brown (7.5 YR 3/3); damp; firm. | | |
| 2'-10' | | | | | CH | Slightly Sandy CLAY (CH): light olive brown (2.5 Y 5/4); damp; firm; plastic; with rock fragments of light olive brown (2.5 Y 5/4), moderately weathered, fine grained SANDSTONE; very hard. | | |
| 10' | | | | | | 10' BOH: BEDROCK: SANDSTONE; olive gray; fine grained; weathered; TDH = 10' | | moderately very hard. |

PROJECT NAME: Tourtelot Property

PROJECT NO.: 35734 / 04.02

CLIENT: ~~Bechtel~~

DRILLING CONTRACTOR: LEE'S BACKHOE

DRILLING EQUIPMENT: Backhoe

DRILLER: LEE

SAMPLING METHOD: N.A.

TOTAL DEPTH: 12'

START DATE: 5-5-99

COMPLETION DATE: 5-5-99

LOGGED BY: R. Burginski

APPROVED BY: RAB R.E. #5674

LOCATION:

SURFACE ELEVATION:

| DEPTH | RECOVERY / ROD | BLOW COUNT | SAMPLE NO. | MODE | SOIL CLASS / GRAPHIC LOG | DESCRIPTION | PID READING (PPM) | REMARKS |
|---------|----------------|------------|------------|------|--------------------------|---|-------------------|---------|
| 0'-6' | | | | | CH | CLAY (CH): dark brown (7.5 YR 3/3); damp; firm; plastic. | | |
| 6'-11' | | | | | CH | CLAY (CH): light olive brown (2.5 Y 5/4); damp; firm, with moderately weathered rock fragments. | | |
| 11'-12' | | | | | CH | Sandy CLAY (CH): olive brown (2.5 Y 4/4); moist; firm; moderate plasticity. | | ▽ e 12' |
| | | | | | | TDH = 12' | | ≡ |

