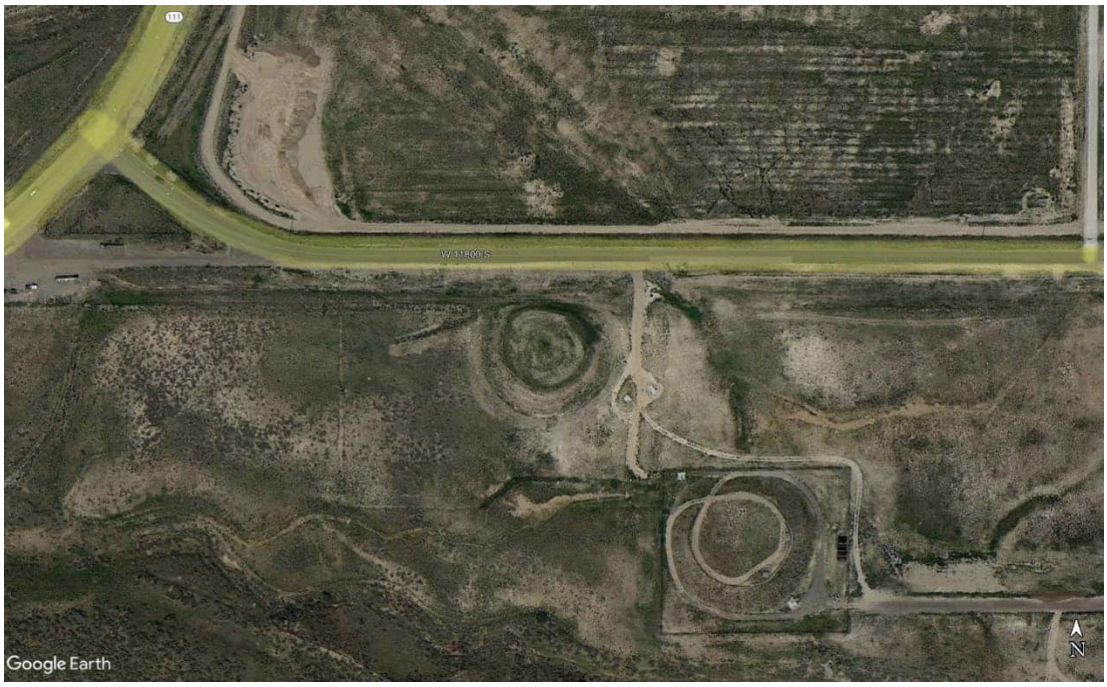
Soil Management Plan

11800 South Zone C Site
Jordan Valley Water Conservancy District
Salt Lake County, Utah

November 3, 2022
Revised January 20, 2023
Terracon Project No. 61227189 Task 3



Prepared for:
Jacobs Engineering Group
Salt Lake City, Utah

Prepared by:
Terracon Consultants, Inc.
Midvale, Utah

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APPENDICES

1.0 INTRODUCTION

The Jordan Valley Water Conservancy District (JVWCD) intends to build a new water reservoir to be located at 7185 West 11800 South (**Exhibit 1**), Salt Lake County, Utah. The project will be referred to as the *11800 South Zone C Site*. Jacobs Engineering (Jacobs) has been retained by JVWCD to design the reservoir and has requested that Terracon provide environmental services to characterize soils prior to development of the site.

The proposed tank location (**Exhibit 2**) is located within the Environmental Protection Agency (EPA) and Utah Department of Environmental Quality (UDEQ) regulated Kennecott South Zone and will pass through the general areas associated with Operable Unit 5 (OU5; Bastian Ditch of Anaconda Tailings) and OU6 (Lark Waste Rock and Tailings), which include the Bastian Ditch, the Mascotte Ditch, and Midas Creek (**Exhibit 3**). The location of the Bastian and Mascotte Ditches are no longer visible or obvious on the property, and the location of the Midas Creek is prominent. Elevated concentrations of lead and arsenic have been reported in soils in these areas.

This Soil Management Plan (SMP) has been developed to provide guidance regarding the on-site management and final disposition of excavated soils reporting elevated concentrations of lead and arsenic during the installation of the new water tank.

1.1 Previous Investigations

Applied GeoTech Engineering Consultants (AGEC) conducted a site investigation in the project area in 2017. According to the *Site Investigation Summary Report* (AGEC, September 12, 2017), the site has mainly been undisturbed, with the exception of dry farming agricultural use for grain crops. The AGEC investigation identified suspect land features using historical aerial photographs and marked the presumed locations of the Bastian Ditch, Mascotte Ditch, and Midas Creek in the area (AGEC Figure 1). Test trenches were excavated across the features to identify the location of the feature and collect soil samples. Excavation activities identified the Bastian Ditch, the Mascotte Ditch, and the Midas Creek in the locations identified on Figure 3 of the report. It is noted that the location of the features identified on the site in the AGEC report do not correspond to the locations mapped by the EPA.

Obvious stained soils were observed in the test trenches (AGEC; Appendix B Photo Log) and soil samples were collected for analyses of lead and arsenic. The AGEC report referenced an unlimited use and unrestricted exposure (UU/UE) screening level of 1,200 milligrams per kilogram (mg/kg) lead and 100 mg/kg arsenic; however, the EPA Unrestricted Land Use action levels for the area are 500 mg/kg lead and 50 mg/kg arsenic.

Surficial soils collected from the ground surface to 6 inches below the ground surface (bgs) by AGEC did not identify concentrations of lead or arsenic that exceeded the EPA Unrestricted Land Use action levels of 500 mg/kg lead and 50 mg/kg arsenic in surface soils at the site.

Terracon conducted a limited screening survey of surficial soils in the project area in 2017. Four 4-point composite soil samples collected from the surface to 2 inches bgs were analyzed using an X-ray fluorescence (XRF) multi-element analyzer following the manufacturer's operation manual. Surficial soils were not identified to exceed the EPA Unrestricted Land Use action levels for lead and arsenic.

A copy of the AGEC report and the Terracon soil screening survey are included in **Appendix B**.

1.2 Constituents of Concern and Regulatory Screening Levels

Lead and arsenic are the primary constituents of concern (COC) for soils within the Kennecott South Zone, as determined by the UDEQ and EPA Region 8 (the Agencies).

The regulatory standards that will be used to evaluate concentrations of lead and arsenic in soils excavated during this investigation and the future excavation of soils will be the action levels established for lead and arsenic in soils as noted below:

- **Unrestricted Land Use Action Level**: Soils reporting up to 500 mg/kg total lead and 50 mg/kg total arsenic may be considered for re-use without restriction. They may be removed from the site or left at the surface without restriction. Soils reporting concentrations of lead greater than 500 mg/kg and 50 mg/kg arsenic will require proper management.
- **Industrial Land Use Action Level**: Soils reporting up to 2,000 mg/kg total lead and 450 mg/kg total arsenic may remain on the property at the surface and will not require clean cover.

The future use of the property will be water storage in the form of a water tank. The Industrial Land Use Action levels will be considered applicable for the screening of soils as to whether they may remain at the surface of the site. Soils will be managed and characterized as detail in **Section 2.0**.

1.2.1 Extent of Impacts

Based on the previous investigations conducted within the property boundaries, the location of the ditches and creek are identifiable based on color changes through the soil profile. Concentrations of lead were reported to exceed the Industrial Land Use action level of 2,000 mg/kg at depths between 6 inches to 27 inches bgs in the Bastian Ditch and at a depth between 6 to 12 inches bgs in the Mascotte Ditch. Concentrations of lead did not exceed the Industrial Land Use action level in the samples collected from Midas Creek. No samples collected on the site during previous investigations exceeded the Industrial Land Use action level of 450 mg/kg for arsenic.

2.0 SOIL MANAGEMENT

As soils reporting concentrations of lead and arsenic exceeding the Unrestricted Land Use action levels for lead and arsenic have been reported in the Bastian Ditch, the Mascotte Ditch, and Midas Creek, soils excavated within these features must be managed during excavation. Any soils that exhibit discoloring, odors, or are suspected to be impacted must be properly characterized to determine appropriate management.

Prior to initiating site excavation activities, the location of the Bastian Ditch, the Mascotte Ditch, and Midas Creek will be marked on the property and surveyed. If excavation or soil disturbance will be conducted through the surveyed boundaries of the features of concern, soils from these areas will be stockpiled on visqueen on the site and managed following the procedures detailed below.

2.1 Excavation Methodologies

Excavation activities will be subject to the Storm Water Pollution Prevention Plan (SWPPP) and Fugitive Dust Control Plan for the project and will include reasonable efforts to minimize fugitive dust and/or loss of excavated material. Reasonable efforts include minimizing drop heights of soil, operating excavation equipment at less than maximum capacities (i.e., not overloading track-hoe buckets), and treating soil with water prior to excavation, if necessary.

Excavated material will be stockpiled adjacent to the work area in a manner supporting safe access for sampling. Soil stockpiles will be placed on visqueen and wetted or covered with visqueen on the day they are created until the soil is determined not to exceed the Industrial Land Use action level or transported off-site for proper disposal to reduce the potential for exposure to wind or precipitation that could potentially cause migration of soils. The stockpiled soils will be managed according to the project's SWPPP and Fugitive Dust Control Plan, and the contractor will implement sediment and erosion controls to prevent run-off and migration of stockpiled soils.

2.2 Stockpile Soil Sampling

Stockpiled soils originating from the features of concern will be sampled and characterized to evaluate the concentrations of lead and arsenic. Terracon intends to use single-use, disposable sampling tools for sample collection. All sampling and decontamination will follow Terracon's Standard Operating Procedures (**Appendix C**)**.** If non-disposable sampling equipment is used, non-disposable sampling equipment will be decontaminated between each sample location by washing the tool with an Alconox detergent solution followed by a triple rinse of deionized water. Terracon will collect a sample of the water in the third rinsate container for laboratory analyses of total lead and arsenic at the end of each day when samples are collected. Decontamination water will be allowed to infiltrate within the decontamination area. Investigation-derived solid waste will be bagged and disposed as non-hazardous waste.

One 10-point composite soil sample will be collected from stockpiled materials, at a frequency not-to-exceed one composite sample per 450 cubic yards. Each composite sample will be collected from the stockpile at multiple locations and depths to be representative of the entire soil stockpile. Large debris and rocks will be removed prior to homogenization of soil. Clay soils, if encountered, will be thoroughly mixed to the extent practicable.

Homogenized composite soil samples will be transported to the analytical laboratory for analyses of total lead and total arsenic, using EPA Method 3051A/6020B. For soils that are planned for off-site disposal and if required by the soil disposal facility, soil samples will be further analyzed using the toxicity characteristic leaching procedure (TCLP), using EPA Method 1311/6020B, to verify leaching of metals is not a concern. Soil samples submitted for TCLP analyses will be biased toward samples reporting the highest concentrations of lead and arsenic. If soil samples are identified to exceed the TCLP standard, the soils will be considered hazardous waste and managed as such immediately. The soil stockpiles may be further divided, and additional soil samples may be analyzed using a tiered approached to better define which materials are classifiable as hazardous waste.

2.2.1 Soil Characterization

Soils excavated within the boundaries of the suspect features, and any suspected impacted soils, must be stockpiled on the site on visqueen until properly characterized. The analytical results of samples collected from stockpiled materials will be used to guide the final disposition of the soils. Laboratory analytical results will be used to characterize the soils as follows:

- Soils reporting total lead concentrations up to 500 mg/kg and total arsenic concentrations up to 50 mg/kg may remain on the surface of the project or may be relocated without restriction either within or outside of the Kennecott South Zone with permission of the property owner.
- Soils reporting total lead concentrations up to 2,000 mg/kg and total arsenic concentrations up to 450 mg/kg may be left at the surface of the property or transported off-site for disposal at an appropriately-permitted and regulated disposal facility.
- Soils reporting total lead concentrations greater than 2,000 mg/kg and total arsenic concentrations greater than 450 mg/kg must either remain on-site under a minimum 18 inch thick, clean cover or be transported off-site for disposal at an appropriately-permitted and regulated disposal facility.
- If soils reporting concentrations of lead and arsenic above the Unrestricted Land Use action level are required to be removed from the site, they must be disposed at an appropriately permitted facility with permission.

JVWCD will notify the UDEQ as to the final disposition of soils exceeding the Unrestricted Land Use action levels.

2.3 Soil Characterization for Off-site Disposal

If soils generated during excavation or other site activities need to be hauled off-site that report concentrations of lead greater than 500 mg/kg and arsenic greater than 50 mg/kg, JVWCD or approved contractor will coordinate with the receiving facility to properly characterize the soils following the receiving facility requirements prior to transport, and in accordance with applicable State and Federal requirements.

If the TCLP limit of 5 mg/L is exceeded for either lead or arsenic in soils to be removed from the site, the material will be managed as a hazardous waste and will be properly transported and disposed of at an appropriately-permitted and regulated hazardous waste disposal facility.

2.4 Laboratory Analytical Program

Soil samples required for characterization will be submitted to Chemtech-Ford Analytical Laboratory (Chemtech). All sample analyses will be performed under Chemtech's Level 3 QC program, which includes a laboratory method blank, laboratory control sample, matrix spike and matrix spike duplicate, a narrative report of QC results, and any corrective actions required. Chemtech will follow their prescribed Quality Manual (**Appendix D**) and the data package generated by Chemtech will include quality control and quality assurance analyses and procedures.

Analyses of total lead and total arsenic will be performed using EPA Method 3051A/6020B. Analyses using the TCLP will be performed using EPA Method 1311/6020B.

2.5 Stormwater and Fugitive Dust Control Management

Stormwater and Fugitive Dust will be managed following the Contractor's *Storm Water Pollution Prevention Plan* and their *Fugitive Dust Control Plan* developed for the project. Stockpiled soils must be managed in a manner that will not allow for the migration of soils across the site or into Midas Creek.

2.6 Decontamination

When excavating within known or identified impacted soil zones, a decontamination area will be set up within the project area. For construction equipment (excavators, trenching equipment, haul trucks, frontend loaders, etc.) and hand tools, visible soil will be brushed from the equipment prior to them leaving the site. Equipment or tool washing, using either water or a water and mild detergent mixture, may be permitted, but only if wash water controls have been established that will inhibit run-off of wash water and/or sediment from the decontamination area. All non-essential vehicles and equipment will be staged outside of the impacted soil areas to minimize equipment contamination. Where practical, vehicles and equipment will remain outside of the impacted zone. Personnel decontamination will comply with Occupational Safety and Health Administration (OSHA) standards.

3.0 SAMPLING QUALITY ASSURANCE / QUALITY CONTROL PROCEDURES

Quality control for the sampling program will include using standardized sample collection and handling methods, documenting pertinent field information, and keeping chain-of-custody records. All sampling and decontamination will follow Terracon's Standard Operating Procedures (**Appendix C SOPs**).

Field duplicate soil samples will be collected at a frequency of 10% of the soil samples submitted to the analytical laboratory for analyses of lead and arsenic. Intra-laboratory precision will be assessed by the comparison of duplicate field soil samples. The Relative Percent Difference (RPD) between the sample and the field duplicate will be calculated, and the data quality objective for the intra-laboratory split sample will be an RPD value of 35% or less.

Inter-laboratory precision will be assessed by the comparison of field split sample results. Inter-laboratory split samples will be collected at a rate of 10% of field duplicate samples. Terracon will split samples collected in the field and deliver one portion of the sample to Pace Analytical Laboratory, and one portion of the sample to Chemtech Ford Analytical Laboratory. The sample will be submitted for analyses of total lead and total arsenic, using EPA Method 3051A/6020B. The data quality objective for the inter-laboratory split sample will be an RPD of 35% or less.

3.1 Data Quality Objectives

The purpose of data quality assessment is to assure that data generated under the QA/QC program is reconciled, accurate, and consistent with program data quality objectives (DQOs). DQOs are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC). Two different sample analyses may be performed on soil collected for this project: (1) total lead and arsenic and (2) TCLP lead and arsenic. The DQOs for Chemtech's internal QA/QC analyses are listed in **Table 1**.

Precision is the degree of agreement among repeated measurements and is quantitatively measured. Laboratory analysis precision will be determined by calculating the Relative Percent Difference (RPD) between the field duplicate sample pairs, field split sample pairs, and the laboratory's matrix spike and matrix spike duplicate samples. RPDs for field duplicate pairs and field split pairs are calculated when the analytical results for the sample and its duplicate are greater than five times the laboratory's reporting limit. If the results are less than five times the laboratory's reporting limit, *precision* is considered in control if the difference between the sample and its duplicate is less than two times the laboratory's reporting limit. The RPD, when calculated, is defined as:

$$\text{RPD} = \frac{|X_1 - X_2|}{\left(\frac{X_1 + X_2}{2}\right)} x100$$

Where X_1 and X_2 are the reported concentrations of the samples being evaluated.

RPD calculations for the MS/MSD pairs will be performed by the laboratory through their QA/QC program. The MS/MSD precision for Chemtech is +/- 20%. RPD calculations for field duplicate sample pairs and field split sample pairs will be performed by Terracon and will be considered within control if they are within +/- 35%.

Accuracy is a measure of confidence in a result (i.e., a determination of how close the measurement is to the true value) and will be assessed via percent recovery in matrix spike, matrix spike duplicate, and laboratory control sample analyses compared to the laboratory's control limits for percent recovery. Percent Recovery (% Recovery) is defined as:

$$\% \text{ Recovery} = \frac{measured\ value}{true\ value} x100$$

Chemtech's Percent Recovery limits for Method 6020B are 70-130% (MS/MSD) and 85-115% (LCS).

Representativeness is the extent to which measurements actually depict the true environmental condition you are evaluating. Representativeness will be assessed by verifying samples were analyzed within their analytical method holding times, that the rinsate sample did not report any contamination, and that laboratory's method blanks do not report any contamination.

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. For the purpose of this project, comparability will be assessed by the units of measure reported in the analytical results compared to the units of measure established for Action Levels and by using analytical methods that are comparable to other similar studies in the same area and under the same regulatory framework.

Completeness is a measure of the number of samples you must take to be able to use the information. Percent completeness represents the percentage of the total number of samples that were collected that were determined to be valid. The data quality objective for Completeness will be 90% valid data.

Table 1
Data Quality Objectives: Measured Performance Criteria in Terms of PARCCs

Parameter	QC Program	Evaluation Criteria	Summary of QA/QC Goals
Precision	Matrix Spike / Matrix Spike Duplicate (MS/MSD) Pairs	Relative Percent Difference (RPD)	+/- 20%
	Field Duplicate Sample Pairs	RPD	+/- 35% if results are >5xLRL +/- 2xLRL if results are ≤5xLRL
	Field Split Sample Pairs	RPD	+/- 35% +/- 2xLRL if results are ≤5xLRL
Accuracy	MS/MSD Pairs	Percent Recovery	70-130%
	Laboratory Control Samples (LCS)	Percent Recovery	85-115%
Representativeness	Holding Times	Representative of Environmental Conditions	Holding times met 100 percent
	Method Blanks	Qualitative Degree of Confidence	No method blank contamination
	Rinsate Samples		No rinsate sample contamination
Comparability	Standard Units of Measure	Qualitative Degree of Confidence	Laboratory methods followed
	Standard Sampling Methods		SOPs followed
Completeness	Complete Sampling	Percent Valid Data	90% valid data

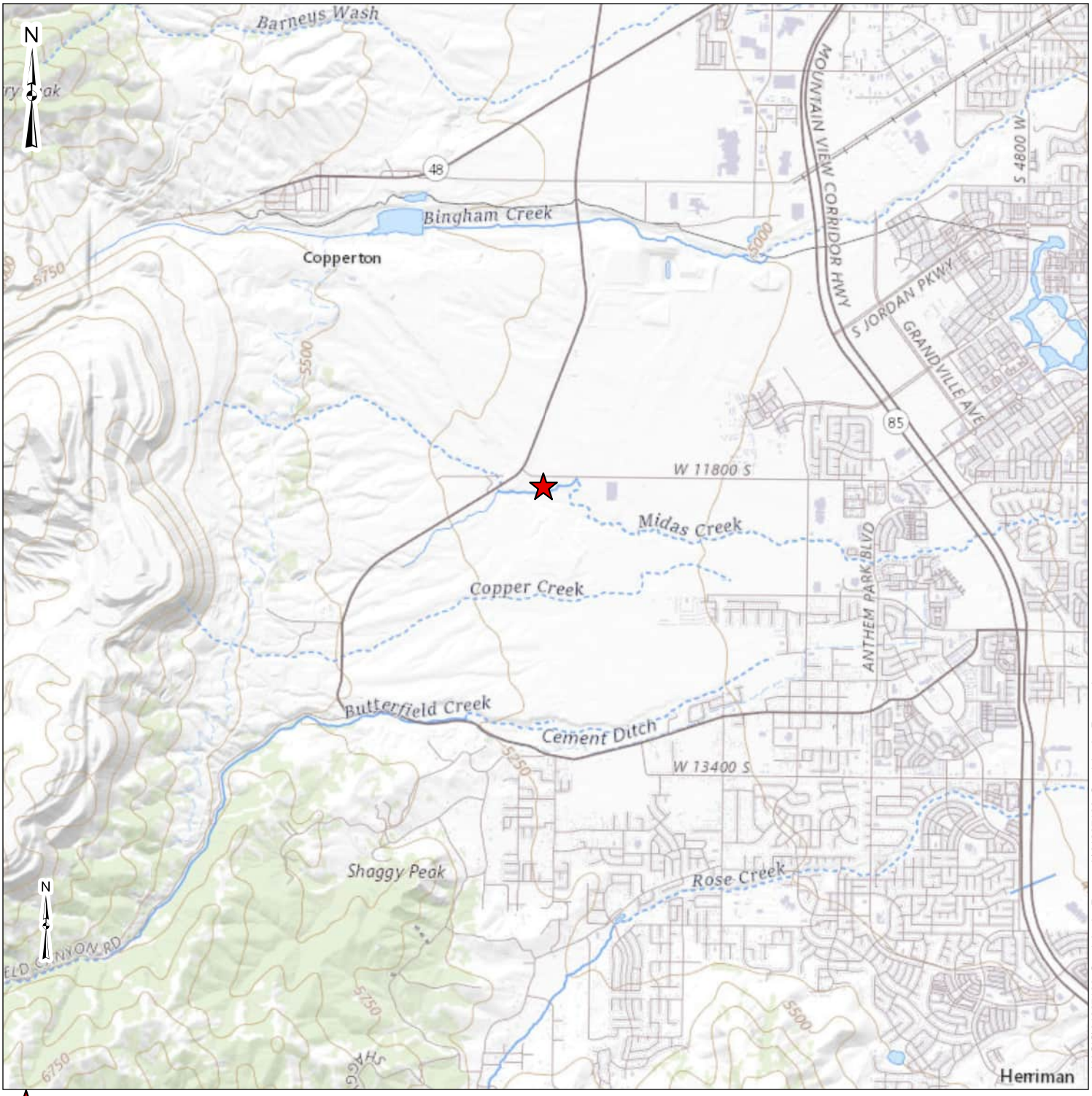
LRL: Laboratory Reporting Limit SOP: Standard Operating Procedure
RPD: Relative Percent Difference

4.0 REPORT

A report will be prepared and submitted within 60 days of receipt of laboratory analytical data. Following the validation of field and laboratory data, all data and information will be reconciled with the project objectives to assess the overall success of sampling activities. The report will include, at a minimum, site observations (subsurface lithology, distribution of impacts, etc.), comprehensive analytical results, QA/QC tables, final soil disposition information, any deviations from the Soil Management Plan, and sample location maps.

APPENDIX A

Exhibits



Approximate Site Location

Miles

0 0.5 1 2

DATA SOURCES:
ESRI - Basemaps

N:\GIS\61227189_SouthJordanReservoir\61227189_SouthJordanReservoir.aprx

Project No.:	61227189
Date:	Nov 2022
Drawn By:	AST
Reviewed By:	AA

terracon

6949 S High Tech Dr
Midvale, UT

PH. 801-545-8500 terracon.com

Topographic Site Overview

11800 South Zone C Reservoir
7185 West 11800 South
Salt Lake County, Utah

Exhibit

1

SOUTH VALLEY WATER RECLAMATION

11800 SOUTH

JVWCD PROPERTY CORNER
N 7364798.16
E 1482504.46

JVWCD PROPERTY CORNER
N 7364792.67
E 1483159.63

WORK LIMITS, NOTE 1

WORK LIMITS CORNER
N 7364773.16
E 1482504.46

WORK LIMITS CORNER
N 7364767.67
E 1483159.32

NOTE:

1. PLACE SILT FENCE ALONG WORK LIMITS PER SPECIFICATIONS.
2. REMOVE AND DISPOSE OFFSITE APPROXIMATELY 575 FEET OF EXISTING HDPE 16" WATERLINE. REPLACE WITH APPROXIMATELY 600 FEET OF NEW PE 4710 IPS 16" HDPE DR11. BUTT FUSE WELD ALL JOINTS INCLUDING CONNECTION TO EXISTING. MINIMUM DEPTH OF COVER = 8 FEET, MINIMUM SLOPE = 0.015, AND MINIMUM BEND RADIUS = 50 FEET. SEE (3123-200) FOR TYPICAL TRENCH DETAIL.

KENNECOTT LAND COMPANY

KENNECOTT LAND COMPANY

12" PRV VAULT
SEE DWG C-02
& (1 / SM-03)

FUTURE ROAD
EL 5162.00

FUTURE
7MG TANK
HWL = 5158
LWL = 5130

FUTURE
3MG TANK
HWL = 5158
LWL = 5130

EXCESS CLEAN EARTH FILL. FOR SITE DETAILS, SEE DWG C-02

HERRIMAN CITY TURNOUT
TURNOUT / AIR VALVE / MANWAY,
SEE (1 / PA-04)

GRAVEL ACCESS ROAD

FUTURE 24" WSP AND HERRIMAN CITY METER VAULT

FUTURE FACILITIES, SEE DWG C-02

WORK LIMITS, NOTE 1

675'±

WORK LIMITS CORNER
N 7364298.15
E 1482504.46

WORK LIMITS CORNER
N 7364292.70
E 1483153.45

WORK LIMITS, NOTE 1

HERRIMAN CITY TANK
LWL = 5120

MIDAS CREEK

648'±

JVWCD PROPERTY CORNER
N 7364098.38
E 1482504.46

JVWCD PROPERTY CORNER
N 7363916.17
E 1483148.79

16" W

16" W

0 50 100 150
1"=50'

RECORD DRAWING

Revisions Drawn By C HOGGARD Date JANUARY 2019

THESE RECORD DRAWINGS HAVE BEPREPARED BY THE ENGINEER BASED ON THE INFORMATION PROVIDED BY THE CONTRACTOR'S FIELD RECORDS.

THE ORIGINAL DRAWING WAS STAMPED BY RYAN WILLEITNER UTAH P.E. NO. 8760818-2202

NO.	DATE	DR	REVISION	CHK	APVD	BY	APVD
DSGN	R WILLEITNER	C.HOGGARD		N JONES		R WILLEITNER	

JORDAN VALLEY WATER CONSERVANCY DISTRICT

11800 SOUTH U-111 PROJECT

CIVIL

OVERALL SITE PLAN FUTURE TANKS AND SUPPORTING INFRASTRUCTURE

RECORD DRAWINGS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	JANUARY 2019
PROJ	680064
DWG	C-01
SHEET	42 of 84

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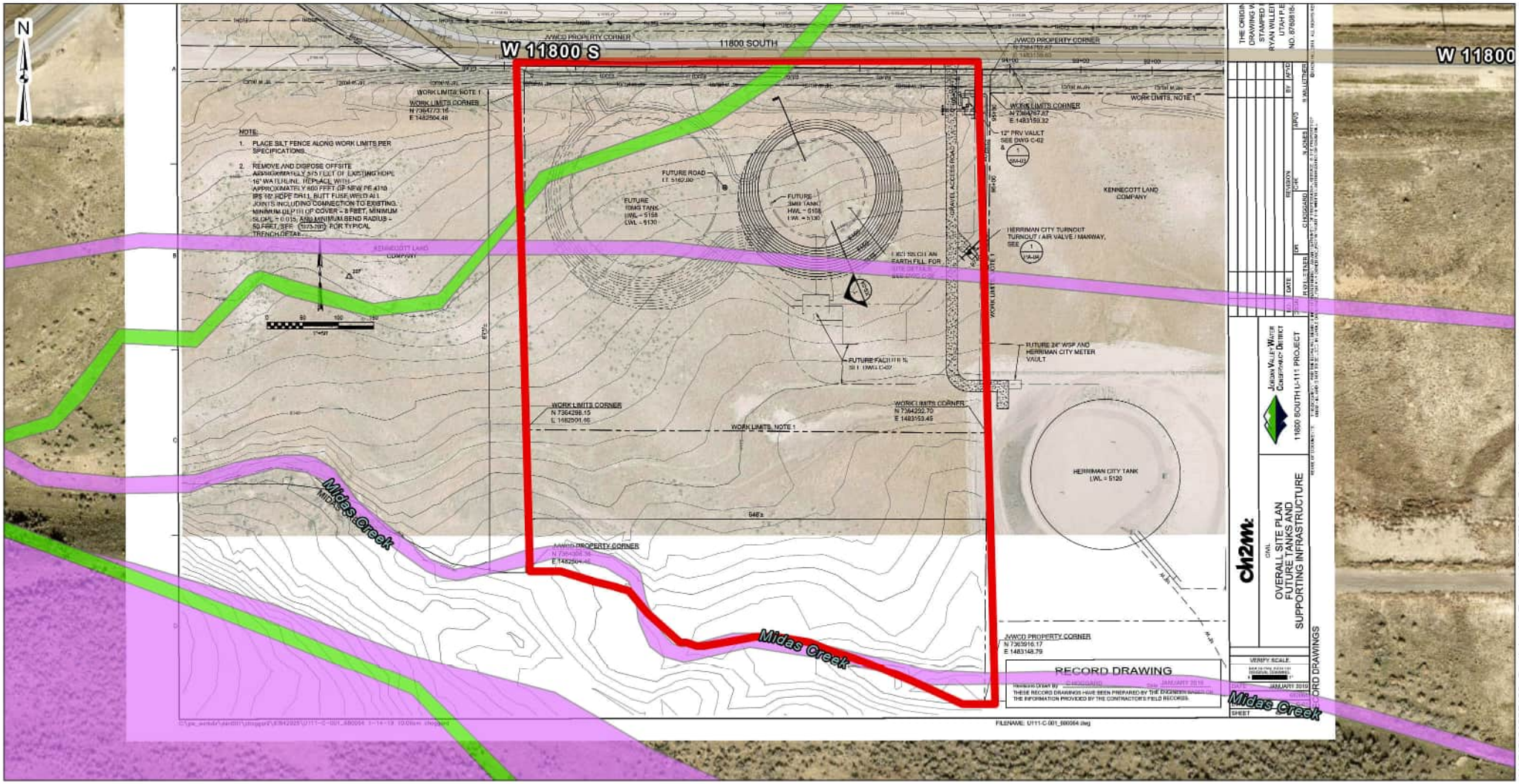


Property Boundary

Operable Unit

- OU5 Bastion Ditch
- OU6 Mascotte Ditch

Feet

0 100 200 400

DATA SOURCES:
ESRI - Basemaps

Project No.:	61227189
Date:	Oct 2022
Drawn By:	[CREATOR INITIALS]
Reviewed By:	[VIEWER INITIALS]

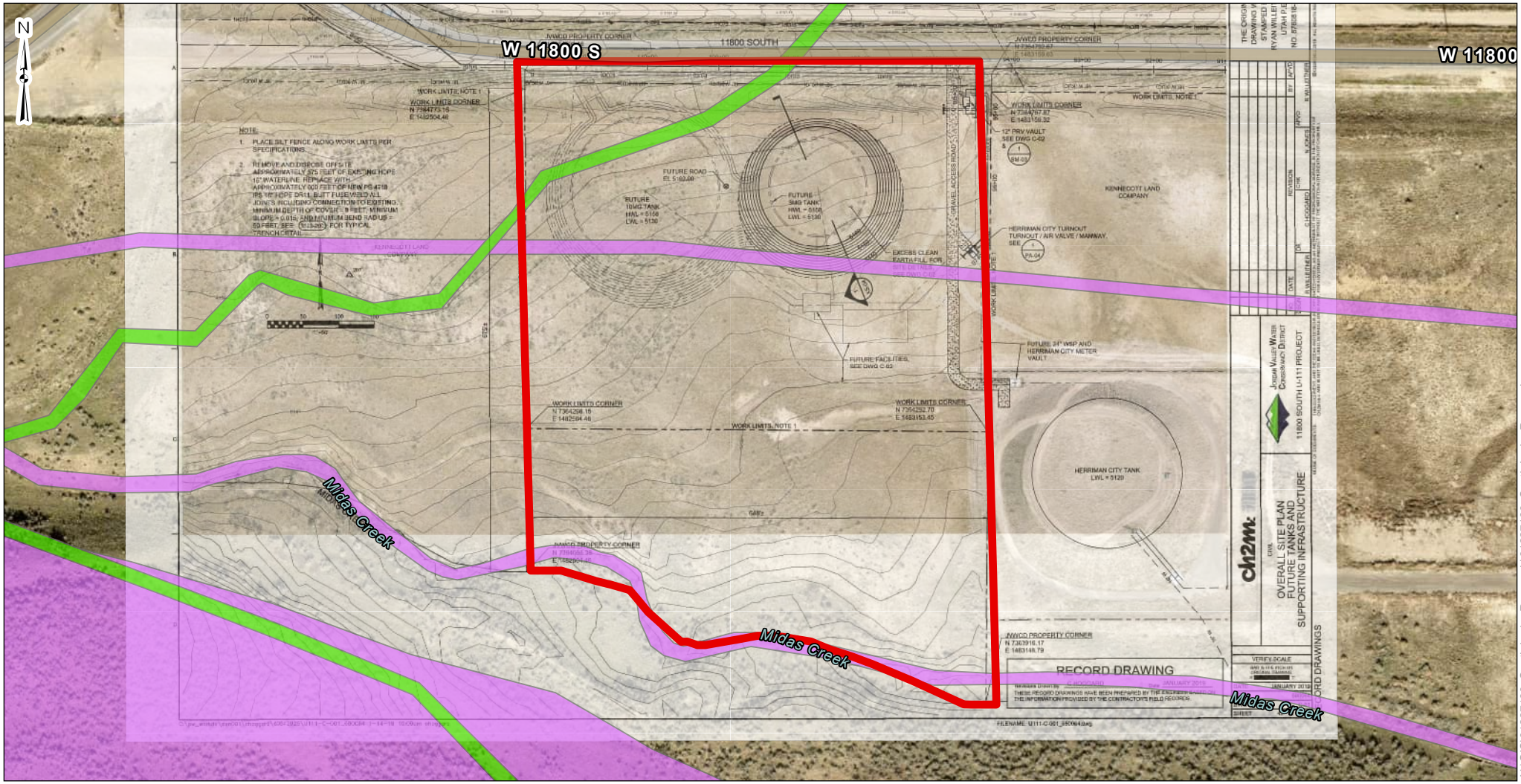
Terracon
6949 S High Tech Dr
Midvale, UT
PH. 801-545-8500 terracon.com

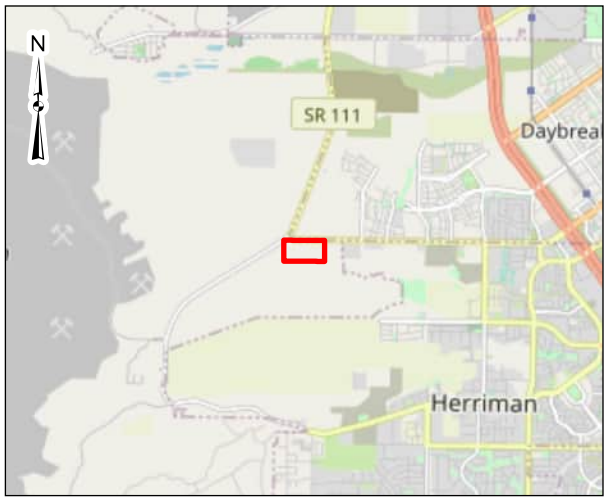
Operable Unit Map

11800 South Zone C Reservoir
7185 West 11800 South
South Jordan, Utah

Exhibit

3





Property Boundary

Operable Unit

- OU5 Bastion Ditch
- OU6 Mascotte Ditch

Feet
0 100 200 400

DATA SOURCES:
ESRI - Basemaps

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Reviewed By:	AA

Terracon
6949 S High Tech Dr
Midvale, UT
PH. 801-545-8500 terracon.com

Operable Unit Map

11800 South Zone C Reservoir
7185 West 11800 South
Salt Lake County, Utah

Exhibit

3

APPENDIX B

Previous Reports

AGEC
Applied GeoTech

SITE INVESTIGATION SUMMARY REPORT

JVWCD TANK SITE

APPROXIMATELY 7200 WEST 11800 SOUTH
SALT LAKE COUNTY, UTAH

PREPARED FOR:

JORDAN VALLEY WATER CONSERVANCY DISTRICT
8215 SOUTH 1300 WEST STREET
WEST JORDAN, UT 84088

ATTENTION: JT CRACROFT

AGEC PROJECT NO. 1170621

SEPTEMBER 12, 2017

600 West Sandy Parkway • Sandy, Utah 84070 • (801) 566-6399 • FAX (801) 566-6493

AGEC
Applied GeoTech

September 12, 2017

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, UT 84088

Attention: JT Cracroft

Subject: 7200 West JVWCD Zone C Subdivision Sampling
7200 West 11800 South Street
Salt Lake County, Utah
AGEC Project No. 1170621

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to conduct environmental soil sampling for the 7200 West JVWCD Zone C Subdivision parcel at approximately 7200 West 11800 South in Salt Lake County, Utah. AGEC previously performed a Phase 1 Environmental Site Assessment (ESA) on the subject property for the Jordan Valley Water Conservancy District. Findings of the study were reported July 17, 2017, under AGEC Project No. 1170504.

SITE BACKGROUND

Historical aerial photographs indicate the majority of the property was vacant and undeveloped until the 1970s when most of the property was cultivated and dry farmed for grain crops. The fields were laid fallow several years ago. Two historical ditches previously crossed the property prior to the fields being cultivated (Figure 1). The Bastian Ditch operated from the late 1800s to approximately 1936 across the northwest corner. The Mascotte Ditch operated from 1942 to 1971 across the south center. The water line was built along the north edge of the property in the 1990s.

A review of several EPA Five Year Review Reports for the Kennecott South Zone Operable Units contained some historical information about the drainages and the nearby sampling and remedial actions performed by Kennecott.

The Bastian Ditch was constructed in the 1880's when water was diverted from Bingham Creek near the Oquirrh foothills to the Bastian Sink vicinity. The ditch conveyed irrigation waters to ranch and farm land south of Bingham Creek and ultimately carried water as far south as Copper Creek. The ditch captured tailings (originating from the Anaconda Tailings) that entered the creek upstream of the diversion. Ditch remnants could be seen along the south side of Anaconda Tailings and on Kennecott lands south of Anaconda Tailings. Subsequent sampling showed scattered elevated lead values in the southern extension of the ditch system. The tailings deposited in Bastian Ditch were removed by Kennecott and ARCO on their respective lands in accordance with decision documents under provisions of two Orders; UAO, CERCLA VIII 93-06, January 15, 1993 and AOC, CERCLA VIII 98-09, 1998.

A Record of Decision (ROD) was issued in 1998 for OU5 (as well as other OUs in the Kennecott South Zone). The ROD selected No Further Action. The tailings in Bastian Ditch were excavated and either placed in a repository near the west end of the Anaconda Tailings or transported to the Bluewater Repository on Kennecott property. The site cleanup levels were risk-based concentrations. The 1993 Action Memorandum identified 2,000 mg/Kg lead as the concentration above which mine wastes at OU5 were consolidated and capped. The 1998 ROD recognized this concentration as protective for open space, recreational and industrial land uses however it is not protective of unrestricted land use. No action level was established for residential, commercial or agricultural land use. Based on the available reports, it is not clear if the remedial actions along the Bastian Ditch extended south of 11800 South Street in the vicinity of the subject property.

The Mascotte Ditch was used to transfer water from Mascotte Tunnel (and potentially from Bingham Tunnel) to the Mascotte Ponds, where the water was then supposedly used for irrigation purposes. The Mascotte Ditch emanated from the portal of the Mascotte Tunnel (near the Bingham Tunnel portal) and proceeded northeast along the northern periphery of the Lark Tailings area. At the juncture of the Mascotte Ditch and Bastian Ditch, the Mascotte Ditch continued in a generally easterly direction past the Midas Creek Silos site and into the Mascotte Pond. The Mascotte Ditch was not characterized or removed, nor was the area between the Midas Creek Silos and Mascotte Pond (where red tainted soils were observed at depth) suspected to be the corridor of the Mascotte Ditch. Midas Creek was not characterized up or down gradient of the confluence of the Mascotte and Bastian Ditches. How the Mascotte and Bastian Ditches crossed Midas Creek is still unknown.

The Midas Creek Silos area, approximately 800 feet to the west, was found to have layers of tailings (similar to Lark Tailings) in the channel of Midas Creek near an intersection with the Mascotte Ditch. This area is suspected to be the location of the intersection of the Bastian and Mascotte ditches. Characterization of the tailings determined a maximum lead and arsenic concentration of 2,643 mg/kg and 142 mg/kg respectively. The sampling also determined a mean lead and arsenic concentration of 454 mg/kg and 37 mg/kg respectively. Some of the sampled material was acidic, with a paste pH of 3.56. The soils were often found to be discolored. The area received a partial removal, after which it was regraded/recontoured. The September 2001 ROD states that post removal sampling delineated a maximum lead and arsenic concentration of 175 mg/kg and 37 mg/kg respectively. The post removal sampling also delineated a mean lead and arsenic concentration of 160 mg/kg and 31 mg/kg. During this review, representatives of Kennecott noted that not all of the Midas Creek Silos area was characterized and it is possible that some soil containing elevated lead and arsenic above the potentially applicable UU/UE standards may still remain at the subject property.

Based on a review of the EPA reports, the Phase 1 ESA revealed no evidence of recognized environmental conditions in connection with the property with the following exception:

> The subject property was crossed by the Mascotte Ditch and the Bastian Ditch prior to the property being cultivated in the 1970s. The Midas Creek previously flowed along the south edge of the property. All three drainages have been impacted by nearby historical mine tailings with elevated concentrations of lead and arsenic. Previous environmental studies for Kennecott have indicated that portions of the three

drainages have been investigated and remediated either up or down gradient of the subject property but do not appear to have been adequately characterized on the subject property. The potential for concentrations of lead and arsenic on the subject property above the potentially applicable UU/UE standards for lead and arsenic (1,200 mg/kg and 100 mg/kg respectively) is a recognized environmental condition.

SAMPLING ACTIVITIES AND RESULTS

To help characterize the soils on the subject property and to determine if the historical drainages have impacted the property, a subsurface soil sampling investigation was performed by excavating three trenches across each of the three drainages on August 31, 2017. The trenches were excavated approximately 3 to 5 feet deep and approximately 15 to 20 feet long perpendicular to the three drainages with a trackhoe. The depth of the trenches varied depending on how deep the drainages were. The locations of the trenches were based on GPS coordinates obtained from Google Earth along with historical aerial photographs showing the three drainages (Figures 1 and 2).

The drainages were labeled Bastian - BA, Mascotte - MA and Midas - MI. Grab soil samples were obtained from each trench on the sidewalls or floor at varying depths. The grab samples were intended to provide an indication that the soils remaining along the drainages contain concentrations of lead and arsenic below the unrestricted use/unrestricted exposure (UU/UE) standards. The soil samples were obtained on a visual basis emphasizing the soil that appears to be more white, yellow, orange or reddish in color than the surrounding soils as these soils were assumed most likely to contain elevated lead and arsenic concentrations. The old canals were identified by the distinctive soil colors formed in a shallow "U" shape below the ground surface (see photographs in Appendix B).

The soil samples were obtained in general accordance with sampling protocols as set by Utah State and the Environmental Protection Agency. At least three grab soil samples were obtained from each trench excavation from locations near the center of the drainage and from each distinct soil layer observed. The soil samples were removed from the trench walls by hand by excavating relatively similar sized samples while wearing new disposable rubber gloves. The grab samples were placed in a new 2-ounce glass jars as provided by the analytical laboratory where they were labeled with the trench number, depth, date and time of sampling.

The surface soils on site were also sampled by obtaining six composite surface samples to help determine what the average lead and arsenic concentration remains in the near surface soils within the sample lots. The subject property was broken up into six relatively equal areas of approximately 2 acres (Figure 3). Each of the composite surface samples consisted of five subsamples obtained from locations near the corners and center of each lot. The five subsamples for each of the six lots were mixed and composited in the field by hand kneading and crushing the soil clods to break up any large lumps, remove gravel and mix the soil into a relatively homogeneous mass prior to submission to the analytical laboratory. The soil samples were stored in a cooler with ice to approximately 4° C and submitted to a Utah certified analytical laboratory (American West Analytical Laboratories-AWAL) for analysis of total lead and total arsenic on September 1, 2017. The laboratory tested the soil samples for dry weight total lead and arsenic using test methods SW-846 6020 and Quality Assurance level 2+ reporting.

The subject property is vacant and undeveloped. Most of the property has been previously cultivated but the fields have been laid fallow. The property is now vegetated with grass, sagebrush, thistle and weeds. There are no structures or pavements on the property. The two previous canals that crossed the property were refilled during the historical farming activities. No evidence of the canals is evident from the surface of the site with the exception of a general thinning in the vegetation along the drainages.

The analytical results from the testing of the 41 trench samples are summarized on the following table.

Trench	Depth (inches)	Lead (mg/kg)	Arsenic (mg/kg)
BA-1	6-12	**4,700**	89.9
BA-1	12-18	91.8	17.0
BA-1	18-21	1,090	60.4
BA-1	21-27	**2,080**	**141**
BA-1	30-36	866	14.7
BA-1	36-42	246	12.2
BA-2	6-12	576	28.5
BA-2	14-19	**2,820**	91.1
BA-2	20-24	**2,930**	**137**
BA-2	30-36	300	14.3
BA-3	6-12	145	29.3
BA-3	24-30	71.2	29.8
BA-3	30-32	284	44.9
BA-3	36-42	199	12.9
MA-1	6-12	**3,820**	**213**
MA-1	16-24	38.3	18.1
MA-1	24-26	123	31.2
MA-1	26-32	51.7	11.7
MA-1	38-40	51.9	11.7
MA-2	0-6	412	48.7
MA-2	6-10	96.7	31.4

Trench	Depth (inches)	Lead (mg/kg)	Arsenic (mg/kg)
MA-2	10-12	207	35.6
MA-2	24-30	85.2	32.5
MA-2	36-40	65.5	29.3
MA-3	0-6	663	55.5
MA-3	6-12	141	35.8
MA-3	14-18	205	41.4
MA-3	24-30	676	21.4
MI-1	6-12	484	56.0
MI-1	24-29	39.4	19.2
MI-1	29-36	80.4	24.7
MI-1	36-42	150	30.0
MI-1	54-60	78.2	10.9
MI-2	6-12	93.1	20.6
MI-2	14-18	87.9	22.0
MI-2	18-22	28.7	23.1
MI-2	24-30	54.4	17.3
MI-2	50-56	87.4	15.6
MI-3	6-12	148	27.3
MI-3	23-28	37.2	14.0
MI-3	45-48	35.6	10.9

The analytical results from the testing of the six surface composite lot samples are summarized on the following table.

	Lead (mg/kg)	Arsenic (mg/kg)
Lot 1	86.7	19.1
Lot 2	101	16.5
Lot 3	156	23.1
Lot 4	388	44.0
Lot 5	349	48.8
Lot 6	304	42.2

The lead concentrations in the trench samples ranged from 28.7 to 4,700 mg/kg and the arsenic concentrations ranged from 10.9 to 213 mg/kg. Two samples each from BA-1 and BA-2 and one sample from MA-1 had concentrations of lead above the UU/UE standard of 1,200 mg/kg. One sample each from BA-1, BA-2 and MA-1 had concentrations of arsenic above the UU/UE standard of 100 mg/kg. None of the composite surface samples contained lead or arsenic above the UU/UE standards.

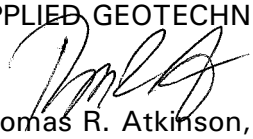
CONCLUSIONS

Based on the analytical test results from the nine trenches, soils impacted with concentrations of arsenic exceeding the UU/UE standards of 1,200 mg/kg lead and 100 mg/kg arsenic are present in the Bastian and Mascotte ditches.

LIMITATIONS

This site investigation summary report has been prepared for the use of the client in accordance with generally accepted environmental practices in this area. Applied Geotechnical Engineering Consultants, Inc. does not represent that the soil and groundwater on the property contains no hazardous materials or other latent conditions beyond the compounds and locations tested.

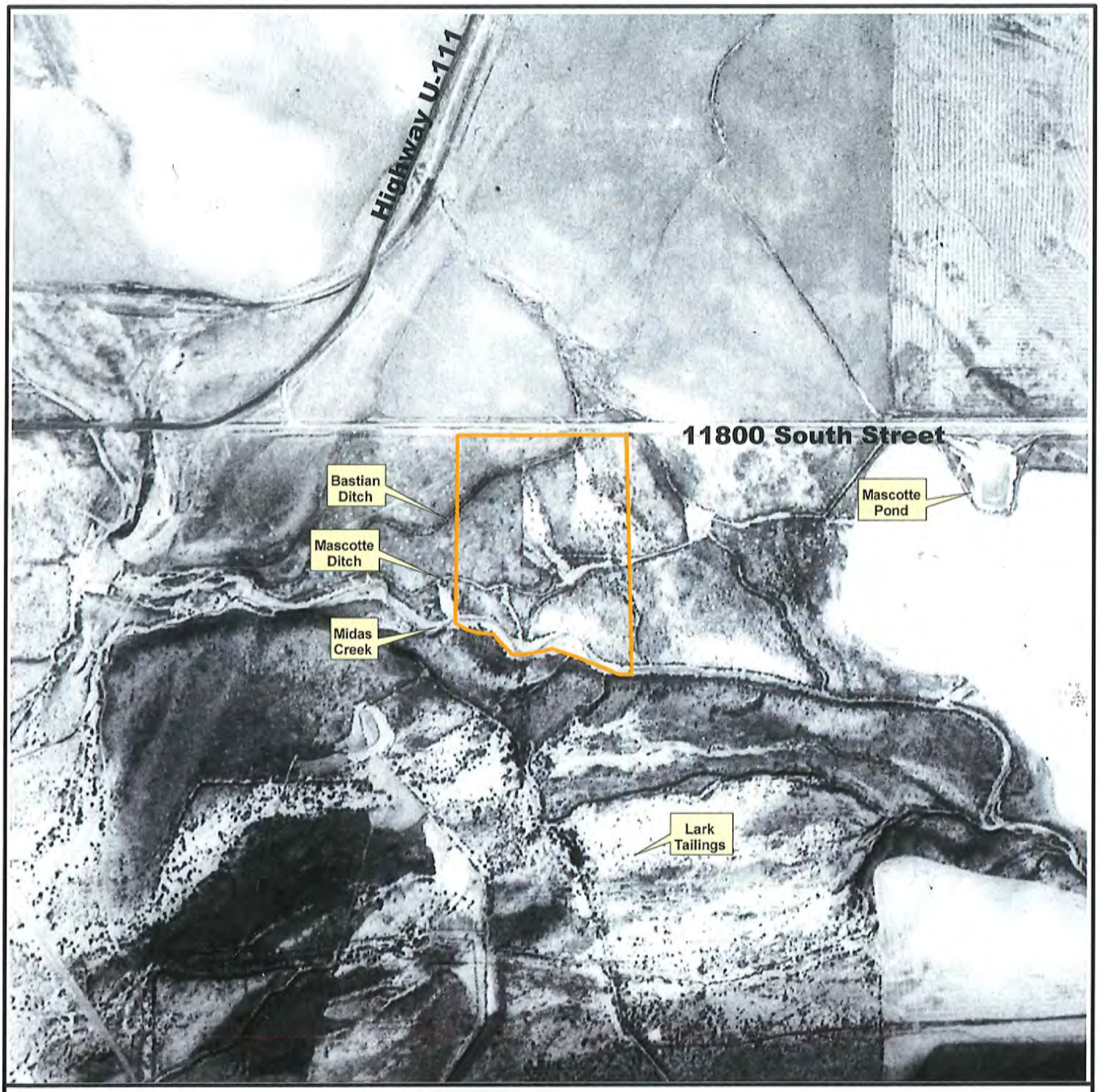
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Thomas R. Atkinson, REPA

Reviewed by DRH, P.E., P.G.

FIGURES



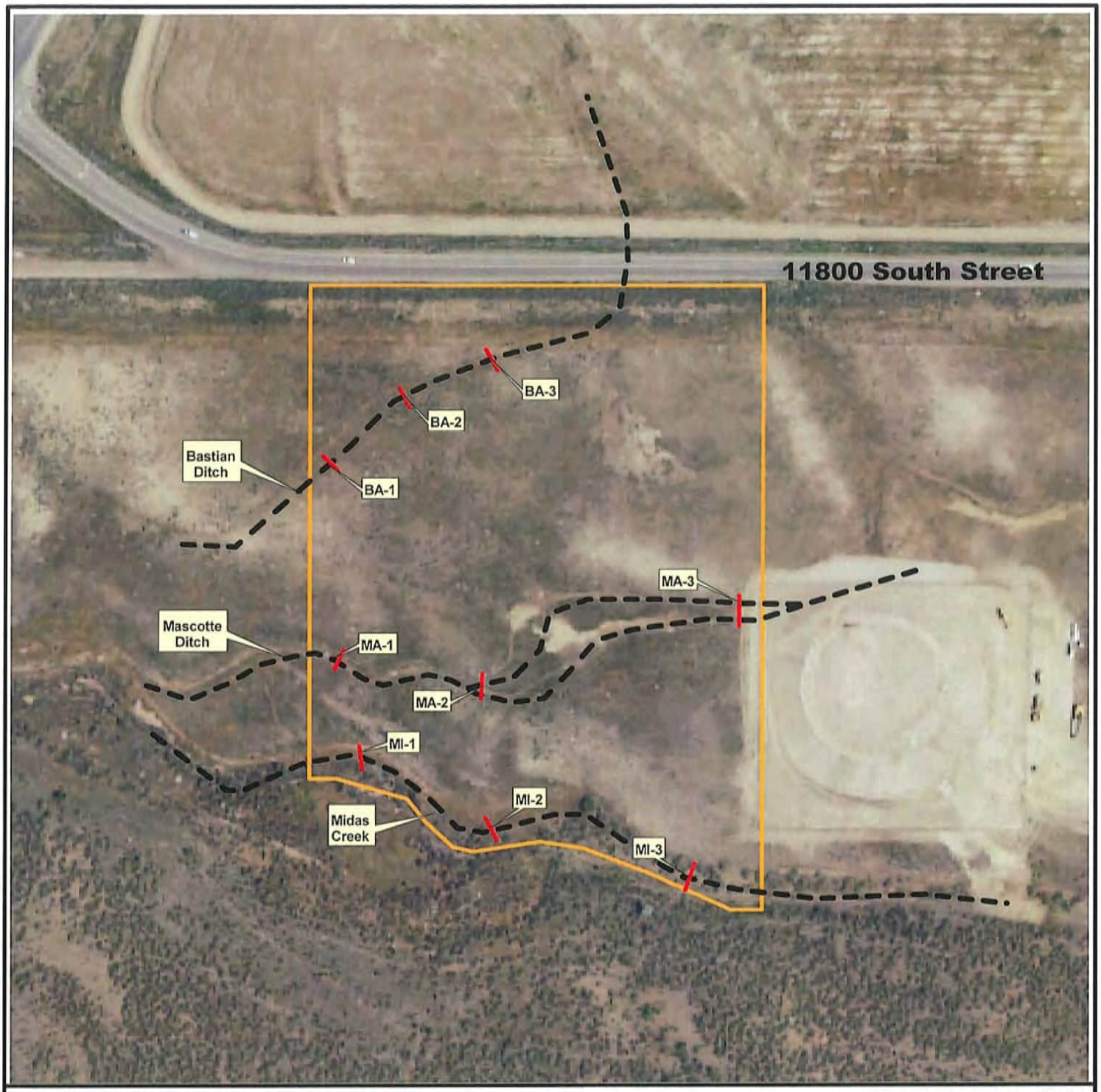
From USDA Aerial Photograph 3-11
September 21, 1937

JVWCD ZONE C SUBDIVISION
APPROXIMATELY 7200 WEST 11800 SOUTH STREET
SALT LAKE COUNTY, UTAH

N

Approximate Scale
1 inch = 520 feet

1170621	AGEC	1937 Aerial Photograph of Site	Figure 1



From USDA NAIP Aerial Photograph
June 27, 2016

N

Approximate Scale
1 inch = 200 feet

JVWCD ZONE C SUBDIVISION
APPROXIMATELY 7200 WEST 11800 SOUTH STREET
SALT LAKE COUNTY, UTAH

1170621	ASES	Trench Sampling Locations	Figure 2

From USDA NAIP Aerial Photograph
June 27, 2016

JVWCD ZONE C SUBDIVISION
APPROXIMATELY 7200 WEST 11800 SOUTH STREET
SALT LAKE COUNTY, UTAH

N

Approximate Scale
1 inch = 200 feet

1170621	AGEC	Surface Sampling Lots	Figure 3

APPENDIX A

AWAL ANALYTICAL TEST RESULTS

American West
ANALYTICAL LABORATORIES

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

Thomas Atkinson
Applied Geotechnical
600 West Sandy Parkway
Sandy, UT 84070
TEL: (801) 566-6399

RE: JVWCD Tank / 1170621

Dear Thomas Atkinson: Lab Set ID: 1709014

American West Analytical Laboratories received sample(s) on 9/1/2017 for the analyses presented in the following report.

American West Analytical Laboratories (AWAL) is accredited by The National Environmental Laboratory Accreditation Program (NELAP) in Utah and Texas; and is state accredited in Colorado, Idaho, New Mexico, Wyoming, and Missouri.

All analyses were performed in accordance to the NELAP protocols unless noted otherwise. Accreditation scope documents are available upon request. If you have any questions or concerns regarding this report please feel free to call.

The abbreviation "Surr" found in organic reports indicates a surrogate compound that is intentionally added by the laboratory to determine sample injection, extraction, and/or purging efficiency. The "Reporting Limit" found on the report is equivalent to the practical quantitation limit (PQL). This is the minimum concentration that can be reported by the method referenced and the sample matrix. The reporting limit must not be confused with any regulatory limit. Analytical results are reported to three significant figures for quality control and calculation purposes.

Thank You,

Approved by: _____
Laboratory Director or designee

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-001
Client Sample ID: BA-1 @ 6-12"
Collection Date: 8/31/2017 1523h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/2/2017 1354h	SW6020B	2.75	**89.9**	2
Lead	mg/kg-dry	9/1/2017 1744h	9/2/2017 1438h	SW6020B	143	**4,700**	2

² - Analyte concentration is too high for accurate matrix spike recovery and/or RPD.

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-002
Client Sample ID: BA1 @ 12-18"
Collection Date: 8/31/2017 1615h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 902h	SW6020B	3.07	**17.0**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 902h	SW6020B	7.97	**91.8**	

3440 South 700 West
Salt Lake City, UT 84119

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Toll Free: (888) 263-8686
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-003
Client Sample ID: BA1 @ 18-21"
Collection Date: 8/31/2017 1530h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 905h	SW6020B	2.44	**60.4**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 811h	SW6020B	127	**1,090**	

3440 South 700 West
Salt Lake City, UT 84119

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Toll Free: (888) 263-8686
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-004
Client Sample ID: BA1 @ 21-27"
Collection Date: 8/31/2017 1535h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 908h	SW6020B	2.76	**141**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 814h	SW6020B	144	**2,080**	

3440 South 700 West
Salt Lake City, UT 84119

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-005
Client Sample ID: BA1 @ 30-36"
Collection Date: 8/31/2017 1545h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 911h	SW6020B	3.10	**14.7**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 817h	SW6020B	161	**866**	

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Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-006
Client Sample ID: BA1 @ 36-42"
Collection Date: 8/31/2017 1550h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 914h	SW6020B	2.86	**12.2**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 914h	SW6020B	7.43	**246**	

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Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-007
Client Sample ID: MA2 @ 0-6"
Collection Date: 8/31/2017 1608h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 918h	SW6020B	2.73	**48.7**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 918h	SW6020B	7.10	**412**	

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Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-008
Client Sample ID: MA2 @ 6-10"
Collection Date: 8/31/2017 1610h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/1/2017 1744h	9/5/2017 921h	SW6020B	2.64	**31.4**	
Lead	mg/kg-dry	9/1/2017 1744h	9/5/2017 921h	SW6020B	6.86	**96.7**	

3440 South 700 West
Salt Lake City, UT 84119

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-009
Client Sample ID: MA2 @ 10-12"
Collection Date: 8/31/2017 1620h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1042h	SW6020B	3.01	**35.6**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1042h	SW6020B	7.82	**207**	²

² - Analyte concentration is too high for accurate matrix spike recovery and/or RPD.

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Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-010
Client Sample ID: MA2 @ 24-30"
Collection Date: 8/31/2017 1625h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1057h	SW6020B	2.73	**32.5**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1057h	SW6020B	7.10	**85.2**	

3440 South 700 West
Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-011
Client Sample ID: MA2 @ 36-40"
Collection Date: 8/31/2017 1627h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 944h	SW6020B	3.08	**29.3**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 944h	SW6020B	8.02	**65.5**	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-012
Client Sample ID: MA-1 @ 6-12"
Collection Date: 8/31/2017 1532h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1100h	SW6020B	2.82	**213**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1613h	SW6020B	73.4	**3,820**	

3440 South 700 West
Salt Lake City, UT 84119

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-013
Client Sample ID: MA1 @ 16-24"
Collection Date: 8/31/2017 1535h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1103h	SW6020B	2.34	**18.1**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1103h	SW6020B	6.07	**38.3**	

3440 South 700 West
Salt Lake City, UT 84119

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-014
Client Sample ID: MA-1 @ 24-26"
Collection Date: 8/31/2017 1537h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1115h	SW6020B	2.70	**31.2**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1115h	SW6020B	7.03	**123**	

3440 South 700 West
Salt Lake City, UT 84119

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-015
Client Sample ID: MA1 @ 26-32"
Collection Date: 8/31/2017 1540h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1118h	SW6020B	3.07	**11.7**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1118h	SW6020B	7.98	**51.7**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-016
Client Sample ID: MA1 @ 38-40"
Collection Date: 8/31/2017 1542h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1121h	SW6020B	3.05	**11.7**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1121h	SW6020B	7.94	**51.9**	

3440 South 700 West
Salt Lake City, UT 84119

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Toll Free: (888) 263-8686
Fax: (801) 263-8687
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-017
Client Sample ID: MI-1 @ 6-12"
Collection Date: 8/31/2017 1545h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 959h	SW6020B	2.74	**56.0**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 959h	SW6020B	7.13	**484**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
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e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-018
Client Sample ID: MI-1 @ 24-29"
Collection Date: 8/31/2017 1547h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1002h	SW6020B	2.48	**19.2**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1002h	SW6020B	6.45	**39.4**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-019
Client Sample ID: MI-1 @ 29-36"
Collection Date: 8/31/2017 1550h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1124h	SW6020B	2.85	**24.7**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1124h	SW6020B	7.40	**80.4**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-020
Client Sample ID: MI-1 @ 36-42"
Collection Date: 8/31/2017 1552h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1128h	SW6020B	2.86	**30.0**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1128h	SW6020B	7.42	**150**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-021
Client Sample ID: MI-1 @ 54-60"
Collection Date: 8/31/2017 1554h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1131h	SW6020B	2.59	**10.9**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1131h	SW6020B	6.73	**78.2**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-022
Client Sample ID: MI-2 @ 6-12"
Collection Date: 8/31/2017 1600h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1134h	SW6020B	2.36	**20.6**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1134h	SW6020B	6.13	**93.1**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-023
Client Sample ID: MI-2 @ 14-18"
Collection Date: 8/31/2017 1602h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1155h	SW6020B	2.73	**22.0**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1155h	SW6020B	7.10	**87.9**	

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Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-024
Client Sample ID: MI-2 @ 18-22"
Collection Date: 8/31/2017 1604h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1158h	SW6020B	2.53	**23.1**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1158h	SW6020B	6.57	**28.7**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-025
Client Sample ID: MI-2 @ 24-30"
Collection Date: 8/31/2017 1605h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1201h	SW6020B	2.72	**17.3**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1201h	SW6020B	7.06	**54.4**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-026
Client Sample ID: MI-2 @ 50-56"
Collection Date: 8/31/2017 1606h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/5/2017 1420h	9/6/2017 1204h	SW6020B	2.66	**15.6**	
Lead	mg/kg-dry	9/5/2017 1420h	9/6/2017 1204h	SW6020B	6.91	**87.4**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-027
Client Sample ID: MI-3 @ 6-12"
Collection Date: 8/31/2017 1614h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1005h	SW6020B	2.67	**27.3**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1005h	SW6020B	6.95	**148**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-028
Client Sample ID: MI-3 @ 23-28"
Collection Date: 8/31/2017 1616h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1018h	SW6020B	2.83	**14.0**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1018h	SW6020B	7.37	**37.2**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-029
Client Sample ID: MI-3 @ 45-48"
Collection Date: 8/31/2017 1618h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1021h	SW6020B	2.74	**10.9**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1021h	SW6020B	7.12	**35.6**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-030
Client Sample ID: MA-3 @ 0-6"
Collection Date: 8/31/2017 1627h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1024h	SW6020B	2.64	**55.5**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1115h	SW6020B	68.7	**663**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-031
Client Sample ID: MA3 @ 6-12"
Collection Date: 8/31/2017 1629h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1027h	SW6020B	2.37	**35.8**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1027h	SW6020B	6.16	**141**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-032
Client Sample ID: MA3 @ 14-18"
Collection Date: 8/31/2017 1631h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1030h	SW6020B	2.84	**41.4**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1030h	SW6020B	7.37	**205**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-033
Client Sample ID: MA3 @ 24-30"
Collection Date: 8/31/2017 1635h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1033h	SW6020B	2.75	**21.4**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1118h	SW6020B	71.6	**676**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-034
Client Sample ID: BA-2 @ 6-12"
Collection Date: 9/1/2017 754h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1036h	SW6020B	2.61	**28.5**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1121h	SW6020B	67.8	**576**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-035
Client Sample ID: BA-2 @ 14-19"
Collection Date: 9/1/2017 758h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1039h	SW6020B	2.51	**91.1**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1124h	SW6020B	65.2	**2,820**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-036
Client Sample ID: BA2 @ 20-24"
Collection Date: 9/1/2017 801h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1042h	SW6020B	3.01	**137**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1136h	SW6020B	78.2	**2,930**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-037
Client Sample ID: BA2 @ 30-36"
Collection Date: 9/1/2017 804h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1045h	SW6020B	2.61	**14.3**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1045h	SW6020B	6.78	**300**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-038
Client Sample ID: BA3 @ 6-12"
Collection Date: 9/1/2017 730h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1057h	SW6020B	2.69	**29.3**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1057h	SW6020B	6.99	**145**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
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Fax: (801) 263-8687
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-039
Client Sample ID: BA3 @ 24-30"
Collection Date: 9/1/2017 735h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1100h	SW6020B	2.59	**29.8**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1100h	SW6020B	6.73	**71.2**	

3440 South 700 West
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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-040
Client Sample ID: BA3 @ 30-32"
Collection Date: 9/1/2017 738h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1103h	SW6020B	2.50	**44.9**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1103h	SW6020B	6.51	**284**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-041
Client Sample ID: BA3 @ 36-42"
Collection Date: 9/1/2017 742h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1106h	SW6020B	2.78	**12.9**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1106h	SW6020B	7.24	**199**	

3440 South 700 West
Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-042
Client Sample ID: Lot 1 @ 0-2"
Collection Date: 9/1/2017 845h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1109h	SW6020B	2.44	**19.1**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1109h	SW6020B	6.34	**86.7**	

3440 South 700 West
Salt Lake City, UT 84119

Phone: (801) 263-8686
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e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-043
Client Sample ID: Lot 2 @ 0-2"
Collection Date: 9/1/2017 845h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/6/2017 1216h	9/7/2017 1112h	SW6020B	2.71	**16.5**	
Lead	mg/kg-dry	9/6/2017 1216h	9/7/2017 1112h	SW6020B	7.04	**101**	

3440 South 700 West
Salt Lake City, UT 84119

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Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-044
Client Sample ID: Lot 3 @ 0-2"
Collection Date: 9/1/2017 845h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/7/2017 1530h	9/8/2017 1517h	SW6020B	1.88	**23.1**	
Lead	mg/kg-dry	9/7/2017 1530h	9/8/2017 1517h	SW6020B	4.88	**156**	[3]

[3] - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

3440 South 700 West
Salt Lake City, UT 84119

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-045
Client Sample ID: Lot 4 @ 0-2"
Collection Date: 9/1/2017 845h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/7/2017 1530h	9/8/2017 1532h	SW6020B	1.91	**44.0**	
Lead	mg/kg-dry	9/7/2017 1530h	9/11/2017 618h	SW6020B	12.4	**388**	

3440 South 700 West
Salt Lake City, UT 84119

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-046
Client Sample ID: Lot 5 @ 0-2"
Collection Date: 9/1/2017 845h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/7/2017 1530h	9/8/2017 1535h	SW6020B	2.02	**48.8**	
Lead	mg/kg-dry	9/7/2017 1530h	9/8/2017 1535h	SW6020B	5.25	**349**	

3440 South 700 West
Salt Lake City, UT 84119

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Toll Free: (888) 263-8686
Fax: (801) 263-8687
e-mail: awal@awal-labs.com

web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical
Contact: Thomas Atkinson
Project: JVWCD Tank / 1170621
Lab Sample ID: 1709014-047
Client Sample ID: Lot 6 @ 0-2"
Collection Date: 9/1/2017 845h
Received Date: 9/1/2017 1052h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	9/7/2017 1530h	9/9/2017 1756h	SW6020B	1.99	**42.2**	
Lead	mg/kg-dry	9/7/2017 1530h	9/9/2017 1756h	SW6020B	5.17	**304**	

3440 South 700 West
Salt Lake City, UT 84119

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Kyle F. Gross
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Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: Applied Geotechnical
Lab Set ID: 1709014
Project: JVWCD Tank / 1170621

Contact: Thomas Atkinson
Dept: ME
QC Type: LCS

Analyte		Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID:	**LCS-51090**	Date Analyzed:	09/02/2017 1351h											
Test Code:	6020B-S	Date Prepared:	09/01/2017 1744h											
Arsenic		20.3	mg/kg	SW6020B	0.142	2.50	20.00	0	101	85 - 115				
Lead		19.5	mg/kg	SW6020B	0.190	6.50	20.00	0	97.7	85 - 115				
Lab Sample ID:	**LCS-51102**	Date Analyzed:	09/06/2017 1039h											
Test Code:	6020B-S	Date Prepared:	09/05/2017 1420h											
Arsenic		19.8	mg/kg	SW6020B	0.142	2.50	20.00	0	99.1	85 - 115				
Lead		20.0	mg/kg	SW6020B	0.190	6.50	20.00	0	100	85 - 115				
Lab Sample ID:	**LCS-51121**	Date Analyzed:	09/07/2017 941h											
Test Code:	6020B-S	Date Prepared:	09/06/2017 1216h											
Arsenic		18.7	mg/kg	SW6020B	0.142	2.50	20.00	0	93.4	85 - 115				
Lead		19.2	mg/kg	SW6020B	0.190	6.50	20.00	0	96.1	85 - 115				
Lab Sample ID:	**LCS-51152**	Date Analyzed:	09/08/2017 1511h											
Test Code:	6020B-S	Date Prepared:	09/07/2017 1530h											
Arsenic		19.5	mg/kg	SW6020B	0.113	2.00	20.00	0	97.5	85 - 115				
Lead		22.3	mg/kg	SW6020B	0.152	5.20	20.00	0	111	85 - 115				

3440 South 700 West
Salt Lake City, UT 84119
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e-mail: awal@awal-labs.com, web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: Applied Geotechnical
Lab Set ID: 1709014
Project: JVWCD Tank / 1170621

Contact: Thomas Atkinson
Dept: ME
QC Type: MBLK

Analyte		Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID:	**MB-51090**	Date Analyzed:	09/02/2017 1348h											
Test Code:	6020B-S	Date Prepared:	09/01/2017 1744h											
Arsenic		< 2.50	mg/kg	SW6020B	0.142	2.50								
Lead		< 6.50	mg/kg	SW6020B	0.190	6.50								
Lab Sample ID:	**MB-51102**	Date Analyzed:	09/06/2017 1036h											
Test Code:	6020B-S	Date Prepared:	09/05/2017 1420h											
Arsenic		< 0.500	mg/kg	SW6020B	0.0283	0.500								
Lead		< 1.30	mg/kg	SW6020B	0.0379	1.30								
Lab Sample ID:	**MB-51121**	Date Analyzed:	09/07/2017 938h											
Test Code:	6020B-S	Date Prepared:	09/06/2017 1216h											
Arsenic		< 2.50	mg/kg	SW6020B	0.142	2.50								
Lead		< 6.50	mg/kg	SW6020B	0.190	6.50								
Lab Sample ID:	**MB-51152**	Date Analyzed:	09/11/2017 602h											
Test Code:	6020B-S	Date Prepared:	09/07/2017 1530h											
Arsenic		< 2.00	mg/kg	SW6020B	0.113	2.00								
Lead		< 5.20	mg/kg	SW6020B	0.152	5.20								

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: Applied Geotechnical
Lab Set ID: 1709014
Project: JVWCD Tank / 1170621

Contact: Thomas Atkinson
Dept: ME
QC Type: MS

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: 1709014-001AMS	Date Analyzed:	09/02/2017 1441h											
Test Code: 6020B-S	Date Prepared:	09/01/2017 1744h											
Lead	5,080	mg/kg-dry	SW6020B	4.09	140	21.56	4700	1,760	75 - 125				²
Lab Sample ID: 1709014-001AMS	Date Analyzed:	09/02/2017 1459h											
Test Code: 6020B-S	Date Prepared:	09/01/2017 1744h											
Arsenic	122	mg/kg-dry	SW6020B	0.153	2.69	21.56	89.9	148	75 - 125				²
Lab Sample ID: 1709014-009AMS	Date Analyzed:	09/06/2017 1051h											
Test Code: 6020B-S	Date Prepared:	09/05/2017 1420h											
Arsenic	66.0	mg/kg-dry	SW6020B	0.187	3.31	26.45	35.6	115	75 - 125				
Lead	268	mg/kg-dry	SW6020B	0.251	8.60	26.45	207	233	75 - 125				²
Lab Sample ID: 1709014-011AMS	Date Analyzed:	09/07/2017 953h											
Test Code: 6020B-S	Date Prepared:	09/06/2017 1216h											
Arsenic	53.2	mg/kg-dry	SW6020B	0.174	3.07	24.52	29.3	97.4	75 - 125				
Lead	92.4	mg/kg-dry	SW6020B	0.232	7.97	24.52	65.5	110	75 - 125				
Lab Sample ID: 1709014-044AMS	Date Analyzed:	09/08/2017 1526h											
Test Code: 6020B-S	Date Prepared:	09/07/2017 1530h											
Arsenic	42.4	mg/kg-dry	SW6020B	0.108	1.90	19.00	23.1	101	75 - 125				
Lead	176	mg/kg-dry	SW6020B	0.144	4.94	19.00	156	104	75 - 125				

² - *Analyte concentration is too high for accurate matrix spike recovery and/or RPD.*

3440 South 700 West
Salt Lake City, UT 84119
Phone: (801) 263-8686, Toll Free: (888) 263-8686, Fax: (801) 263-8687
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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

QC SUMMARY REPORT

Client: Applied Geotechnical
Lab Set ID: 1709014
Project: JVWCD Tank / 1170621

Contact: Thomas Atkinson
Dept: ME
QC Type: MSD

Analyte	Result	Units	Method	MDL	Reporting Limit	Amount Spiked	Spike Ref. Amount	%REC	Limits	RPD Ref. Amt	% RPD	RPD Limit	Qual
Lab Sample ID: 1709014-001AMSD	Date Analyzed:	09/02/2017 1444h											
Test Code: 6020B-S	Date Prepared:	09/01/2017 1744h											
Lead	5,100	mg/kg-dry	SW6020B	3.92	135	20.71	4700	1,900	75 - 125	5080	0.287	20	[2]
Lab Sample ID: 1709014-001AMSD	Date Analyzed:	09/02/2017 1502h											
Test Code: 6020B-S	Date Prepared:	09/01/2017 1744h											
Arsenic	120	mg/kg-dry	SW6020B	0.147	2.59	20.71	89.9	144	75 - 125	122	1.69	20	[2]
Lab Sample ID: 1709014-009AMSD	Date Analyzed:	09/06/2017 1054h											
Test Code: 6020B-S	Date Prepared:	09/05/2017 1420h											
Arsenic	64.2	mg/kg-dry	SW6020B	0.181	3.20	25.58	35.6	112	75 - 125	66	2.68	20	
Lead	272	mg/kg-dry	SW6020B	0.242	8.31	25.58	207	258	75 - 125	268	1.63	20	[2]
Lab Sample ID: 1709014-011AMSD	Date Analyzed:	09/07/2017 956h											
Test Code: 6020B-S	Date Prepared:	09/06/2017 1216h											
Arsenic	52.8	mg/kg-dry	SW6020B	0.171	3.01	24.10	29.3	97.4	75 - 125	53.2	0.813	20	
Lead	94.4	mg/kg-dry	SW6020B	0.228	7.83	24.10	65.5	120	75 - 125	92.4	2.06	20	
Lab Sample ID: 1709014-044AMSD	Date Analyzed:	09/08/2017 1529h											
Test Code: 6020B-S	Date Prepared:	09/07/2017 1530h											
Arsenic	45.0	mg/kg-dry	SW6020B	0.116	2.04	20.43	23.1	107	75 - 125	42.4	5.93	20	
Lead	184	mg/kg-dry	SW6020B	0.155	5.31	20.43	156	137	75 - 125	176	4.59	20	[3]

[2] - Analyte concentration is too high for accurate matrix spike recovery and/or RPD.

[3] - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

American West Analytical Laboratories

5 Day Rush

Rpt Emailed: UL

WORK ORDER Summary

Work Order: **1709014**

Client: Applied Geotechnical
Due Date: 9/11/2017
Client ID: APP100 **Contact:** Thomas Atkinson
Project: **JVWCD Tank / 1170621** **QC Level:** II+ WO Type: Standard
Comments: 5 Day Rush; QC 2+;

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1709014-001A	**BA-1 @ 6-12"**	8/31/2017 1523h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-002A	**BA1 @ 12-18"**	8/31/2017 1615h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-003A	**BA1 @ 18-21"**	8/31/2017 1530h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-004A	**BA1 @ 21-27"**	8/31/2017 1535h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-005A	**BA1 @ 30-36"**	8/31/2017 1545h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-006A	**BA1 @ 36-42"**	8/31/2017 1550h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-007A	**MA2 @ 0-6"**	8/31/2017 1608h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				

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WORK ORDER Summary

Work Order: **1709014**

Client: Applied Geotechnical

Due Date: 9/11/2017

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1709014-007A	**MA2 @ 0-6"**	8/31/2017 1608h	9/1/2017 1052h	**PMOIST**	Soil		DF-Metals	1
1709014-008A	**MA2 @ 6-10"**	8/31/2017 1610h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-009A	**MA2 @ 10-12"**	8/31/2017 1620h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-010A	**MA2 @ 24-30"**	8/31/2017 1625h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-011A	**MA2 @ 36-40"**	8/31/2017 1627h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-012A	**MA-1 @ 6-12"**	8/31/2017 1532h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-013A	**MA1 @ 16-24"**	8/31/2017 1535h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-014A	**MA-1 @ 24-26"**	8/31/2017 1537h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-015A	**MA1 @ 26-32"**	8/31/2017 1540h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	

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WORK ORDER Summary

Work Order: **1709014**

Client: Applied Geotechnical

Due Date: 9/11/2017

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1709014-016A	**MA1 @ 38-40"**	8/31/2017 1542h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-017A	**MI-1 @ 6-12"**	8/31/2017 1545h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-018A	**MI-1 @ 24-29"**	8/31/2017 1547h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-019A	**MI-1 @ 29-36"**	8/31/2017 1550h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-020A	**MI-1 @ 36-42"**	8/31/2017 1552h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-021A	**MI-1 @ 54-60"**	8/31/2017 1554h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-022A	**MI-2 @ 6-12"**	8/31/2017 1600h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-023A	**MI-2 @ 14-18"**	8/31/2017 1602h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK_____ HOK_____ HOK_____ COC Emailed_____

WORK ORDER Summary

Work Order: **1709014**

Client: Applied Geotechnical

Due Date: 9/11/2017

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1709014-024A	**MI-2 @ 18-22"**	8/31/2017 1604h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-025A	**MI-2 @ 24-30"**	8/31/2017 1605h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-026A	**MI-2 @ 50-56"**	8/31/2017 1606h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-027A	**MI-3 @ 6-12"**	8/31/2017 1614h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-028A	**MI-3 @ 23-28"**	8/31/2017 1616h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-029A	**MI-3 @ 45-48"**	8/31/2017 1618h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-030A	**MA-3 @ 0-6"**	8/31/2017 1627h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-031A	**MA3 @ 6-12"**	8/31/2017 1629h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-032A	**MA3 @ 14-18"**	8/31/2017 1631h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1

FOR LABORATORY USE ONLY [fill out on page 1]: %M ☐ RT ☐ CN ☐ TAT ☐ QC ☐ HOK_____ HOK_____ HOK_____ COC Emailed_____

WORK ORDER Summary

Work Order: **1709014**

Client: Applied Geotechnical

Due Date: 9/11/2017

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1709014-032A	**MA3 @ 14-18"**	8/31/2017 1631h	9/1/2017 1052h	**6020B-S**	Soil		DF-Metals	1
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-033A	**MA3 @ 24-30"**	8/31/2017 1635h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-034A	**BA-2 @ 6-12"**	9/1/2017 0754h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-035A	**BA-2 @ 14-19"**	9/1/2017 0758h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-036A	**BA2 @ 20-24"**	9/1/2017 0801h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-037A	**BA2 @ 30-36"**	9/1/2017 0804h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-038A	**BA3 @ 6-12"**	9/1/2017 0730h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-039A	**BA3 @ 24-30"**	9/1/2017 0735h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-040A	**BA3 @ 30-32"**	9/1/2017 0738h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1

WORK ORDER Summary

Work Order: **1709014**

Client: Applied Geotechnical

Due Date: 9/11/2017

Sample ID	Client Sample ID	Collected Date	Received Date	Test Code	Matrix	Sel	Storage	
1709014-040A	**BA3 @ 30-32"**	9/1/2017 0738h	9/1/2017 1052h	**6020B-S**	Soil		DF-Metals	1
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-041A	**BA3 @ 36-42"**	9/1/2017 0742h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-042A	**Lot 1 @ 0-2"**	9/1/2017 0845h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-043A	**Lot 2 @ 0-2"**	9/1/2017 0845h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-044A	**Lot 3 @ 0-2"**	9/1/2017 0845h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-045A	**Lot 4 @ 0-2"**	9/1/2017 0845h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-046A	**Lot 5 @ 0-2"**	9/1/2017 0845h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	
1709014-047A	**Lot 6 @ 0-2"**	9/1/2017 0845h	9/1/2017 1052h	**3051A-ICPMS-PR**	Soil		DF-Metals	1
				6020B-S			DF-Metals	
				2 SEL Analytes: AS PB				
				PMOIST			DF-Metals	

American West Analytical Laboratories

3440 S. 700 W. Salt Lake City, UT 84119
Phone # (801) 263-8686 Toll Free # (888) 263-8686
Fax # (801) 263-8687 Email awal@awal-labs.com
www.awal-labs.com

CHAIN OF CUSTODY

All analysis will be conducted using NELAP accredited methods and all data will be reported using AWAL's standard analyte lists and reporting limits (PQL) unless specifically requested otherwise on this Chain of Custody and/or attached documentation.

1709014
AWAL Lab Sample Set #
Page 1 of 1

QC Level:	Turn Around Time:	Unless other arrangements have been made, signed reports will be emailed by 5:00 pm on the day they are due.	Due Date:
1 2 (2+) 3 3+	1 2 3 4 (5) Stnd		9/11

Client: Applied Geotechnical
Address: 600 West Sandy Pkwy
City, State, Zip: Sandy UT 84070
Contact: Tom Atkinson
Phone #: 801-566-6399 Cell #: 801-651-5376
E-mail: Atkinson@agecinc.com
Project Name: JVWCD Tank
Project #: 1170621
PO #:
Sampler Name: Tom Atkinson / Joe DeGeorge

- ☐ Report down to the MDL
- ☐ Include EDD:
- ☐ Lab Filter for:
- ☐ Field Filtered For:

For Compliance With:
- ☐ NELAP
- ☐ RCRA
- ☐ CWA
- ☐ SDWA
- ☐ ELAP / A2LA
- ☐ NLLAP
- ☐ Non-Compliance
- ☐ Other:

Known Hazards & Sample Comments

Laboratory Use Only

Samples Were:
1 Shipped or hand delivered
2 Ambient or Chilled
3 Temperature 3.1 °C
4 Received Broken/Leaking (Improperly Sealed) Y (N)
5 Properly Preserved (Y) N Checked at bench
6 Received Within Holding Times (Y) N

COC Tape Was:
1 Present on Outer Package Y N (NA)
2 Unbroken on Outer Package Y N (NA)
3 Present on Sample Y N (NA)
4 Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? (Y) N
#2 jar read MA-2 @ 12-18" on unit chain

	Sample ID:	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Total Lead	Total Arsenic
1	BA-1 e 6-12"	8/31/17	323	1	S	✓	✓
2	BA1 e 12-18"		415				
3	BA1 e 18-21"		330				
4	BA1 e 21-27"		335				
5	BA1 e 30-36"		345				
6	BA1 e 36-42"		350				
7	MA2 e 0-6"		408				
8	MA2 e 6-10"		410				
9	MA2e 10-12"		420				
10	MA2e 24-30"		425				
11	MA2 e 36-40"		427				
12	MA-1 e 6-12"		332				
13	MA1 e 16-24"		335				

	Date	Received by	Date	Special Instructions:
Relinquished by: Signature	9/1/17	Received by: Signature	9/6/17	per Tom.
Print Name: Tom Atkinson	Time: 1052	Print Name: Elaine Hayes-Hamilton	Time: 1052	
Relinquished by: Signature	Date:	Received by: Signature	Date:	
Print Name:	Time:	Print Name:	Time:	
Relinquished by: Signature	Date:	Received by: Signature	Date:	
Print Name:	Time:	Print Name:	Time:	
Relinquished by: Signature	Date:	Received by: Signature	Date:	
Print Name:	Time:	Print Name:	Time:	

American West
Analytical Laboratories
3440 S. 700 W. Salt Lake City, UT 84119
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www.awal-labs.com

CHAIN OF CUSTODY

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1709014
AWAL Lab Sample Set #
Page 2 of 4

QC Level:	Turn Around Time:	Unless other arrangements have been made, signed reports will be emailed by 5:00 pm on the day they are due.	Due Date:
1 2 3+ 3 3+	1 2 3 4 Stnd		9/11

Client: Applied Geotechnical
Address: 6080 W St Sandy Plaza
City, State, Zip: Sandy UT 84070
Contact: Tom Atkinson
Phone #: 801-566-6399 Cell #: 801-651-5379
E-mail: Atkinson@agecinc.com
Project Name: JUWCD Tank
Project #: 117.0621
PO #:
Sampler Name: Tom Atkinson / Joe Debroy

☐ Report down to the MDL
☐ Include EDD:
☐ Lab Filter for:
☐ Field Filtered For:

For Compliance With:
☐ NELAP
☐ RCRA
☐ CWA
☐ SDWA
☐ ELAP / A2LA
☐ NLLAP
☐ Non-Compliance
☐ Other:

Laboratory Use Only

Samples Were:
1 Shipped or hand delivered
2 Ambient or Chilled
3 Temperature 3.1 °C
4 Received Broken/Leaking (Improperly Sealed) Y (N)
5 Properly Preserved (Y) N Checked at bench
6 Received Within Holding Times (Y) N

COC Tape Was:
1 Present on Outer Package Y N (NA)
2 Unbroken on Outer Package Y N (NA)
3 Present on Sample Y N (NA)
4 Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? (Y) N
see pg 1

	Sample ID:	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Total Lead	Total Arsenic	Known Hazards & Sample Comments
14	MA-1 e 24-26"	8/31/17	337	1	S			
15	MA1 e 26-32"		340					
16	MA1 e 38-40"		342					
17	MI-1 e 6-12"		345					
18	MI-1 e 24-29"		347					
19	MI-1 e 29-36"		350					
20	MI-1 e 36-42"		352					
21	MI-1 e 54-60"		354					
22	MI-2 e 6-12"		400					
23	MI-2 e 14-18"		402					
24	MI-2 e 18-22"		404					
25	MI-2 e 24-30"		405					
26	MI-2 e 50-56"		406					

Relinquished by: Signature	Date:	Received by: Signature	Date:	Special Instructions:
Print Name: Tom Atkinson	Time: 1052	Print Name: Elma Hayes	Time: 1052	
Relinquished by: Signature	Date:	Received by: Signature	Date:	
Print Name:	Time:	Print Name:	Time:	
Relinquished by: Signature	Date:	Received by: Signature	Date:	
Print Name:	Time:	Print Name:	Time:	
Relinquished by: Signature	Date:	Received by: Signature	Date:	
Print Name:	Time:	Print Name:	Time:	

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CHAIN OF CUSTODY

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1709014
AWAL Lab Sample Set #
Page 3 of 4

QC Level: 1 2 (3) 3+

Turn Around Time: 1 2 3 4 (5) Stnd

Unless other arrangements have been made, signed reports will be emailed by **5:00 pm** on the day they are due.

Due Date: 9/11

Client: Applied Geotechnical
Address: 600 West Sandy Pkwy
City, State, Zip: Sandy Ut 84070
Contact: Tom Atkinson
Phone #: 801-566-6399 Cell #: 801-651-5379
E-mail: Atkinson@agseciences.com
Project Name: JWWCD Tank
Project #: 1870621
PO #:
Sampler Name: Tom Atkinson / Jake De Groot

- ☐ Report down to the MDL
- ☐ Include EDD:
- ☐ Lab Filter for:
- ☐ Field Filtered For:

For Compliance With:
- ☐ NELAP
- ☐ RCRA
- ☐ CWA
- ☐ SDWA
- ☐ ELAP / A2LA
- ☐ NLLAP
- ☐ Non-Compliance
- ☐ Other:

Laboratory Use Only

Samples Were:
1. Shipped or (Hand delivered)
2. Ambient or (Chilled)
3. Temperature 3.1 °C
4. Received Broken/Leaking (Improperly Sealed) Y (N)
5. Properly Preserved (Y) N Checked at bench
6. Received Within Holding Times (Y) N

COC Tape Was:
1. Present on Outer Package Y N (NA)
2. Unbroken on Outer Package Y N (NA)
3. Present on Sample Y N (NA)
4. Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? (Y) N
See pg 1

	Sample ID:	Date Sampled	Time Sampled	# of Containers	Sample Matrix	(Total Hg) Total Arsenic	Known Hazards & Sample Comments
27	MI-3 e 6-12"	8/31/17	914	1	S	✓	
28	~~MA-3 e 6-12"~~ MI-3e 23-28"		916				
29	MI-3 e 45-48"		918				
30	MA-3 e 0-6"		927				
31	MA3 e 6-12"		929				
32	MA3 e 14-18"		931				
33	MA3 e 24-30"	↓	935	↓	↓		
34	BA-2 e 6-12"	9/1/17	754				
35	BA-2 e 14-16"		758				
36	BA2 e 20-24"		801				
37	BA2 e 30-36"		804				
38	BA3 e 6-12"		730				
39	BA3 e 24-30"		735				

Relinquished by: Signature / Print Name	Date:	Time:	Received by: Signature / Print Name	Date:	Time:
Tom Atkinson	9/1/17	1052		9/1/17	1052

Special Instructions:

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CHAIN OF CUSTODY

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1209014
AWAL Lab Sample Set #
Page 2 of 4

QC Level:	Turn Around Time:	Unless other arrangements have been made, signed reports will be emailed by	Due Date:
1 2 (2+) 3 3+	1 2 3 4 (5) Stnd	5:00 pm on the day they are due.	9/11

Client: Applied Geotechnical
Address: 600 West Sandy Pkwy
City, State, Zip: Sandy Ut 84070
Contact: Tom Atkinson
Phone #: 801-566-6399 Cell #: 801-651-5329
E-mail: Atkinson@agecinc.com
Project Name: JUWCD Tank
Project #: 170621
PO #:
Sampler Name: Tom Atkinson

- ☐ Report down to the MDL
- ☐ Include EDD:
- ☐ Lab Filter for:
- ☐ Field Filtered For:

For Compliance With:
- ☐ NELAP
- ☐ RCRA
- ☐ CWA
- ☐ SDWA
- ☐ ELAP / A2LA
- ☐ NLLAP
- ☐ Non-Compliance
- ☐ Other:

Laboratory Use Only

Samples Were:
1. Shipped or hand delivered
2. Ambient or Chilled
3. Temperature 3.1 °C
4. Received Broken/Leaking (Improperly Sealed) Y (N)
5. Properly Preserved (Y) N Checked at bench
6. Received Within Holding Times (Y) N

COC Tape Was:
1. Present on Outer Package Y N (NA)
2. Unbroken on Outer Package Y N (NA)
3. Present on Sample Y N (NA)
4. Unbroken on Sample Y N (NA)

Discrepancies Between Sample Labels and COC Record? (Y) N
See pg 1

	Sample ID:	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Total Lead	Total Arsenic	Known Hazards & Sample Comments
40	BASe 35-32"	9/1/17	738	1	S	✓	✓	
41	BASe 36-72"		742					
42	Lot 1 e 0-2'		845					
43	Lot 2		845					
44	Lot 3		845					
45	Lot 4		845					
46	Lot 5		845					
47	Lot 6		845					
9								
10								
11								
12								
13								

	Relinquished by: Signature / Print Name	Date / Time	Received by: Signature / Print Name	Date / Time
1	Thomas Atkinson	9/1/17 1052	Elena Hayes	9/1/17 1052
2				
3				
4				

Special Instructions:

APPENDIX B

PHOTOGRAPHS


8/31/2017 2:00:58 PM
Photo 1 - BA-1.JPG


8/31/2017 2:51:51 PM
Photo 2 - BA-1.JPG


9/1/2017 6:54:05 AM
Photo 3 - BA-2.JPG


9/1/2017 6:54:12 AM
Photo 4 - BA-2.JPG


9/1/2017 6:48:38 AM
Photo 5 - BA-3.JPG


9/1/2017 6:48:46 AM
Photo 6 - BA-3.JPG


8/31/2017 3:40:29 PM
Photo 7 - MA-1.JPG


8/31/2017 3:40:36 PM
Photo 8 - MA-1.JPG


8/31/2017 3:08:22 PM
Photo 9 - MA-2.JPG

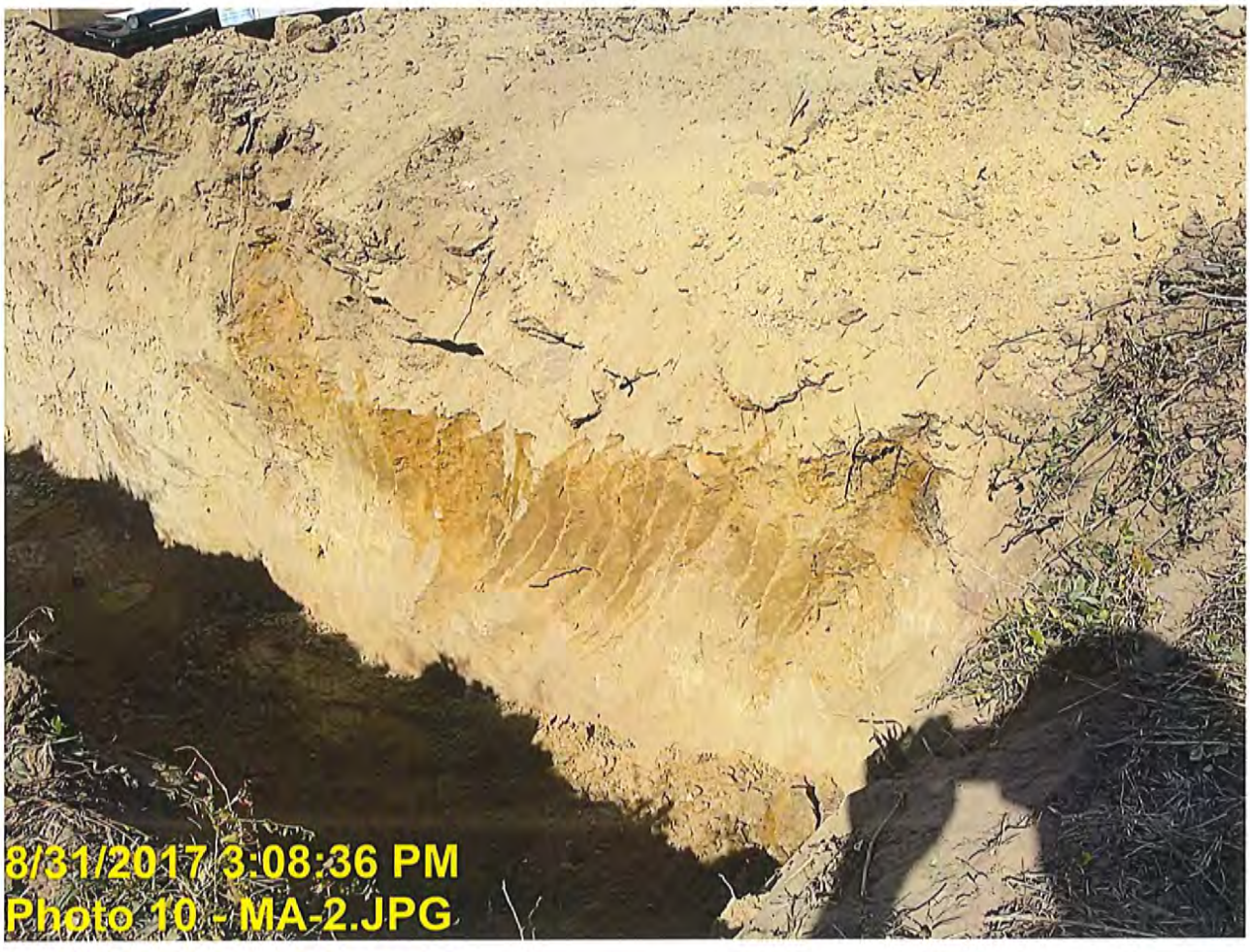
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Photo 10 - MA-2.JPG


8/31/2017 4:23:26 PM
Photo 11 - MA-3.JPG


8/31/2017 4:23:36 PM
Photo 12 - MA-3.JPG


8/31/2017 3:55:37 PM
Photo 13 - MI-1.JPG

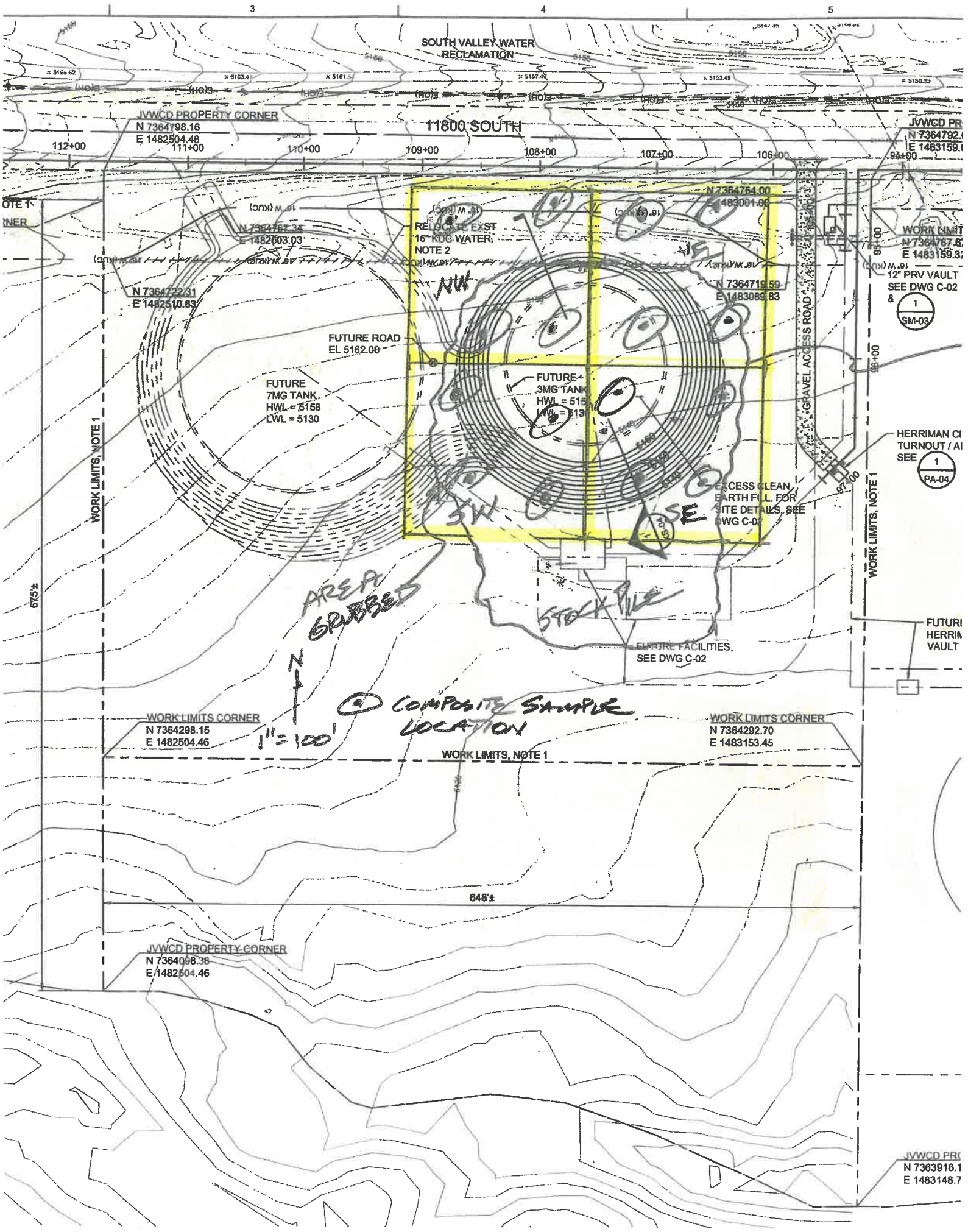

8/31/2017 3:55:55 PM
Photo 14 - MI-1.JPG


8/31/2017 4:07:19 PM
Photo 15 - MI-2.JPG


8/31/2017 4:07:42 PM
Photo 16 - MI-2.JPG


8/31/2017 4:12:32 PM
Photo 17 - MI-3.JPG


8/31/2017 4:12:38 PM
Photo 18 - MI-3.JPG


SOUTH VALLEY WATER RECLAMATION
11800 SOUTH
JVWCD PROPERTY CORNER
N 7364798.16
E 1482504.46
112+00
111+00
110+00
109+00
108+00
107+00
106+00
N 7364764.00
E 1483001.00
RELOCATE EXST 16" RUC WATER, NOTE 2
N 7364767.35
E 1482603.03
N 7364722.31
E 1482510.83
N 7364719.59
E 1483089.83
FUTURE ROAD
EL 5162.00
FUTURE 7MG TANK
HWL = 5158
LWL = 5130
FUTURE 3MG TANK
GRAVEL ACCESS ROAD
12" PRV VAULT
SEE DWG C-02
&
1
SM-03
HERRIMAN CI
TURNOUT / AI
SEE
1
PA-04
WORK LIMITS, NOTE 1
EXCESS CLEAN EARTH FILL FOR SITE DETAILS, SEE DWG C-02
AREA GRUBBED
STOCK PILE
FUTURE FACILITIES, SEE DWG C-02
N
1"=100'
COMPOSITE SAMPLE LOCATION
WORK LIMITS CORNER
N 7364298.15
E 1482504.46
WORK LIMITS CORNER
N 7364292.70
E 1483153.45
WORK LIMITS, NOTE 1
648±
675'±
JVWCD PROPERTY CORNER
N 7364098.38
E 1482504.46
JVWCD PR
N 7363916.1
E 1483148.7

DATE	10 / 5 / 17
SHEET	1 of 1

FIELD ACTIVITY DAILY LOG

Project: VanCon - JVWCD U-111 Pipeline	PROJECT NO. 61177070

FIELD ACTIVITY SUBJECT: XRF SOIL SCREENING & FUTURE ZONE C TANK

TIME AND DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

0740 CALIBRATION CHECK XRF, PASSED

0920 ON SITE. EXCAVATION CONTINUES ON OLD BINGHAM HWY ~1/2 WAY NORTH ACROSS ROADWAY.
- SOUTH CREW NOT EXCAVATION, UNLOADING PIPE.

0930 - 1130 ASSESSED FUTURE ZONE C GRID & GRUBBING
- SOUTH CREW EXCAVATED TO 169+30

1205 COLLECTED 10 PT COMPOSITE FROM SOIL STOCK PILE BETWEEN STA 171+20 TO 169+40 8.7 DEEP x 7/27 x 180' = 406 yd³

Pb	267	224	319	= 268 mg/kg AVG
As	17	<11	22	= 22 mg/kg AVG

16.7

1230 LAYOUT 150' GRID FROM CENTER OF TANK NE, NW, SW & SE AT FUTURE ZONE C TANK LOCATION AFTER GRUBBING

1340 FZC-NW SAMPLE 4 PT COMPOSITE XRF READINGS

Pb	86	85	82	= 84.3 mg/kg AVG
As	12	10	11	= 11 mg/kg AVG

SAMPLES COLLECTED FROM 0-2"

1355 FZC-NE 4 PT COMPOSITE SAMPLE XRF READINGS

Pb	92	95	93	= 93.3 mg/kg AVG
As	11	15	17	= 14.3 mg/kg AVG

SAMPLES COLLECTED FROM 0-2"

1405 FZC-SE 4 PT COMPOSITE SAMPLE XRF READINGS

Pb	144	88	1892	= 108 mg/kg AVG
As	<9	9	18	= 12 mg/kg AVG

SAMPLES COLLECTED 0-2"

1415 FZC-SW 4 PT COMPOSITE SAMPLE XRF READING

Pb	101	99	105	= 102 mg/kg AVG
As	17	14	16	= 15.7 mg/kg AVG

SAMPLES COLLECTED 0-2"

1500 SOUTH CREW HAD EXCAVATED TO ± STA 168+40

1515 NORTH CREW HAD EXCAVATED TO ± STA 225+00

1520 LEFT SITE

APPENDIX C

Standard Operating Procedures

SOP 1
Soil Sampling and Logging

Introduction

This SOP describes the procedures for properly collecting, handling, and logging soil samples.

Equipment

Equipment needs will vary depending on the sample collection or drilling method. Refer to the appropriate SOP listed above for method-specific equipment needs.

Procedures

Non-Sleeved Grab Samples

Immediately upon receiving the sample, either from the split spoon or backhoe bucket, the material will be screened with the appropriate direct reading instrument, such as a PID or XRF, and the reading will be recorded on the log form or in the field notebook. The portion of the sample collected for chemical analysis will be transferred immediately into the appropriate sample container using decontaminated equipment, new wooden tongue depressors, or by hand wearing new disposable chemical-resistant gloves. Avoid gravels and rock fragments when filling soil sample containers. If the sample is to be analyzed for volatile organics, the container will be completely filled with soil to minimize headspace. The container will be labeled appropriately and immediately stored in an iced cooler to maintain a temperature of 4° Celsius. The following information will be included on the sample container label:

- Sample Identification
- Project Name
- Project Number
- Date and time collected
- Sampler's initials

This information above should also be recorded in the field notebook.

Grab Samples Using Sleeves (auger drilling methodology)

When sampling for volatile compounds, the sample will be kept in the brass or plastic sleeves and the sleeves will be handled with chemical-resistant gloves. The sample will be screened with the direct reading instrument by exposing the end of one sample tube to the instrument probe. The sample sleeve selected for chemical analysis will be packaged immediately by covering each end of the sleeve with Teflon™ tape and sealed with plastic caps. The sample sleeve will be labeled as described above and immediately stored in an iced cooler to maintain a temperature of 4° Celsius.

Grab Samples Using Sleeves (geoprobe drilling methodology)

The sample sleeve will be cut and the sleeves will be handled with chemical-resistant gloves. The sample will be screened with the direct reading instrument by removing a portion of the sleeve, exposing the soil to the instrument probe. The soil sample selected for chemical analysis will be packaged immediately into laboratory-supplied soil jars, labeled as described above, and immediately stored in an iced cooler to maintain a temperature of 4° Celsius.

Composite Soil Samples

Composite samples will be prepared by placing equal amounts of soil in a stainless steel bowl or a clean plastic bag using a stainless steel spoon or by hand wearing new chemical-resistant gloves. The sample will be homogenized with a stainless steel spoon or gloved hand. The homogenized soil will be packaged in a laboratory-supplied sample container, labeled appropriately, and placed in an iced cooler to maintain a temperature of 4° Celsius.

Soil Logging

A description of visual soil characteristics will be recorded for all soil samples. The soil description may include the following information (in the order listed below):

- Soil type according to unified soil classification system
- Color according to the Munsell color chart
- Grain size and roundness
- Percentage fines, sands, and gravels
- Presence of interbedding, and number and thickness of layers
- Description of odors, staining, or sheen
- Density or stiffness
- Relative moisture content

A description of soil types and various field tests for soil classification is given at the end of this SOP.

The following information will be recorded in the appropriate spaces provided on the sample log form:

- Depth of all drive samples;
- Sample interval submitted for laboratory analysis;
- Meter reading from direct-reading instrument (if applicable);
- Contacts between soil types.

In addition to logging soils, the geologist will record the occurrence of first water and the approximate static water level within each borehole. The reference point for all subsurface measurements will be included on all boring logs (i.e., feet below ground surface).

Decontamination

Strict decontamination procedures will be used to prevent cross-contamination of samples. The soil sampling tool (e.g., auger barrel, split spoon) will be decontaminated between sample locations by washing the tool with an Alconox detergent solution followed by a triple rinse of clean potable water and a final rinse with distilled water. After decontamination, sample tools will be stored in a clean area and placed into their appropriate storage containers after use. Sample personnel will change into a new pair of chemical-resistant gloves between samples and the previously worn gloves will be discarded.

When possible, samples will be collected using disposable equipment to avoid the need for decontamination.

Unified Soil Classification System

The following is an overview of classifying soil according to the USC system. The distinction between soil types is based on the percentage of fine vs. coarse material in a sample. This is easily done in a laboratory but involves a lot of guesswork in the field. The key is to be consistent. If you are fortunate enough to have samples submitted to a geotechnical lab for sieve analysis, check your field classifications against the laboratory results. This will help you estimate percentages in the field.

1) Distinguishing Coarse-grained from Fine-grained Soils:

A) Determine if material is predominantly coarse grained (sand or gravel) or fine grained (silt or clay). Coarse-grained materials are those with more than 50% retained on a No. 200 sieve (very fine-grained sand or larger).

B) If coarse grained, determine if it is predominantly sand or gravel. Be aware that in the USCS system, pea gravel-size particles are considered “very coarse grained sand.”

C) Further classify material based on the amount of fines present. Roughly, no or very little fines is a SP or GP classification; slight amount of fines is a GP-GM or a SP-SM classification; much fines is a GM or SM classification. The following chart shows the breakdown for these classifications.

Classification of Coarse-grained Sands
>50% larger than No. 200 sieve

Percentage Fines	Soil Name	USC Designation
<5% Fines	Gravel	GP or GW[1]
	Sand	SP or SW[1]
5-12% Fines	Gravel with Silt or Clay	GP-GM or GP-GC
	Sand with Silt or Clay	SP-SM or SP-SC
>12%	Silty or Clayey Gravel	GM or GC
	Silty or Clayey Sand	SM or SC

1 - The designation SW or GW means well sorted -not well graded (confusing for geologists). This is a condition not normally found in natural depositional environments and usually indicates engineered fill. Do not use this classification unless you think the material is specifically graded-engineered fill.

D) If material is fine grained, determine if any coarse-grained materials are present. Note that all fine-grained materials have the same USC designation. Therefore, you must use both the name and the designation to adequately describe the soil. Use the following chart to classify fine-grained materials.

Classification of Fine-grained Soils
>50% passing No. 200 sieve

Percentage Coarse	Soil Name	USC Designation
<15% Coarse	Silt	ML, MH
	Clay	CL, CH
15-29% Coarse	Silt w/Coarse	ML, MH
	Clay w/Coarse	CL, CH
>29% Coarse	Sandy Silt	ML, MH
	Gravelly Silt	ML, MH
	Sandy Clay	CL, CH
	Gravelly Clay	CL, CH

2) Classification of Fine-grained Soils
   A) Distinguish clay from silt. The following are field tests for determining if a material is clay or silt.
      1) Dilatency (reaction to shaking)
      Remove course-grained materials. Prepare a pat of moist soil with a volume of about 1/2 cubic inch. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A clean fine-grained sand will rapidly show water on the surface and become glossy. When squeezed between fingers, the gloss disappears from the surface, the pat stiffens and finally cracks or crumbles. A very plastic clay will show little reaction to shaking and squeezing; an inorganic silt will react somewhere in between.
      2) Dry strength (crushing characteristics)
      After removing coarse-grained particles, mold a pat of soil to a 1/2-inch cube, adding water, if necessary. Allow to dry completely. Test the strength of the dry cube by crushing between fingers. The dry strength increases with increasing plasticity, with a plastic clay having high dry strength. An inorganic silt and silty fine-grained sands are similar. Fine sand feels gritty where silt has a smooth, flour-like feel.
      3) Toughness (consistency near plastic limit)
      The worm test: roll soil into a rope (or worm). A clay can usually be rolled to 1/8-inch diameter before it breaks.
   B) CH vs. CL and MH vs. ML
   C) Additional Characteristics
      1) Relative Density (coarse-grained material)

Blows per foot	Relative Density
<4	very loose
4 - 10	loose
10 - 30	medium dense
30 - 50	dense
> 50	very dense

      2) Consistency (fine-grained material)

Blows per foot	Consistency	Field Test

0 - 2	very soft	easily penetrated several inches with fist
2 - 4	soft	easily penetrated several inches with thumb
4 - 8	medium stiff	penetrated several inches by thumb with moderate effort
8 - 15	stiff	readily indented by thumb but penetrated only with great effort
15 - 30	very stiff	readily indented by thumbnail
> 30	hard	indented with difficulty by thumb nail

3) Relative Moisture

Moisture is measured relative to its optimum water content for compaction. Use the following descriptions:

Relative Moisture	**Field Test**
Dry	does not contain water.
Slightly Moist	damp, will not hold together.
Moist	soil will reach its maximum compaction under pressure.
Wet	contains excess moisture for compaction.
Saturated	below the water table.

SOP 17
Sampling Equipment Decontamination

In order to reduce the risk of transferring contaminants from areas of known contamination to known clean areas, decontamination of personnel and equipment is required. The decontamination procedures shall be established for each site based on the degree of hazard associated with the site and the amount of contact with hazardous materials resulting from site work. Final decontamination procedures shall be reviewed and approved by the Site Safety and Health Manager. This procedure contains general decontamination protocols, suitable for most sites, although decontamination procedures will be reviewed on a site-by-site, contaminant-by-contaminant basis.

Decontamination Guidelines
Terracon uses a four-step decontamination procedure described below:

Step 1 Gross Contaminant Removal
This step consists of a scrubbing using a detergent solution and water and a stiff brush. Scrubbing will continue until visible contaminants are removed. The water will be changed as necessary, daily at a minimum.

Step 2 Alconox Wash
An Aclonox wash will be prepared by mixing 1 to 1-½ tablespoons of Alconox per gallon of warm water. The water will be changed as necessary, daily at a minimum.

Step 3 Clear Water Rinse
A rinse with clear potable water. This water will be changed as necessary to ensure its purity, daily at a minimum.

Step 4 Distilled Water Rinse
Distilled water will be used as a final rinse for all decontamination procedures. The water may be poured or sprayed, or the item may be submerged in distilled water.
Decontamination Blanks to document the decontamination procedures will be collected as required in the Work Plan.

SOP 20
Sample Handling and Documentation

Introduction

This SOP describes procedures to follow once soil, sediment or water samples are collected to ensure that the samples are handled properly and that appropriate documentation is completed.

Sample Handling

All samples will be promptly placed in an iced cooler to maintain a temperature of 4°C. Typically, samples selected for chemical analysis are delivered at the end of each day to the analytical laboratory. If they are not submitted to the laboratory on the same day collected, they will be stored in a refrigerator in a locked sample storage room at Terracon's office until delivery to the laboratory.

Documentation

Sample Identification and Labeling

Soil samples will be labeled following the specific labeling requirements set forth in the sampling plan or using labeling methods that identify the area from which they were collected and the depth.

Each sample sleeve or sample container will be immediately labeled with the following information:

- Project name
- Project number
- Sample identification
- Sample depth
- Date and time collected
- Analyses requested
- Filtered or unfiltered (for water samples)
- Sampler's initials

Chain-of-Custody

Chain-of-custody documentation will begin in the field for each sample submitted to the laboratory and will be maintained by laboratory personnel. Samples will remain in the possession of the sampler at all times, or in a locked facility until delivery to the analytical laboratory. A chain-of-custody form will be completed and will accompany each sample cooler to the analytical laboratory.

Field Book

Terracon field personnel will maintain a field log book to record all field activities. All data generated during the project and any comments or other notes will be entered directly into the field logbook.

APPENDIX D

Chemtech Ford Laboratory Quality Manual

Chemtech-Ford, Inc.
9632 South 500 West
Sandy, UT 84070
(801) 262-7299

Vice President of Quality: Paul Ellingson

Quality Manager: Ron Fuller

Laboratory Director: Dave Gayer

Date of Issue: October 1, 2017

Controlled Copy #: QM-27

Dave Gayer, Laboratory Director

Paul Ellingson, Vice President

Ron Fuller, QA Officer

Quality Manual

This Quality Manual meets the requirements of ISO 17025, ISO 9001, and TNI. This Quality Manual is confidential and assigned as outlined below.

Original Document: Quality Manager

☐ Controlled Copy
☒ Uncontrolled Copy

All employees have access to a controlled version through Quality Manager, or through the Chemtech-Ford intranet. Printed copies are not considered controlled documents.

Companies whose Quality Systems are defined by this document are:

Chemtech-Ford Laboratories
9632 South 500 West
Sandy, UT 84070
801.262.7299

Timpview Analytical Laboratories
1384 West 130 South
Orem, UT 84058
801.229.2272

This Quality Manual has been approved for use by affiliate laboratories of Chemtech-Ford, Inc.

Table of Contents

Introduction

Purpose

This Quality Manual contains all the requirements that our laboratory uses to demonstrate our quality management system, technical competence, and valid results.

Section 4 specifies how we demonstrate sound management and maintain client satisfaction.

Section 5 specifies how we demonstrate technical competence in our laboratory.

In addition, this Quality Manual outlines how we meet:

- ISO 17025
- ISO 9001
- TNI

All personnel are to take an active role in establishing, implementing, and maintaining our quality management program. We do not separate quality from our daily business. Quality is integrated into every facet of the decision-making process in the management of our laboratory and the science that we practice.

It is the policy of Chemtech-Ford, Inc. and its employees to perform their duties in a consistently legal and ethical manner. A professionally high level of ethical behavior is characterized by, but not limited to, dealing honestly and forthrightly with all clients and co-workers, maintaining data integrity, the open and timely treatment of inaccurate, invalid, or misreported analytical data, and abiding by all pertinent rules, regulations, company policies, and standard operating procedures.

Chemtech-Ford, Inc. encourages its employees to demonstrate consistently ethical and professional behavior by implementing programs consonant with that purpose. These programs, generally, include:

1) a thorough training program for new employees and continuing seminars throughout employment which reflect Chemtech-Ford, Inc.'s commitment to integrity and quality control and which present specific ways to honor that commitment

2) a comprehensive documentation program for all facets of laboratory operation, which allows ready reconstruction of any quality process

3) a program of continual evaluation, both internally and externally, with required levels of quality acceptance

4) a management monitoring system which routinely evaluates the overall performance of the laboratory.

This Quality Manual summarizes the policies and procedures employed by Chemtech-Ford, Inc. It is the purpose of these policies and procedures to maintain the highest level of integrity and ethical behavior in all aspects of laboratory work.

Distribution List

The approved version of this manual is available to all employees through Quality Manager and/or Chemtech-Ford Laboratories intranet. All printed copies are uncontrolled.

In the event that a controlled copy of this manual is necessary, the Quality Manager will maintain a distribution list.

1. Scope

This Quality Manual facilitates:

- Recognition of technical competence for standardized methods, non-routine methods, and laboratory-developed methods we perform
- Inspection and product certification capabilities and/or services we provide
- Total quality for our administrative and technical systems
- Audits by clients, regulatory authorities and accreditation bodies
- Meeting the requirements of ISO 17025, ISO 9001, and TNI
- Client satisfaction

Chemtech-Ford Laboratories displays all Fields of Accreditation on our website.

2. Normative References

Reference List

ISO/IEC 17000, Conformity assessment – Vocabulary and general principles

VIM, International vocabulary of basic and general terms in metrology, issued by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.

ISO 9001:2000 – Quality Management Systems – Fundamentals and vocabulary.

ISO/IEC 17025:2005 – General Requirements for the Competence of Testing and Calibration Laboratories.

TNI Standard, Volume 1, 2009 NELAC Standard.

Cross-references

This manual is numerically aligned with the international standard ISO 17025. Furthermore, each section cross-references the ISO 9001 standard.

For ease of use, each section starts with a brief summation of what the section addresses and a listing of the quality terminology and key words.

3. Terms and Definitions

For the purposes of this manual, the following documents and their corresponding definitions apply: ISO/IEC 17000; ISO/IEC Guide 30; ISO Council Committee on Conformity Assessment (CASCO); ISO 9000; ISO 5725-1; ISO 17025; TNI 2009 Standard; AOAC; and International Vocabulary of Basic and General Terms in Metrology (VIM).

Accreditation – formal recognition of a laboratory by an independent science-based organization that the laboratory is competent to perform specific tests.

4.1 Organization

Section Synopsis

This section tells you our laboratory has:

1. Appointed a Quality Manager
2. Organized the workforce to achieve quality
3. Provided adequate resources to ensure quality

Key Words

Quality Manager
Organizational Chart
Authority
Resources
Confidential Information
Proprietary Rights
Responsibilities
Conflict of Interest

Cross-references

ISO 17025:2005 Section 4.1
ISO 9001:2000 Section 4.1, 5.1, 5.3, 5.4.1, 5.5.1, 5.5.2, 5.5.3, 6.1, 6.2.1, 6.2.2, 6.3.1, 7.1, 7.5.4

4.1.1 Legal Identification / Registration

Chemtech-Ford, Inc.
9632 South 500 West.
Sandy, UT 84070
(801)262-7299
(866)792-0093

4.1.2 Laboratory Requirements

The work area of Chemtech-Ford, Inc has been organized to satisfy the needs of the customer and regulatory authorities and to meet the international standards TNI, ISO 17025 and ISO 9001. Chemtech-Ford, Inc. is composed of the following work areas:

President/CEO/Vice Presidents
Lab Director
QA/QC Department
Customer Service Department
Receiving/Shipping Department
Organics Lab
Inorganics Lab
Microbiology Lab
Metals Lab

4.1.3 Scope of Management System

The management system covers activities all of the laboratory's facilities. The fields of activities include:

Environmental Sample Testing
Medical Device Testing
Nutraceutical Product Testing
Specialty Testing

The laboratory's scope of tests is listed in the current Price List.

4.1.5 Organization

A) Management and Technical Personnel

Policy:

The laboratory managerial and technical personnel, irrespective of other responsibilities, have the necessary authority and resources needed to meet the mandates assigned to their areas.

Details:
Responsibilities are detailed in 5.2.5

Departures from the organizational and management policies in this manual can only be approved by a Vice President.

Departures from quality management system procedures can only be approved by a Vice President or the Quality Manager.

Departures from test methods or technical standard operating procedures (SOPs) can only be approved by the Quality Manager and/or the Laboratory Director.

See also section 5.2.

B) Conflict of Interest

Policy:
Management and personnel are to be free from any undue internal and external commercial, financial and other pressures that may adversely affect the quality of their work. The integrity of test results is the responsibility of all personnel. Management ensures that employees are never instructed or forced to alter or falsify data. Chemtech-Ford Laboratories performs annual data integrity training. A review of the undue pressure policy is part of this training.

Details:
The following list provides some guidelines on how employees avoid conflict of interest situations. Employees shall not:

- falsify records, prepare fraudulent reports, or make false claims

- seek or use privileged or confidential company information, or data from any customer, for any purpose beyond the scope of employment
- conduct non-laboratory business on laboratory time, or use company facilities or equipment to conduct outside interests in business, unless prior approval has been obtained
- solicit business on their own behalf (rather than the laboratory) from a customer
- be employed by, or affiliated with, organizations whose products or services compete with laboratory products or services
- have employment that negatively affects or interferes with their performance of laboratory duties
- compete with the laboratory in the purchase, sale, or leasing of property or goods
- allow association, family, or friends to influence business decisions to their benefit. Decisions must be made on a strictly business basis, always in the best interest of the laboratory
- make any decision that provides gains or benefits to the employee and/or others
- have personal financial dealings with an individual or company that does business with the laboratory which might influence decisions made on the laboratory's behalf

Firm adherence to this code of values forms the foundation of our credibility. Personnel involved in dishonest activities are subject to a range of disciplinary action including dismissal.

C) Customer Confidentiality

Policy:
It is the policy of our laboratory to protect the confidential information and proprietary rights of our customer including the electronic storage and transmission of results.

Details and Procedures:
All employees sign a Confidentiality Agreement. The signed agreement is retained in each employee's Human Resources file.

Test results are only released to the customer. Release to someone other than the customer requires the express permission of the customer, except when the situation contravenes State or Federal Legislation and the results must be provided to the appropriate agency. The release of test results to anyone other than the customer requires the permission of management. Laboratory reports are reviewed for accuracy prior to release.

D) Operational Integrity

Policy:
The laboratory will avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity.

Details and Procedures:
To ensure confidence in laboratory operations a formal quality assurance program is implemented. Technical competence is ensured through commercial performance testing studies and data formatted in DOCs (Demonstration of Competency) reports. Impartiality is assessed through audits and approvals. Judgment is ensured through the hiring of qualified personnel and by continuously refining, upgrading, and improving his or her skills. Operational integrity is reviewed by management on a regular basis at management review meetings to ensure continued suitability and effectiveness of laboratory policies and procedures. Any problems are acted on immediately through corrective action procedures.

E) Organizational Structure

Policy:
The organization and management structure of the laboratory and the relationships between management, technical operations, support services, and the quality management system is defined through the aid of an organizational chart.

Details:
The most current organizational structure is contained within Quality Manager. The organizational structure is reviewed at regular intervals (at least two times per calendar year).

F) Responsibility and Authority

The responsibility, authority and interrelationships of all personnel who manage, perform or verify work affecting the quality of the tests and/or calibrations is defined in section 5.2.5

G) Laboratory Supervision

Policy:

Adequate supervision is provided in each area of the laboratory for all testing and calibration personnel, including trainees, by persons familiar with the methods and procedures.

Details:
Adequate supervision is ensured through designated supervisors as well as through documentation such as this Quality Manual, test methods and SOPs. Initial and ongoing training for regular personnel is required. The successful completion of analyses in the commercial PT study program, and/or DOC studies are evidence of successful and continued training.

H) Technical Management

Policy:
A technical manager is assigned to each major work area of the laboratory. They have overall responsibility for the technical operations and the provision of resources needed to ensure the required quality of laboratory operations.

Details:
While the technical manager may at times delegate duties to other personnel, the technical manager is responsible for the work produced in his area of the laboratory, and is accountable for any nonconforming activities.

I) Quality Manager

Policy:
The Quality Manager is appointed by the highest level of management. The Quality Manager, who, irrespective of other duties and responsibilities, has defined responsibility and authority for ensuring that the management system related to quality is implemented and followed. The Quality Manager has direct access to the highest level of management where decisions are taken on laboratory policy or resources.

Details:
This statement notifies all laboratory personnel that the Quality Manager is authorized by senior management and the President to administer all activities relating to the Chemtech-Ford Laboratories quality system. A formal announcement to the laboratory and appropriate certification/regulatory authorities will be made if a change is made to the person filling this position.

J) Managerial Substitutions

Policy:
Deputies for key personnel are appointed to fulfill the key personnel's duties in their absence.

Details:
In the absence of the Lab Director, the Quality Manager or Deputy Lab Director will assume his/her responsibilities.

In the absence of the Quality Manager, the Lab Director will assume his/her responsibilities.

In the absence of the Laboratory Supervisor, the Lab Director, Deputy Lab Director and/or Quality Manager will assume his/her responsibilities.

Management is responsible for ensuring that current and/or increased workload requirements are met. This includes making adjustments as a result of employee absence. Only fully trained employees are utilized to fulfill the duties of personnel who are absent. Evidence of a DOC for each specific analysis must be recorded prior to allowing the employee to perform any testing in the laboratory. If sufficient human resources are not available, management will identify the best possible solution to meet operational requirements.

K) Awareness

Policy:
Management ensures that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.

Details:
Supervisors review the details of each employee's job description with the appropriate employee and how the overall Quality Policy Statement (Section 4.2.2) relates to their activities to achieve the objectives of the management system.

4.1.6 Communication Processes

Policy:
Top management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

Details:
Management meetings are held regularly. Assignments and important communications are made in this meeting. The appropriate manager communicates the assignment or communication to their direct reports. These meetings are documented and follow-up activities are recorded.

Revision History

Changes from Revision 26
Modified section 4.1.3 to include all of the facilities of the company rather than just the main facility.

4.2 Management System

Section Synopsis

This section tells you that our Management System (or Quality Management System) is based on:

1. A well-defined quality policy statement
2. Say what you do through documentation
3. Do what you say following your documentation
4. Record what you did

Key Words

Establish, Implement, and Maintain
Policies, Systems, Processes, Programs, Procedures, Instructions
Communicate, Understand
Quality Policy Statement
Quality Manual
SOP
Test Method

Cross-references

ISO 17025:2005 Section 4.2

ISO 9001:2000 Section 4.1, 4.2.1, 4.2.2, 5.1, 5.3, 5.4.1, 5.4.2, 5.5.1, 5.5.2, 6.2.1, 7.1

4.2.1 Policies and Procedures

Policy:
The Quality Management System is established, implemented, and maintained by management. It is applicable to all the fields of testing and activities in which the laboratory is involved and undertakes. All policies, systems, programs, procedures and instructions are documented to the extent necessary to enable the laboratory to assure the quality of results generated. These documents are communicated to, understood by, available to, and implemented by the appropriate personnel.

Details:
The purpose of our Quality Management System is to ensure that all services and products satisfy the customer's requirements and have been designed, tested, and delivered under controlled conditions.

The effectiveness of the Quality Management System is assessed in several ways:

- by a program of planned internal audits, covering all aspects of the operation of the quality management system
- by regular management reviews of the suitability and effectiveness of the quality management system
- by analysis of potential and actual problems as shown by customer complaints and supplier and subcontractor assessments
- by other methods approved from time to time by the appropriate authority.

This Quality Manual and associated documents (including procedures) and records serve as the quality plan for the laboratory. Other documents and records may include:

- standard operating procedures (SOPs)
- quality control plans in test methods
- organizational charts
- proposals
- project management schemes
- Equipment manuals
- Reference methods
- Regulations
- Accreditation standards
- Software

4.2.2 Quality Policy Statement

Policy:
The policies and objectives for laboratory operations are documented in this Quality Manual. The overall objectives are set out in the Quality Policy Statement and reviewed during management review. The Quality Policy Statement is issued under the authority of the Senior Management on the effective date.

Quality Policy Statement:
To ensure accurate and timely analytical services and to continuously meet or exceed the stated or implied expectations of our customers through day-to-day interactions.

Effective Date: February 15, 2016

a) *Management commitment to good professional practice and quality of services provided to the customer*: tests and calibrations are always carried out in accordance with stated standardized methods and customers' requirements. Requests to perform tests that may jeopardize an objective result or have a low validity are rejected, or the laboratory's concerns are noted in the certificate of analysis.

b) *Standards of service include*:
- Customer Satisfaction
- Accuracy
- Timeliness
- Compliance with applicable standards and procedures

Excellence in the workplace is promoted by providing all employees with the knowledge, training, and tools necessary to allow for the completion of accurate and timely work.

c) *Purpose of management system related to quality*: to manage our business by meeting the needs of our customers and the requirements of the applicable standards and procedures.

d) *Personnel*: familiarize them with quality documentation and implement the policies and procedures in their work.

e) Management is committed to complying with the applicable standards and regulations (e.g. TNI, ISO, OGWDW etc.) and to continually improve the effectiveness of the management system: the objective of this Quality Manual is to document the compliant policies and associated procedures that are integrated into our daily activities. Continual improvements are established, implemented, and locked into the management system.

Additional objectives include:

- to establish the level of the laboratory's performance
- to make test method changes to improve performance
- to participate in proficiency testing or quality evaluation programs with peer laboratories
- to ensure that all personnel are trained to a level of familiarity with the quality management system appropriate to the individual's degree of responsibility
- to improve and validate laboratory methodologies by participation in method validation collaborative tests
- to establish and report on quality savings

4.2.3 Commitment to the Management System

Policy:
Top management is committed to the development and implementation of the management system and continually improving its effectiveness.

Details:
The results of the management system are regularly reviewed during management review (see Section 4.15) and continual improvements are made as outlined in Section 4.10 – Improvements.

4.2.4 Communication of Requirements

Policy:
Top management communicates to the organization the importance of meeting customer requirements as well as statutory and regulatory requirements.

Details:
In general, the underlying message in all oral and written management communications involves meeting the aforementioned requirements. Meeting customer requirements ensures that ongoing business relationships secure the contracts that keep everyone employed. Meeting statutory and regulatory requirements ensures that laboratory operations will not be disrupted and the organization can continue to meet customer needs.

4.2.5 Quality Manual

Policy:
This Quality Manual outlines the structure of the documentation used in the quality management system. This Quality Manual makes reference to supporting procedures including technical procedures and is maintained up to date.

Details:
This quality management system is structured in three tiers of documentation. The tiers are as follows:
I. Quality Manual
II. Standard Operating Procedures and Test Methods
III. Records

For most customers, this Quality Manual and the associated documents form a general Quality Plan. If necessary, specific Quality Plans will be prepared on a 'per-customer' basis. These Quality Plans will modify the general requirements stated in the Manual and associated documents.

All of the above documents are controlled documents. Not all quality system documents and procedures are maintained in this manual, rather some are referenced and located in other documents. The following records and directive documents are contained or referenced in the Quality Manual:

- organizational chart (section 4.1.5.E)
- identification of resources and management review (section 4.15.1)
- job descriptions (section 5.2.4)
- statistical techniques (section 5.9)
- test reports (section 4.13.2 and 5.10)
- identification of the laboratory's approved signatures (section 5.10.2)

- laboratory's scope of tests (section 4.1.3)
- equipment inventory and records (sections 5.5.4 and 5.5.5)
- calibration status indicators (section 5.5.8)
- reference standards inventory (section 5.6.3)
- verification records (section 5.9)
- quality control plan / criteria for workmanship (section 5.4.1)
- corrective action records (section 4.11)
- preventive action records (section 4.12)
- customer complaint records (section 4.8.1)
- audit schedule and records (section 4.14.3)
- procurement and subcontracting records (sections 4.6 and 4.5.4)
- training records (section 5.2.5)
- master list of documentation (section 4.3.2)
- confidentiality agreements (section 4.1.5 C)
- contract review (section 4.4.2)
- validation of test methods (section 5.4.5)
- facility floor plan (section 5.3.1)

4.2.6 Change Management

The roles and responsibilities for change management are outlined in QSP 4-2-6.

4.2.7 Technical Management and the Quality Manager

The roles and responsibilities for technical management and the Quality Manager are outlined in section 5.2.5 of this manual.

Technical management ensures that section 5 of this manual is implemented and maintained. The Quality Manager ensures that section 4 of this manual is implemented and maintained.

4.2.8 Maintenance

Policy and Details:
Top management ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented.

Revision History

Changes from Revision 24

Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.3 Document Control

Section Synopsis

This section tells you that Document Control involves:

1. Writing good procedures
2. Getting them to the users
3. Keeping procedures good

Key Words

Controlled Document
Master List
Unique Identification
Revise
Revision Number
Effective Date
Review and Approval
Obsolete
Archive
Hand-written changes

Cross-references

ISO 17025:2005 Section 4.3

ISO 9001:2000 Section 4.2.1, 4.2.3, 4.2.4

4.3.1 Policies and Procedures

Policy:
The SOP# QSP 4-3-1 is used to control all quality management system documents (internally generated and from external sources). These include documents of external origin, such as regulations, standards, other normative documents, test and/or calibration methods, as well as drawings, specifications, instructions, and manuals.

Details:
Document means any information or instructions including policy statements, procedures, specifications, charts, text books, posters, notices, memoranda, software, drawings, and plans. These may be in various media, whether hard copy or electronic and they may be digital, analog, photographic or written.

The documents to be controlled include:
- Quality Manual
- Standard Operating Procedures and test methods
- Forms
- Standards
- Software manuals
- Reference methods and manuals
- Equipment manuals
- Applicable regulations/statutes

The control of data related to testing and calibration is covered in section 5.4.7. The control of records is covered in section 4.13.

4.3.2 Document Approval and Issue

4.3.2.1 Review / Approval / Master List

Policy and Details:
All documents issued to personnel in the laboratory as part of the quality management system are reviewed and approved for use by authorized personnel prior to issue (i.e., reviewed by personnel knowledgeable in the documented activity and then approved by management). A master list can be obtained by viewing the lists located on the Chemtech Quality Manager and the SOP database for performance based methods, or intranet under the SOP section. The categories are divided by folders. Each folder has a hyperlinked list

of the SOPs. A listing of document revision is posted on the announcement area of the Chemtech Document Archive tab. A revision history is maintained. Documents are formally reviewed periodically to ensure their continuing suitability.

4.3.2.2 Availability and Obsolete Documents

Policy and Details:
The master list shows the current status of all controlled documents. The master list document is organized with the following information:

- Document Title
- Effective Date
- Revision Number
- Method Reference (if applicable)
- Date of last review

Controlled documents are approved before issue.

The SOP# QSP 4-3-1 for document control ensures that:

- authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed
- documents are periodically reviewed and where necessary revised to ensure continuing suitability and compliance with applicable requirements
- invalid or obsolete documents are promptly removed from all points of issue or use to assure against unintended use
- obsolete documents retained for either legal or knowledge preservation purposes are suitably marked (i.e., “INACTIVE" and dated) and/or archived appropriately.

4.3.2.3 Identification

Policy and Details:
All quality management system documentation is identified by:

- date of issue and/or revision number
- page numbering
- total number of pages (e.g., page 5 of 5)
- issuing authority (i.e., reviewer approval)

4.3.3 Document Changes

4.3.3.1 Review / Approval

Policy:
Changes to documents are reviewed and approved by the same function (i.e., personnel or position) that performed the original review.

Details:
Developments in policies and procedures require documents to be changed from time to time. Changes to documents receive the same level of review and approval as the originals.

The Quality Manual is reviewed annually by the Quality Manager. Records are kept of this review.

Test methods and SOPs are reviewed on a biennial basis. Procedures for this are outlined in SOP# QSP 4-3-1.

Obsolete documents are withdrawn, but are retained for archive purposes and clearly labeled as obsolete.

4.3.3.2 Identification of Changes

Policy:
The nature of document changes is identified in the document.

Details:
As outlined in SOP# QSP 4-3-1.

In general, the nature of changes is identified in the document by changing the font color to blue. Revision history is recorded at the end of the document.

4.3.3.3 Amendments by Hand

Policy and Details:
Hand-written amendments to documents are permitted only by those personnel authorized to do so (see section 4.1.5 A). Amendments are clearly marked, initialed, and dated. A revised document is formally re-issued at the time of the annual review. For further details refer to SOP# QSP 4-3-1.

4.3.3.4 Computerized Documents

Policy and Details:
The SOP# QSP 4-3-1 details how changes in documents maintained in computerized systems are made and controlled.

Revision History

Changes from Revision 24

None

4.4 Review of Requests, Tenders, and Contracts

Section Synopsis

This section tells you that you must:

1. Clearly understand customer requirements

Key Words

Requirements
Subcontractor
Request
Tender
Contract
Review

Cross-references

ISO 17025:2005 Section 4.4

ISO 9001:2000 Section 5.2, 6.1, 7.2.1, 7.2.2, 7.2.3

4.4.1 Policies and Procedures

Policy:
Prior to the commencement of any services that fall within the scope of this Quality System, Chemtech-Ford will ensure that the scope of the work is clearly defined and that the objectives of the project can be met. In some cases, the requests are formalized through a statement of work and signed contract. Other cases require less formalized contracts. In all instances Chemtech-Ford formalizes a contract between the laboratory and the client. The lab ensures that:

a) the customer requirements including the methods to be used are adequately defined, documented and understood (see section 5.4.2)
b) the laboratory has the capability and resources to meet the requirements
c) the appropriate test method is selected and capable of meeting the customer's requirements (see section 5.4.2)

When practicable, any differences between the request or tender and the contract are resolved before any work commences. Each contract must be acceptable by both the laboratory and the customer.

Details:
The review of capability establishes that the laboratory possesses the necessary physical, personnel, and information resources, and that the laboratory's personnel have the skills and expertise necessary for the performance of the tests in question. The review may also encompass results of earlier participation in inter-laboratory comparisons or proficiency testing and/or the running of trial test using samples or items of known value in order to determine uncertainties of measurement, limits of detection, and confidence limits.

Some contracts are formalized through a bidding process, RFP etc. Some contracts are less formal. When a formal process initiates the work, the specifications of the project are agreed upon and programed into the LIMS. When appropriate contracts are signed by necessary parties.

All work orders at Chemtech-Ford Laboratories are considered contracts between the lab and the customer. After logging the sample(s) into the LIMS and after a login review is performed by the lab, a login summary of requested analyses is submitted to the customer for their review. The customer is informed of tests to be performed including test method, subcontracted work, conditions of samples upon receipt and any other anomaly that might have an adverse effect on the results of the analyses. The customer is requested to review the work order for accuracy and note any discrepancies to the lab in a

timely manner. If the customer does not reply in a timely manner, Chemtech-Ford Laboratories proceeds with the work. For some analyses, the lab is required to start work immediately (e.g. short holding times or rush analyses). The customer has the ability to stop this work as needed.

The contract review ensures that each customer's requirements are adequately defined and documented in a timely manner. This should ensure that any order, once accepted, can be completed without delay, and that the customer's requirements including delivery date, technical specification can be met.

Typical types of contracts include:

- approved service quotations
- confidentiality agreements
- non-disclosure agreements
- sample submission requests
- memorandum of agreement
- memorandum of understanding
- research proposals and contracts
- verbal orders (oral agreements)
- activity plans

4.4.2 Records of Review

Policy:
Records of request, tender and contract review, including significant changes, are maintained. Records of pertinent discussions with a customer relating to the customer's requirements or the work during the period of execution of the contract are also maintained.

Details:
Records of request is made by the client via chain-of-custody. Alternative requests may also be made through other mechanisms (e.g. email). In the event that an alternative mechanism besides the chain-of-custody is used for a request, such documentation is retained. After samples have been entered into the LIMS and reviewed for correctness, a summary of the requested work is sent to the client via email to verify the accuracy of their request compared to Chemtech-Ford Laboratories interpretation of the request. Chemtech-Ford Laboratories assumes that the request is accurate unless the client

informs us otherwise. If there is a discrepancy, the change is noted and documented in the LIMS or chain-of-custody.

Other work may demand more complex and formalized contract review. These contracts are maintained by Chemtech-Ford Laboratories and the client. Formal contracts should be stored in the project in LIMS. The LIMS project can be customized for most of the project requirements such as pricing, analyte lists, reporting limits, QC limits, report format, report recipients, etc.

When a formal contract is entered into between the lab and the client, the appropriate lab member of management must sign the contract (usually the Vice President or their designee). The person responsible for managing the project ensures that all of the aspects of the project can be met. That person coordinates the project plan and execution of the project with the appropriate laboratory staff. They also communicate any problems meeting the client objectives to the client and will advise the lab how to proceed.

4.4.3 Review of Subcontracted Work

Policy:
Request, tender, and contract review also includes work that is subcontracted by the laboratory.

Details:
Subcontractor laboratories are reviewed as described in section 4.5. Performance based methods developed by Chemtech-Ford Laboratories are not subcontracted.

4.4.4 Notification of Customer

Policy and Details:
Customers are informed of deviations from the contract. This is typically communicated to the customer prior to the performing the deviation.

4.4.5 Contract Amendment

Policy and Details:

If a contract needs to be amended after the work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.5 Subcontracting of Tests and Calibrations

Section Synopsis

This section tells you that we must:

1. Know what tests and calibrations need to be done by another laboratory
2. Check out the other laboratories

Key Words

Competence
Register of Subcontractors
Assessment

Cross-references

ISO 17025:2005 Section 4.5

ISO 9001:2000 Section 7.2.3, 7.4.1, 7.4.3, 8.2.4

4.5.1 Subcontractor Competence

Policy:
Performance based methods developed by Chemtech-Ford Laboratories are not subcontracted unless directed by the client. Work that must be subcontracted is done so to a technically competent laboratory due to:

- unforeseen circumstances
- workload
- project specifications/requirements
- contracts requiring some extra technical expertise

Details:
The subcontracted laboratory demonstrates technical competence by possession or receipt of one or more of the following:

- recognized technical accreditation (e.g. TNI, ISO, EPA etc.)
- satisfactory performance of appropriate quality control check samples, certified reference material, in-house reference material or replicate analysis
- audit of the subcontractor's quality management system by our auditors

It is the responsibility of the Quality Manager to assess and approve the competence level of subcontractor laboratories. The approved subcontract laboratories are maintained in Quality Manager.

4.5.2 Customer Approval

Policy:
Customers are advised of work (or any portion thereof) that is being subcontracted to another laboratory and their approval is obtained (preferably in writing).

Details:
Customers are advised of subcontracted work through the contracting process (see 4.4).

4.5.3 Assurance of Subcontractor Competence

Policy:
If the laboratory selects the subcontracted lab, then the laboratory is responsible to the customer for the subcontractor's work. Technical competence of subcontractor

laboratories is demonstrated through various records including accreditation records from the laboratories Accreditation Body. There may be circumstances where the customer specifies which subcontractor is to be used. In such cases we may not be able to demonstrate the competence of the subcontractor and therefore are not responsible for the results.

Details:
Records of subcontractor competence can include, but are not limited to, the following:
- accreditation certificates or documentation
- registration certificates
- check sample results
- audit results
- approval by the Quality Manager
- approval by the client

4.5.4 Subcontractor Register

Policy:
A register of all subcontractors performing tests and calibrations is maintained in Quality Manager or within the project records.

Details:
The approved register of subcontractors is maintained by the applicable Accreditation Body or in the project records.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.6 Purchasing Services and Supplies

Section Synopsis

This section tells you that we must:

1. Know what we want
2. Check out our suppliers

Key Words

Selection
Verify
Specifications
History

Cross-references

ISO 17025:2005 Section 4.6

ISO 9001:2000 Section 6.3.1, 7.4, 7.5.5, 8.2.4

4.6.1 Policies and Procedures

Policy:
The SOP# QSP 4-6-1 is used to select and purchase services and supplies. The SOP# QSP 4-6-1 is used for procurement, reception, and storage of supplies.

Details:
Consumable materials are stored according to the appropriate test method, SOP, or work instruction.

4.6.2 Specifications

Policy:
Only services and supplies of the required quality are used. These quality requirements are detailed in laboratory SOPs under the "*Equipment and Supplies"* and "*Reagents and Standards"* sections and will identify the appropriate minimum specifications when necessary.

Details:
Packing slips are checked against package content labels and matched with the Purchase Order if accepted. Once accepted, the packing slip is dated and initialed as evidence of compliance. Certificates of analysis (COA) are scanned and maintained on file in the LIMS or other appropriate area after the COA is checked to ensure the received item meets minimum specifications.

Chemicals are purchased with manufacturer's certificates where possible. Uncertified chemicals are purchased from ISO 9000 registered companies. Whatever the source, the laboratory verifies the quality of the standards by comparing the new batch of standards to the old. Due regard is paid to the manufacturer's recommendations on storage and shelf life.

Reagents are generally purchased from manufacturers who have a quality management system based on ISO 9000. The grade of any reagent used (including water) is stated in the method together with guidance on any particular precautions to be observed in its preparation or use.

Where no independent assurance of the quality of procured goods or services is available or the supplier's evidence is insufficient the laboratory ensures that purchased goods and

services comply with specified requirements. Where possible and practical the laboratory ensures that goods are inspected, calibrated, or are otherwise in compliance with any standard specification relevant to the calibrations or tests concerned.

4.6.3 Purchasing Documents

Policy:
Purchasing requests are recorded on the Purchase Order form and contain data describing the product ordered. The Purchase Order is reviewed and approved for technical content prior to release.

Details:
The description may include type, class, grade, precise identification, specifications, drawings, inspection instructions, other technical data including approval of test results, quality required and quality management system standard under which they were produced.

The completion of the Purchase Order is the responsibility of the originator or supervisor. Either reviews the Purchase Order for accuracy and approve the technical content prior to release with their signature and the date.

4.6.4 Approved Suppliers

Policy:
Suppliers of critical services are evaluated and approved before use. An approved supplier list is maintained.

Details:
Audits or tender evaluation is conducted to qualify suppliers of critical services prior to use. The criteria for evaluation may include, but is not limited to the following:

- references
- accreditation
- formal recognition

The records are maintained by purchasing personnel.

Revision History

Changes from Revision 24

Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.7 Service to the Customer

Section Synopsis

This section tells you that we must:

1. Facilitate clarification of the customer's request
2. Give customer access to relevant testing area
3. Maintain customer contact
4. Inform customer of delays or deviations
5. Utilize customer surveys

Key Words

Clarification
Deviations
Delays
Customer Satisfaction Survey

Cross-references

ISO 17025:2005 Section 4.7

ISO 9001:2000 Section 6.1, 7.2.1, 7.2.3, 7.4.3, 7.5.1

4.7.1 Service

Policy:
Customer requests are clarified for the customers or their representatives. Furthermore, the customer or their representative will be afforded the right to monitor the performance of the laboratory in relation to the work performed, provided that the laboratory ensures confidentiality to other customers.

Details and Procedures:
Service to the customer includes:

- Affording the customer or the customer's representative reasonable access to relevant areas of the laboratory for the witnessing of work performed for the customer; it is understood that such access should not conflict with rules of confidentiality of work for other customers or with safety.

- Maintaining of open contacts. The customer values advice and guidance in technical matters, and opinions and interpretations based on results. Contact with the customer, especially in large assignments, should be maintained throughout the work. The laboratory should inform the customer of any delays or major deviations in the performance of the tests.

4.7.2 Feedback

Policy and Details:
The laboratory seeks feedback from the customer. Positive and negative feedback can be obtained passively through ongoing communications with the customer (e.g., review of test reports with customers) or actively through customer satisfaction surveys. The feedback is used to improve the quality management system, testing activities, and customer service.

One mechanism Chemtech-Ford Laboratories has established is a database that allows for the entry of customer feedback (both positive and negative). The database categorizes each item of feedback. When a laboratory representative receives feedback from a client or other interested party, this should be reported in the database. When feedback requires an action this is documented and assigned to the appropriate team member for review.

Other mechanisms are in place to review customer feedback. During weekly management meetings, customer feedback is reviewed (positive and negative).

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.8 Complaints

Section Synopsis

This section tells you that you must:

1. Maintain records of Complaints
2. Maintain records of Corrective Action

Key Words

Resolving
Investigation
Corrective Action
Follow-up Verification

Cross-references

ISO 17025:2005 Section 4.8

ISO 9001:2000 Section 7.2.3

4.8.1 Policies and Procedures

Policy:
The SOP# QSP 4-8-1 is used for resolving complaints received from customers or other parties. Records are maintained of all complaints and follow-up.

Details:
Records of complaints include the following information:

- description of the complaint
- investigation
- corrective action (if necessary)
- solution notes and date
- follow-up verification
- issuance level

See also section 4.11.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.9 Control of Nonconforming Testing and Calibration Work

Section Synopsis

This section tells you that you must:

1. Stop testing when nonconforming work is identified
2. Determine what is causing nonconforming work

Key Words

Nonconforming
Root Cause

Cross-references

ISO 17025:2005 Section 4.9

ISO 9001:2000 Section 5.5.1, 7.4.3, 7.5.1, 8.2.4, 8.3, 8.5.3

4.9.1 Procedures to Control Nonconforming Work

Policy:
The SOP# QSP 4-9-1 is used to control any aspect of testing and/or calibration work, or the results of this work, when they do not conform with the test methods or the agreed requirements of the customer.

Details:
The procedure ensures that:

- Responsibilities and authorities for the management of nonconforming work are designated and actions (including halting of work and withholding of test reports as necessary) are defined and taken into consideration when nonconforming work is identified
- an evaluation of the significance of the nonconforming work is made
- correction is taken immediately, together with any decision about the acceptability of the nonconforming work
- where necessary, the customer is notified and the work is recalled
- the responsibility for authorizing the resumption of work is defined

Identification of nonconforming work or problems with the quality management system or with testing activities can occur at various locations within the quality management system and technical operations such as:

- customer complaints
- quality control
- instrument calibration
- checking of consumable materials
- staff observations or supervision
- test report checking
- management reviews
- internal or external audits

4.9.2 Root Cause Analysis

Policy:
Where evaluation indicates that nonconforming work could recur or that there is doubt about the compliance of the laboratory's operations with its own policies and procedures, the corrective action procedures given in 4.11 are followed to identify the root cause(s) of the problem and to eliminate this (these) cause(s). All notes, discoveries, and actions

taken by participating personnel are to be reflected on the corrective action form. The QM directs this process and retains all documentation within the appropriate files for future reference. These corrective action documents will be stored for five years.

Details:
The SOP# QSP 4-11-1 outlines the recording of the root cause analysis for investigating nonconforming work.

Situations warranting corrective action investigation include:
- failure to comply with test method including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- presentation of uncertain knowledge as to compliance with test methods including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- failure or suspected failure in method performance as demonstrated by results provided by quality control samples
- lack of relevant evidence provided by quality audit, proficiency testing, or customer feedback
- lack of relevant evidence provided by data validation
- neglect to check the inherent property of the sample that compromises the testing

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.10 Improvements

Section Synopsis

This section tells you that you must:

1. Review procedures for improvements
2. Continually implement improvements

Key Words

Continually
Effectiveness
Analysis of data

Cross-references

ISO 17025:2005 Section 4.10

ISO 9001:2000 Section 6.1, 8.1, 8.2.1, 8.4, 8.5.1

4.10.1 Policies and Procedures

Policy:
The laboratory continually improves the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions, and management review.

Details:
The laboratory has implemented a continual improvement philosophy within the management system. Every employee in the laboratory is encouraged to suggest new ideas for improving services, processes, systems, productivity, and the working environment.

Opportunities for improvement of operations and processes are identified by managers on a continual basis from ongoing feedback on operations and through management reviews. Opportunities for improvement of services are identified by anyone within the organization including Sales, and Marketing.

Inputs for improvement opportunities may be obtained from the following sources:
- customer satisfaction surveys and any other customer feedback
- market research and analysis
- employees, suppliers, and other interested parties
- internal and external audits of the management system
- records of service nonconformities
- data from process and service characteristics and their trends

Opportunities for improvement may also be identified on a special project basis. The following are listed only as examples:
- improving usefulness of bench space
- reducing excessive inspection/testing
- reducing excessive handling and storage
- reducing test/calibration failures

Opportunities for improvement from daily feedback on operational performance (i.e., internal audits, customer feedback, test/calibration failures) are evaluated by the Technical or Quality Manager. Typically, they are implemented through the corrective and preventive action system.

Opportunities for improvement from analysis of longer-term data and trends are evaluated and implemented through the management review process. They are prioritized with respect to their relevance for achieving quality objectives. When opportunities for improvement are no longer supported by the current policy and objectives, management will establish new quality objectives, and possibly change the policy. The process for this evaluation is described in Section 4.15. Longer-term improvement projects are initiated through the management review process, as well as the corrective and preventive action system.

Service improvement opportunities are evaluated by management. They are implemented through the supervisor of the laboratory who ensures that the improvements are validated as outlined in Section 4.12 of this manual and appropriate level of quality control is performed on an ongoing basis.

Revision History

Changes from Revision 24
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4.11 Corrective Action

Section Synopsis

This section tells you that you must:

1. Identify problems
2. Determine why the problem occurred
3. Fix the cause of the problem
4. Verify that your changes worked

Key Words

CAR
Root Cause
Monitor
Audit
Nonconforming work

Cross-references

ISO 17025:2005 Section 4.11
ISO 9001:2000 Section 5.5.1, 5.5.2, 8.1, 8.2.2, 8.2.3, 8.4, 8.5.2, 8.5.3

4.11.1 General

Policy:
The SOP# QSP 4-11-1 is utilized for implementing corrective action when nonconforming work or departures from policies and procedures in the quality management system or technical operations have been identified. The procedure requires that appropriate authority be designated for the implementation of corrective actions and includes cause analysis, selection and implementation of corrective action, and monitoring of actions.

Details:
Problems with the quality management system or technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feed-back from customers, or staff observations.

Corrective action investigations are documented and required changes to operational procedures are implemented. The corrective action request (CAR), investigation and resolution are recorded in the CAR database.

4.11.2 Cause Analysis

Policy:
Corrective action always begins with an investigation to determine root cause(s) of the problem (see SOP# QSP 4-11-1).

Details:
Potential causes of the problem could include customer requirements, the samples, sample specifications, methods and procedures (see 4.11.6), personnel skills and training, consumable materials, or equipment and its calibration.

4.11.3 Selection and Implementation of Corrective Actions

Policy and Details:
After determining the cause(s) of the problem, potential corrective actions are identified. The most likely action(s) (this includes practical and/or reasonable) are selected and implemented to eliminate the problem and to prevent recurrence. It should be noted that

any corrective actions taken to eliminate the cause(s) of nonconformities or other departures are to a degree appropriate to address the magnitude of the problem and commensurate with the risks encountered (Note – in plain language, this means determine whether the benefit outweighs the cost). Controls are applied to prevent recurrence. The laboratory documents and implements the required changes resulting from corrective action investigations.

4.11.4 Monitoring of Corrective Action

Policy:
After implementing the corrective action(s), the laboratory monitors the results to ensure that the actions taken have been effective in overcoming the problems originally identified.

Details:
Monitoring is assigned to an appropriate individual such as the originator of the CAR or the originator's manager. Changes resulting from corrective action are documented.

4.11.5 Additional Audits

Policy:
Where the identification of nonconformities or departures casts doubts on compliance of policies, procedures, regulations, international quality standards, the appropriate areas of activity are promptly audited in accordance with section 4.14.

Details:
Special audits follow the implementation of corrective actions to confirm their effectiveness. A special audit is only necessary when a serious issue or risk to the business is identified. Special audits are carried out by trained and qualified personnel who are [whenever resources permit] independent of the activity to be audited. See section 4.14 for more details.

4.11.6 Responsibility

Policy:
Analytical data routinely generated by the laboratory is evaluated to determine acceptability, including precision and accuracy. Laboratory analyst and supervisors are responsible for evaluating QC in comparison to acceptance criteria.
Details:
When data falls outside of the established control limits or acceptance limits for a given method (as defined by the SOP), that information is evaluated and appropriate action taken. If a problem is discovered that could merit corrective action, the person that discovers the problem should discuss with the Quality Manager the need to initiate a formal corrective action. All Chemtech-Ford Laboratories employees can recommend corrective action. If it is determined that the problem merits corrective action, the Quality Manager will initiate the corrective action.

Revision History

Changes from Revision 24

None

4.12 Preventive Action

Section Synopsis

This section tells you that you must:

1. Identify potential problems
2. Determine why the problem could occur
3. Fix the cause of the potential problem
4. Verify that your changes worked

Key Words

PAR
Potential Nonconformity
Action Plan

Cross-references

ISO 17025:2005 Section 4.12

ISO 9001:2000 Section 4.2.4, 6.3.1, 8.4, 8.5.1, 8.5.2, 8.5.3

4.12.1 Preventative Action Identification

Policy:
Opportunities for needed improvement and potential sources of nonconformities, either technical or with the quality management system shall be identified. If action is required, action plans are developed, implemented and monitored, to reduce the likelihood of occurrence of such nonconformities and to take advantage of the improvement opportunities.

Details:

Records of preventive action include the following information:

- details of potential nonconformities
- investigation
- preventive action
- follow-up verification

4.12.2 Preventive Action Plans

Policy:
The preventive action procedure includes the initiation of such actions and application of controls to ensure that they are effective.

Details:
Preventive action may result from the review of operational procedures and analysis of data. Analysis of data includes trend analysis, analysis of proficiency testing results, and risk analysis.

Preventive actions can be designated and documented in the Corrective Action database or in management meeting notes or other approved laboratory mechanism for recording/monitoring preventive actions.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.13 Control of Records

Section Synopsis

This section tells you that you must:

1. Identify the records to be kept
2. Keep identified records in a useful state
3. Destroy records when they are no longer needed

Key Words

Collection
Indexing
Access
Storage
Maintenance
Disposition
Legible
Traceable
Retrievable
Secure

Cross-references

ISO 17025:2005 Section 4.13

ISO 9001:2000 Section 4.2.4, 6.3, 6.4, 7.1, 7.5.1, 7.5.2, 7.5.3, 8.1, 8.2.2, 8.2.3, 8.2.4

4.13.1 General

4.13.1.1 Procedures

Policy:
The SOP# QSP 4-13-1 is used to identify, collect, index, access, file, store, maintain, protect, backup, and dispose quality and technical records. Quality records include reports from internal audits and management reviews as well as corrective and preventive action records.

Details:
Records are available to demonstrate conformance to requirements and effective operation of the Quality Management System. Quality records from suppliers are also controlled.

All records, including test reports, are safely stored and held secure (either electronically or physically), and in confidence to the customer. Records are maintained in the designated archival area for five (5) years.

4.13.1.2 Record Integrity

Policy:
All records are to be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.

Details:
The retention times for records are generally set at five (5) years. Records may be in the form of any type of media, such as hard copy or electronic media.

4.13.1.3 Record Security

Policy:
All records are held secure and in confidence.

Details:
Access to records is secured through locked rooms, filing cabinets, passwords.

4.13.1.4 Record Backup

Policy:
The SOP# QSP 4-13-1 is followed to protect and backup data/records held on computers at all times and to prevent unauthorized access to or amendment of data/records on computers.

Details:
Data is password protected.

Backups ensure integrity and availability of data/information in the event of a system/power failure.

4.13.2 Technical Records

4.13.2.1 Record Information

Policy:
Original observations, calculations, derived data and sufficient information to establish an audit trail, calibration records, personnel records and a copy of each test report issued are retained for five (5) years.

The records for each test or calibration shall contain sufficient information to facilitate, if possible, identification of factors affecting the test uncertainty and to enable the test or calibration to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for sampling, performing of each test and/or calibration and checking of results.

Details:
Technical records are accumulations of data (see 5.4.7) and information that result from carrying out tests and/or calibrations and which indicate whether specified quality or process parameters are achieved. They may include forms, contracts, work sheets, work

books, note books, instrument printouts, magnetic media, check sheets, work notes, control graphs, test reports, calibration certificates, customer's notes, papers and feedback, and test reports to customers.

The records for each test contain sufficient information to permit its repetition. Records include:

- date of sampling
- sample receipt
- sample handling, storage, and disposal
- identification of personnel
- analyst proficiency
- equipment identification and performance
- calibration records
- media performance, where appropriate
- test organism batch # or lot #, where appropriate
- results
- reports (mailed, emailed, or faxed)
- review

Note – the above records may be stored in separate locations. They are cross-referenced for easy retrieval.

4.13.2.2 Recording

Policy:
Observations, data, and calculations are clearly and permanently recorded and identifiable to the specific job at the time they are made.

Details:
Handwritten records must be legible and made with indelible ink immediately after an observation, after data is collected and/or after calculations are made.

4.13.2.3 Corrections to Records

Policy:
Changes to test data are made so as not to obscure or delete the previous data entry.

Details:
Mistakes are crossed out with a single line, initialed, dated and the correct value entered alongside. Mistakes are not erased, made illegible, or deleted. All alterations to records are signed or initialed by the person making the correction. In the case of computer-collected data, similar measures are taken to avoid loss or change of original data.

4.13.2.4 Transfer of records

Policy:
Records will be maintained or transferred in the event that a laboratory transfers ownership or goes out of business.

Details:
In the event that the laboratory changes ownership, all records will be transferred to the new owners. The new owner(s) will then be given the responsibility of maintaining the records.

If the laboratory goes out of business, all hard copy and electronic records will be maintained by the ownership group at the time of the dissolution of the company for a period of 5 years.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.14 Internal Audits

Section Synopsis

This section tells you that:

1. Trained internal auditors examine your internal operations for quality
2. Auditors report the results to those in charge
3. You must correct any areas that need fixing

Key Words

Schedule
Elements
Independent
Nonconformity
CAR

Cross-references

ISO 17025:2005 Section 4.14

ISO 9001:2000 Section 8.1, 8.2.2, 8.2.3

4.14.1 Internal Audit Program

Policy:
The internal audit program involves periodic audits conducted according to a predetermined schedule for each year. Each year different aspects of the Quality System are evaluated. The schedule is reviewed during the managerial review. All elements of the management system including the testing activities are covered on a regular basis. These audits are performed to verify operations continue to comply with the requirements of this Quality Manual and are effective.

Details:
The tracking of internal audit results is maintained in Quality Manager. The frequency is also maintained in Quality Manager. The Quality Manual, test procedures, and laboratory results are verified for compliance. It is the responsibility of the Quality Manager to plan and organize audits as required by the schedule and requested by management. Audits are carried out by trained and qualified personnel who are [wherever resources permit] independent of the activity to be audited. Personnel are not to audit their own activities except when it can be demonstrated that an effective audit will be carried out (see also 4.11.5). Audits are performed through the aid of a checklist prepared in advance to minimize the possibility of overlooking any details during the audit. The results of the internal audit are maintained and accessible.

Generally, the types of audits include:
- quality management system
- technical methods
- products, services, and reports

4.14.2 Corrective Action

Policy:
When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of test or calibration results, timely corrective action is taken and customers are notified if investigations show that laboratory results may have been affected.

Details:
Nonconformities that can be resolved easily are to be corrected immediately, ideally during the audit. Records are made on the audit checklist. Nonconformities that require a

more involved resolution are recorded on a CAR and resolved as described in section 4.11.

Corrective actions and customer notifications must be kept on record for each audit deviation that casts doubt as described in this section.

4.14.3 Records and Management

Policy:
Records are made of the activity being audited, the audit findings, and corrective actions that arise. Management ensures that corrective actions are discharged within an appropriate and agreed timeline.

Details:
A report is prepared by the auditors and distributed to those audited and/or the area manager/supervisor within an appropriate and agreed timeline. The audit report may include the following sections, as appropriate:

- audit objective and scope
- area or section audited
- personnel involved – auditors and auditees
- date of audit
- reference documents
- observations including nonconformities and commendations
- opening and closing meetings
- recommendations
- audit report distribution

The appropriate manager is responsible for ensuring that corrective actions are sufficiently recorded. Follow-up is performed by the auditor and recorded when corrective action is complete and deemed effective. The audit records are kept in the laboratory.

4.14.4 Follow-up Audits

Policy:
Follow-up audits are performed to verify and record the implementation and effectiveness of the corrective action taken.

Details:
The follow-up audit is performed at a mutually acceptable time between the area implementing corrective action and the auditor. This time is determined when the CAR is issued.

Revision History

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Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

4.15 Management Reviews

Section Synopsis

This section tells you that management must:

1. Periodically review technical competence and customer satisfaction
2. Keep records of reviews
3. Ensure follow-up is executed
4. Measure progress

Key Words

Supervisor Reports
Audit Reports
CAR / PAR
Proficiency Results
Customer Satisfaction Survey
Resources

Cross-references

ISO 17025:2005 Section 4.15

ISO 9001:2000 Section 5.1, 5.4.2, 5.6, 6.2.1, 7.1, 8.5.1

4.15.1 Review of Quality Management System and Testing

Policy:
Top management periodically (at least annually) and in accordance with a predetermined schedule and SOP# QSP 4-15-1, conduct a review of the laboratory's quality management system and testing and/or calibration activities to ensure their continuing suitability and effectiveness and to introduce any necessary changes or improvements.

Details:
The review takes account of:

- suitability of policies and procedures (including the Quality Policy outlined in this manual)
- reports from managerial and supervisory personnel
- the outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of inter-laboratory comparisons or proficiency tests
- changes in the volume and type of work undertaken
- feedback from customers, including complaints and customer satisfaction surveys
- recommendations for improvement
- other relevant factors, such as quality control activities, resources and personnel training

A minimum period for conducting a management review is once a year. Results of the review feed into the laboratory planning system and include goals, objectives and action plans for the coming year.

A management review can be supplemented by consideration of related subjects at regular management meetings.

4.15.2 Findings, Actions, and Records

Policy and Details:
Findings from management reviews and the actions that arise are recorded in the minutes of the meeting. Management will ensure that the actions are discharged within an appropriate and agreed upon timeline.

Revision History

Changes from Revision 24

Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.1 General

Section Synopsis

This section informs you that:

1. Many factors contribute to the correctness and reliability of tests and/or calibrations
2. The laboratory must account for these factors

Key Words

Correctness
Reliability
Uncertainty

Cross-references

ISO 17025:2005 Section 5.1

ISO 9001:2000 Section 7.1, 7.5.1

5.1.1 Correctness and Reliability

Policy and Details:
Correctness and reliability of the tests and/or calibrations performed have many contributing factors including:

- Human factors (see section 5.2)
- Accommodation and environmental conditions (see section 5.3)
- Test and calibration methods and method validation (see section 5.4)
- Equipment (see section 5.5)
- Measurement traceability (see section 5.6)

5.1.2 Measurement Uncertainty

Policy:
When developing test and calibration methods and procedures, total measurement uncertainty must be accounted for in the training and qualification of personnel, and in the selection and calibration of equipment.

Details:
The extent to which the factors contribute to total measurement uncertainty differs between tests, matrices, methodologies.

See section 5.4.6 for more details.

Revision History

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Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.2 Personnel

Section Synopsis

This section tells you that management:

1. Analyzes training needs
2. Provides training to employees for them to do their jobs
3. Qualifies people performing specific tasks

Key Words

Competence
Qualification
Authorize
Training Needs
Job Description
Registry of Skills

Cross-references

ISO 17025:2005 Section 5.2

ISO 9001:2000 Section 5.5.1, 6.2.1, 6.2.2, 7.5.1, 7.5.2

5.2.1 Competence and Qualification

Policy:
Management ensures the competency of all employees including specific equipment operators, those performing tests and/or calibrations, those evaluating results and signing test reports. Appropriate supervision is provided for employees undergoing training. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required.

In addition, personnel responsible for the opinions and interpretations included in test reports also have:

- Relevant knowledge of the technology used in the performance of analyses, materials, products tested, or the way they are used or intended to be used and of the defects or degradation that may occur during sampling, analysis, or use.
- Knowledge of the general requirements expressed in the legislation and standards.
- An understanding of the significance of deviations found with regard to the normal use of the items, materials, or products concerned.

Details:
Management defines the minimum levels of qualification and experience necessary for all posts within the laboratory. The educational and experience requirements for various laboratory positions are listed in the following sections:

5.2.1.1 Laboratory Director – The minimum requirements for the technical director are:

Bachelor's degree in the chemical, environmental, biological sciences, physical sciences or engineering with at least twenty-four (24) college semester credit hours in chemistry and at least two (2) years of experience in the environmental analysis of representative inorganic and organic analytes for which the Chemtech-Ford Laboratories seeks or maintains accreditation. A master's or doctoral degree in one of the above disciplines may be substituted for one (1) year of experience.

For microbiological analyses the technical manager must have a minimum of an associate's degree with at least four (4) college semester credit hours in general microbiology when the laboratory is engaged in microbiological analysis limited to fecal coliform, total coliform, E. coli and standard plate count. In

addition, the person shall have one (1) year of experience in microbiological analyses.

If the laboratory maintains a scope beyond fecal coliform, total coliform, E. coli and standard plate count, then the technical director must have a bachelor's degree in microbiology, biology, chemistry, environmental sciences, physical sciences or engineering with a minimum of sixteen (16) college semester credit hours in general microbiology and biology and at least two (2) years of experience in the environmental analysis of representative analytes for which the laboratory seeks or maintains accreditation. A master's or doctoral degree in one of the above disciplines may be substituted for one (1) year of experience.

5.2.1.2 Quality Manager - The minimum requirements for the quality manager are:

Bachelor's degree and 2 years of experience in environmental laboratory analysis/operation or an associate's degree and 4 years of experience in environmental laboratory analysis/operation. Understanding of quality systems including QA/QC. Understanding of laboratory operations. Strong communication skills including to work with a variety of staff and management

5.2.1.3 Supervisor - The minimum requirements for a laboratory supervisor are:

A bachelor's degree plus one-year work experience in a certified environmental laboratory or in a laboratory that the prospective supervisor demonstrates as one that substantially meets equivalent quality standards for a certified laboratory; or

An associate's degree in the biological, chemical, or physical sciences from an institution of higher education, plus four years work experience in a certified laboratory or in a laboratory that the prospective supervisor demonstrates as one that substantially meets equivalent quality standards for a certified laboratory.

The supervisor must demonstrate competency to supervise testing in the areas over which they supervise.

5.2.1.4 Technical Employees - The minimum requirements for technical laboratory employees vary as to position and job requirements. The education requirements

differ based on the job assignments. In general, the requirements are:

A bachelors degree in the biological, chemical, or physical sciences from an institution of higher education; or

An associates degree in the biological, chemical, or physical sciences from an institution of higher education; or

A high school degree.

Continued competence is monitored through the use of blind performance evaluation samples and Demonstrations of Competency. Where this is not achieved, the need to retrain personnel is considered. Where a method or technique is not in regular use, verification of personnel performance before they undertake tests, may be necessary.

5.2.2 Training Policies and Procedures

Policy:
Management will formulate the goals with respect to the education and the skills of the laboratory personnel. The training program is relevant to the present and anticipated tasks of the laboratory. SOP# QSP 5-2-1 is utilized to identify training needs and providing the necessary training for personnel.

Details:
The skills and knowledge are defined in the job description for each job function as described in section 5.2.1. Management compares the job description to the skills and knowledge of the new incumbent to determine the training needs.

5.2.2.1 QA Program - Chemtech-Ford, Inc. provides easy access to controlled copies of this "quality assurance program" as written within this document for all employees of this laboratory.

5.2.2.2 Training Files - Chemtech-Ford, Inc. maintains training files for all employees involved with data generation and reduction. The training files contain the following sub-files:

- Job description (minimum qualifications, experience, and skills defined).

- Analytical qualification documentation "Demonstrations of Capability," (DOC's). DOCs are neither appropriate nor required for the analyses of Odor, Color, and Paint Filter Test. Also alternatively, duplicate checks of capability are performed for Dissolved Oxygen, Flashpoint, and all microbiological analyses.
- Training attendance sheets.
- SOP reading documentation.
- Certificates, degrees, etc.
- Signed "Ethics Statement."

Training in the laboratory must include all methods or parts of methods and techniques that personnel are asked to perform. Minimally, the analyst must demonstrate competency through observation by management and verification using replicate and/or check samples. For technicians who perform only parts of the method, confirmation of competency may be verified by observation only. Re-verification of all personnel must be performed annually on all methods or techniques pertinent to their job description by use of blind performance evaluation samples and/or Demonstrations of Competency tests.

5.2.3 Employees

Policy:
Competent permanent or contractual employees are employed in the laboratory. The technical manager ensures that contractual, additional technical employees, and key support personnel are supervised and work in accordance to the policies and procedures of this Quality Manual.

Details:
Testing must be either performed or supervised by an experienced person qualified by the experience and/or degree level requirements from section 5.2.1.

5.2.4 Job Descriptions

Policy:
Current job descriptions for managerial, technical and key support personnel involved in tests and/or calibrations are maintained centrally in the administration area of the laboratory.

Details:
Minimum contents of job descriptions include:
- The duty of performing tests.
- The act of planning tests and evaluation of results.
- The responsibility of developing and validating new methods as / when requested.
- Expertise and experience.
- Qualifications and training programs.
- Managerial duties.

5.2.5 Key Personnel and Responsibilities

Policy:
Chemtech-Ford, Inc. complies with the managerial staff requirements as identified and required by "Utah Rule R444-14-8."

Details:
Key Personnel include the following listed positions:

5.2.5.1 Authority and Interrelationships – The laboratory has designated the following lines of authority:
- CEO
- President – Reports to CEO
- Executive Vice President reports to President
- Vice President, Quality Manager, Laboratory Director report to Executive Vice President
- Deputy Lab Director report to Lab Director
- Section Manager reports to Lab Director or Deputy Lab Director
- Team Leader reports to Section Manager
- Analysts & Technicians report to Team Leader

These lines of authority may have exceptions (e.g. there may not be a Team Leader and the analyst/technician may report to a Section Manager. The organizational chart is reviewed and updated (as needed) at least semi-annually (or more frequently as needed).

5.2.5.2 Laboratory Director - The Laboratory Director is responsible for the administrative oversight and overall technical operation of the laboratory. The laboratory director will:

- Define minimum qualifications, experience, and skills necessary for all technical employees.

- Ensure and document through an annual competency check that each technical employee demonstrates initial and on-going proficiency for the tests performed by that employee.

- Review the Quality Managers audit findings and document such reviews.

- Oversee laboratory technical and support staff.

- Review and approve all new and existing analytical procedures.

- Review and approve all deviations from normal analytical protocols.

- Review external and internal quality control audits and all other relative documentation/information.

- Perform final review and approval of new laboratory projects including reports and documents.

- Nominate deputies in case of temporary absence. Unless otherwise specified, the QM or deputy Lab Director will serve as acting laboratory director in the director's absence.

- Review laboratory resources and capabilities prior to accepting new non-routine project work that may affect or adversely tax the present capacity of the laboratory.

- Ensure that subcontracted laboratories are capable and appropriately certified for analytical work sent to them.

5.2.5.3 Quality Manager (QM) - The QM reports directly to the executive team. The QM has the responsibility for the quality system and its implementation (See Section 6 of the QM). The Quality Assurance Officer will:

- Have direct access to the highest level of management at which decisions are taken on laboratory policy and resources, and to the laboratory director.

- Serve as the focal point for quality assurance and oversee and review quality control data.

- Have functions independent from laboratory operations for which he or she has quality assurance oversight.

- Have documented training or experience in quality assurance procedures and be knowledgeable in the quality assurance requirements of Utah Rule R444-14; also be knowledgeable in the quality systems.

- Have knowledge of the approved methods used by the laboratory in order to accurately evaluate laboratory performance.

- Objectively evaluate data and objectively perform assessments without undue influence.

- Oversee all quality aspects of sample handling, testing, and report generation.

- Schedule, oversee, and be responsible for reviews of the entire technical operation of the laboratory. This includes conducting annual technical audits.

- Arrange, when available, analytical participation in inter-laboratory comparisons and proficiency testing programs. For purposes of qualifying for and maintaining accreditation, the QM shall arrange for participation in an external proficiency test program according to Utah Rule R-444-14 and as identified in the Quality Systems of NELAP.

- Notify laboratory management of deficiencies in the quality system and monitor corrective actions (ensure managers review all corrective actions initiating from their areas of concern, using corrective action reports as references during QA training meetings).

- Serve as the back-up to the Laboratory Director in the absence of the Laboratory Director.

5.2.5.4 Laboratory Area Supervisors - These managers are responsible for the day-to-day operation of the laboratory. Their responsibilities include:

- Supervise all technical and non-technical employees.
- Be responsible for the production and quality of all data reported by the laboratory.
- Review and approve analytical data generated within the area.
- Develop and submit new methods and operating procedures for approval by the Laboratory Director.
- Evaluate instrument and personnel needs.
- Ensure that all samples are accepted, analyzed, and reported in accordance with laboratory SOPs.

5.2.5.5Technical Staff - Technical personnel, generally, are responsible for the routine receipt, analysis and reporting of all laboratory samples. The technical staff will:

- Report directly to the assigned supervisor.
- Perform duties in accordance to laboratory policy and procedures.
- Read, understand, and follow the Quality Manual and all appropriate SOPs.

5.2.6 Laboratory Organizational Chart

The official organizational structure is contained in Quality Manager.

5.2.7 Staff Management Policies

Policy:

Management authorizes specific personnel to perform particular types of testing, to issue test reports, to give opinions and interpretations and to operate particular types of equipment. Records of the relevant competence, educational and professional qualifications, training, skills and experience of all technical personnel and contracted personnel are maintained. This information is readily available and includes the date on which authorization and/or competence was confirmed and the criteria on which the authorization is based and the confirming authority.

Details:

5.2.7.1 Confidentiality

Each employee shall read, understand, and acknowledge that the analytical work performed in the laboratory demands a high degree of confidentiality. In a practical sense, this has to do with the potential communication of laboratory procedures and analytical results to clients, regulatory agencies, and other interested parties. All employees should understand that **analytical data legally belongs to the client who contracted such work**.

5.2.7.1.1 Telephone Correspondence

A request for analytical results via telephone should be verified by requesting the name of the requestor (and as applicable the phone number, FAX number, e-mail address, or mailing address) before releasing data. It should be clear that the contracting client is the same as the client requesting the data. **For any data request from a client other than the contracting client, the contracting client must approve its use by the requesting client before release.** Such permission must be documented (requestor, contracting client, date and time of request, staff member taking request) and placed in the client data file.

5.2.7.1.2 E-mail and FAX Correspondence

Similar guidelines to 5.2.7.1.1 apply to requests for results transmitted by e-mail or FAX. Chemtech-Ford, Inc. will keep electronic records of e-mail/FAX requests and reports for 5 years.

5.2.7.1.3 "In-Person" Requests

Similar guidelines to 5.2.7.1 apply to clients who appear at the laboratory in person and request analytical data or other laboratory documentation. Copies of such reports or documentation may be released only after determining that the requestor is the contracting party, or has written permission from the contracting party to release the data.

5.2.7.1.4 Statement of Confidentiality

Each employee shall sign a Confidentiality Agreement, which describes the understanding of such laboratory confidentiality and acknowledges the penalties for failing to follow established laboratory procedures regarding confidentiality.

5.2.7.2 Improper, Unethical, and Illegal Actions

It is the policy of Chemtech-Ford, Inc. and its employees to perform their duties in a consistently legal and ethical manner. A high level of ethical behavior is characterized by, but not limited to, dealing honestly and forthrightly with all clients and co-workers, maintaining data integrity, open and timely treatment of inaccurate, invalid, or misreported analytical data, and abiding by all pertinent rules, regulations, company policies, and standard operating procedures.

Deliberate violations of such behavior will result in disciplinary action up to and including termination, the consequences of which could additionally lead to direct liability and legal action against the responsible individual.

It is the responsibility of each Chemtech-Ford, Inc. employee to report any observed violation of this policy. This observation may result from a visual or studied review of protocol, generated data, or reported information. Laboratory management will review the evidence of any such reported violation; confirmation that such a violation occurred will result in severe disciplinary action, up to and including termination and possible legal action.

Serious violations of Chemtech-Ford, Inc.'s ethical policy include, but are not limited to, the following:

- Changing a reported value in the LIMS database without proper support of documentation;
- Intentionally misrepresenting data generated by instrument or calculation;
- Recording invalid or otherwise altered data to make the analysis conform to "expected" levels;
- Recording invalid or otherwise altered data at someone else's suggestion or insistence;
- Recording invalid or otherwise altered data to satisfy quality assurance acceptance criteria;
- Manually integrating chromatographic data to satisfy quality assurance acceptance criteria;
- Withholding information that was noted during sample receipt or analysis;
- Purposefully destroying a sample prior to the completion of analysis; and
- Willfully circumventing the sample disposal Standard Operating Procedure.

Each Chemtech-Ford, Inc. employee is required to participate in a training session within two weeks of employment. The training will include Chemtech-Ford's ethical policies, examples of unethical behaviors, and penalties for non-compliance. The new employee will be required to sign an attestation statement as a condition of employment which will again define Chemtech-Ford's policies and penalties.

Each year, or more frequently if needed, each Chemtech-Ford, Inc. employee is required to attend ethical training to review company policies and penalties. At the conclusion of the training, each employee will be required to sign an attestation called an Ethical Attestation Statement that summarizes the employee's ethical and legal responsibilities. This Statement acknowledges that penalties exist for deliberately violating this policy.

In order to promote an atmosphere of integrity, management will reiterate at routine staff meetings the importance of reporting discovered errors and the insistence that such reporting will not necessarily result in personal punishment, even though the company may suffer financially.

Furthermore, management will institute internal proficiency testing (blind and double blind samples) where applicable; QC meetings whose emphasis is on

appropriate and inappropriate laboratory technique and instrument/data manipulation will be held routinely to address this topic.

5.2.7.2 Manual Integration

In keeping with Chemtech-Ford's policy of producing data of the highest possible quality, integrations performed in the laboratory must be generated by fully calibrated instruments and not altered in an unsubstantiated manner.

Improper manual integrations performed for the purposes of meeting quality control criteria or any other reason are not allowed. Such unsubstantiated integrations are subject to possible disciplinary action by laboratory management.

If a manual integration is necessary, the integration produced after manual integration shall both be labeled and present in the raw data package. The intent is to demonstrate the results of the integration are appropriate and according to good laboratory practices. It is recommended that a short explanation be provided if an unusual integration has to be made (e.g. for unusual tailing due to matrix effect).

All manual integrations are subject to strict scrutiny to ensure that they are performed appropriately. Analysts are advised that they must be prepared at any time to defend a manual integration. When there is a question to the validity of the manual integration by the analyst, then they should discuss the integration with their supervisor. Supervisors should regularly review the manual integrations of employees.

Manual integrations are noted in the raw data package. Typically, these are denoted by an "m" next to the integrated area or concentration.

5.2.7.3 Undue Pressure

An appropriate working atmosphere will be provided at Chemtech-Ford, Inc. so that all employees will be free from any commercial, financial, or other undue pressures, which might adversely affect the quality of their work.

If a Chemtech-Ford, Inc. employee feels that his or her work has been affected by undue pressure of any sort, the following recourses are available:

5.2.7.3.1 The employee may report the source of the pressure(s) affecting lab performance to his or her supervisor, or to the laboratory director or owner if the employee believes notifying the supervisor will be ineffective or problematic; and/or

5.2.7.3.2 The employee may generate a Corrective Action Form. This form will specify those requests, behaviors, or other pressures, which adversely affect the quality of the employee's work. The form will then follow normal review channels through the laboratory in order to be resolved.

5.2.7.4 Validation of Employee Qualifications

It is the responsibility of Chemtech-Ford, Inc. management to ensure that all employees have demonstrated capability in the activities for which they have been hired and are responsible. This includes verification that a potential employee possesses all of the technical, organizational, and communication skills prior to employment; and that, once hired, each employee continues to upgrade his knowledge and skills.

Each new employee is required to read, sign, and understand a comprehensive employment documents provided at time of employment. These documents verify the position's required skills as well as educating the employee in all aspects of the company's operations and policies. This documents include, but are not limited to containing:

- An attestation that all educational qualifications and technical and communication skills requirements have been fulfilled and reviewed by management.
- A Confidentiality Agreement.
- An Ethics Statement.
- A Harassment Prevention Policy.
- An attestation that the employee has read, acknowledged, and understood the Chemtech-Ford, Inc. Quality Manual.
- An attestation that the employee has read, understood, and agreed to perform the most recent version(s) of the test method(s) for which the employee is responsible.

- Demonstrations of Capability for all technical competencies required.
- An explanation of the Chemtech-Ford, Inc. Laboratory Information Management System (LIMS) and its functions.

New employees are apprised of all laboratory security systems and the Training Files to be kept by each employee.

Specialized training sessions will be routinely held to 1) review current policies and procedures; 2) institute new policies and procedures; 3) review particular technical skills, Quality Assurance topics, or corrective actions; and 4) institute cross training. These training sessions/courses will be documented in each employee's training file.

Prior to the initiation and acceptance of test results from an employee on any test method, satisfactory demonstration of capability is required.
Following the completion of all capability demonstration work, the initial analytical work of any new employee will be carefully reviewed for accuracy, thoroughness, and timeliness by the laboratory supervisor. Correct and accurate entry of data into the LIMS will also be monitored. Once the supervisor is satisfied of the technical competency of the new employee, a less rigorous review of the employee's skills and generated data will be required.

Records are held in Quality Manager.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.3 Accommodation and Environmental Conditions

Section Synopsis

This section tells you:

1. That laboratory facilities are suitable for attaining correct performance of tests and calibrations
2. Critical environmental conditions are monitored, controlled and recorded
3. Incompatible activities are separated
4. Access to laboratories is controlled
5. Good housekeeping is practiced

Key Words

Incompatible activities
Prevent cross-contamination
Controlled access

Cross-references

ISO 17025:2005 Section 5.3

ISO 9001:2000 Section 6.3, 6.4, 7.1, 7.5.1, 7.5.2, 7.6, 8.2.3

5.3.1 Facility

Policy:
Laboratory facilities shall be appropriate to allow for the proper performance of analytical testing. This may include, but not limited to, energy sources, lighting, heating, ventilation and any other environmental conditions.

Appropriate care is taken to ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement. The technical requirements for accommodation and environmental conditions that can affect the results of tests and calibrations are documented.

Details:
This section deals with the test areas in the laboratory and premises for support such as sample receipt and storage. Central laboratory supplies and services, such as water purification systems, air supply, vacuum source, and sample storage, are appropriate to facilitate proper performance of tests.

5.3.2 Monitoring

Policy:
Critical environmental conditions are monitored, controlled and recorded as required by the relevant specifications, methods, and procedures or where they may influence the quality of the results. Tests and calibrations are stopped when the environmental conditions jeopardize the results of the tests and/or calibrations.

Details:
Laboratories are ventilated to reduce the levels of contamination, lower humidity, and control temperature. Laboratories' test areas are air-conditioned and the temperature is 20-25 °C.

Bench tops and floors are made of impervious, smooth easily cleaned materials. There is at least two linear meters workspace per analyst while working. Walls and ceilings are made of materials that are smooth and easily cleaned.

5.3.3 Separation of Incompatible Activities

Policy:
Effective separation between neighboring areas is made when the activities are incompatible. Measures are taken to prevent cross-contamination.

Details:
Reference materials and certified reference materials must be kept separated from samples (log-in and storage). Sample log-in and storage must be segregated, ideally in a separate area from the testing laboratory, and include proper sanitation to exclude the possibility of cross-contamination. Segregation of activities is achieved through time and space allocations.

5.3.4 Controlled Access

Policy:
Access to and use of areas affecting quality of the tests is defined and controlled.

Details:
Access to the laboratory is restricted to authorized personnel only. The authorized personnel are made aware of the following items:

- the intended use of the area
- the restrictions imposed on working within such areas
- the reasons for imposing the restrictions

5.3.4.1 *Sample Receiving* - The sample receiving area is designed to be independent of the other laboratory areas. The sample receiving area is designed with a convenient access from the out-of-doors. This access is controlled allowing security of the laboratory and sample storage. The sample receiving area may also be used for preparing and shipping of containers to clients.

5.3.4.2 *Volatiles Laboratory* - The volatiles laboratory is located within a climate controlled area away from the main laboratory in order to eliminate solvent cross-contamination from other areas of the laboratory. As with the main laboratory, access to this building is limited to authorized personnel only. All GC/MS volatiles work is performed in this area.

5.3.4.3 *Inorganic Chemistry Laboratory* - The inorganic chemistry laboratory occupies the largest of the lab area within the building. The area consists of a centrally located spacious rooms equipped with several large benches for analytical work. Conventional wet techniques such as gravimetric, colorimetric, titrimetric are performed here. Several fume hoods are located within the rooms to provide ease of sample preparation.

5.3.4.4 *Wet Chemistry Laboratory* - This laboratory is adjacent to the inorganic chemistry laboratory and contains the necessary equipment required to perform various wet chemistries (e.g., BOD, COD, and TSS).

5.3.4.5 *Metals Laboratory* - The metals analysis laboratory contains all of the metals analytical equipment. However, samples are prepared for metals analysis in the inorganic laboratory, thus reducing the possibility of instrument contamination. The metals laboratory is designed for ICP, ICP/MS, and Hg cold-vapor instrumentation.

5.3.4.6 *GC and Semi-Volatile GC/MS Laboratory* - The preparation lab contains standard fume hoods and ample bench space for sample extraction. The GC and Semi-volatile GC/MS instrument laboratory has several benches with GC and GC/MS instrumentation and supplies.

5.3.4.7 *Microbiology Laboratory* - The microbiology laboratory is a separate room that is climate-controlled with ample bench space on which to perform the required analytical procedures. The laboratory contains its own supplies and storage facilities for ease of analysis and for prevention of contamination.

5.3.4.8 *Sample Storage* - Samples remaining in the sample analysis stream are located within their respective holding areas (refrigerators, etc.) until required analyses have been complete. Additional post-analysis storage for metals-preserved sample bottles is accomplished via storage shelves located within the metals laboratory. All other inorganic/organic samples are kept for a maximum of three months (following data reporting) in refrigerated storage throughout the laboratory.

5.3.5 Good Housekeeping

Policy:
Measures are taken to ensure good housekeeping in the laboratory. Special procedures are followed when necessary.

Details:
Controlled use of cleaning and pest control materials is exercised. The laboratory complies with the local health and safety requirements.

Revision History

Changes from Revision 25
Section 5.4.5.3 Title edited for grammar.

5.4 Test Methods and Method Validation

Section Synopsis

This section tells you:

1. Preference is given to the use of a standard method when selecting procedures
2. All methods must be validated before use
3. Measurement uncertainty is estimated
4. Data is controlled

Key Words

Standard Methods
Laboratory-Developed Methods
Non-standardized Methods
Validation
Uncertainty of Measurement
Data Checks

Cross-references

ISO 17025:2005 Section 5.4

ISO 9001:2000 Section 4.2.1, 4.2.3, 6.1, 6.3, 6.4, 7.1, 7.2.1, 7.2.2, 7.3, 7.4.3, 7.5.1, 7.5.2, 7.6, 8.1, 8.2.3, 8.2.4

5.4.1 General

Policy:
Methods and procedures used for all tests and/or calibrations are appropriate as per:

- sampling, handling, transport, storage, and preparation of items to be tested and/or calibrated
- an estimation of the measurement of uncertainty as well as statistical techniques for analysis of test and/or calibration data where appropriate

Instructions on the use and operation of all relevant equipment and on the handling and preparation of items for testing and/or calibration are available. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and readily available to personnel. Deviation from test and calibration methods must be documented, technically justified, authorized, and accepted by the customer.

Details:
There are SOPs for sample handling, storage, preparation of test items, QA/QC procedures (media QC, incubation times and temperatures, equipment calibration and maintenance, process control QC), and standards for approving / rejecting results. These may be combined with or separate from the method. The content of an environmental (TNI) test method should include:

- Applicable Matrices
- Detection Limit
- Method Scope
- Method Summary
- Definitions
- Interferences
- Safety
- Equipment and Supplies
- Reagents and Standards
- Sample Collection, Preservation, Shipment and Storage
- Quality Control
- Calibration and Standardization
- Procedure
- Calculations
- Method Performance
- Changes to the Approved Method
- Data Assessment and Acceptance Criteria

- Corrective Action & Contingencies for Out of Control Data
- Pollution Prevention and Waste Management
- References
- Editorial Changes to SOP
- Appendices

International, national, or regional standards or other recognized specifications that contain sufficient and concise information on how to perform the tests and/or calibrations are not necessarily supplemented or rewritten as an internal procedure when they are written in a way that can be used as published by laboratory staff. Consideration may need to be given to providing additional documentation for optional steps in the method.

5.4.2 Selection of Methods

Policy:
Test and/or calibration methods, including methods for sampling, meet the needs of the customer and are appropriate for the tests and/or calibrations it undertakes. Preference is given to reference methods published as international, national, or regional standards. The laboratory ensures that the latest edition of a standard is used unless it is not appropriate or possible to do so. When necessary, the standard is supplemented with additional details to ensure consistent application.

Details:
Methods that have been published either in international, national, or regional standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer are selected when the customer does not specify the method to be used. Methods may be adopted from but are not limited to the following sources: EPA, Standard Methods, USP, AOAC, FDA BAM, USDA FSIS & AMS, APHA SMEDP, APHA, AWWA, WEF, NELAC, TNI, Compendium of Methods for the Microbiological Examination of Foods, ISO, ICMSF, National Food Processors, American Association of Cereal Chemists, Association of Dressing and Sauces, Health Canada, Environmental Protection Agency, OIE, and ASTM.

The ability of the laboratory to achieve satisfactory performance against documented performance characteristics is verified before samples are analyzed.

Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated. The customer is

informed as to the method chosen. The laboratory confirms that it can properly operate standardized methods before introducing the tests or calibrations. If the standardized method changes, the confirmation is repeated.

The customer is informed when the method proposed by the customer is considered to be inappropriate or out of date.

5.4.3 Laboratory-Developed Methods

Policy:
Introduction of test and calibration methods developed internally is a planned activity and is assigned to qualified personnel equipped with adequate resources. Plans are updated as development proceeds and ensures effective communication among all personnel involved.

Details:
Methods developed in-house are validated and authorized before use. Where available, Certified Reference Materials (CRMs) are used to determine any systemic bias, or where possible results are compared with other techniques, preferably based on different principles of analysis. As applicable, determination of uncertainty is part of this validation process and is essential for ongoing quality control.

5.4.4 Non-Standard Methods

Policy:
Utilization of non-standard methods is subject to agreement with the customer and includes a clear specification of the customer's requirements and the purpose of the test. The developed method is validated appropriately before use.

Details:
Discussion and agreement for the use of non-standard methods is recorded as part of contract review procedures (see section 4.4).

All non-standard and new tests are validated for their intended purpose. Qualitative test methods must be validated to demonstrate estimated sensitivity and specificity, relative accuracy to official methods (if appropriate), positive and negative deviation, limit of detection, matrix effect, repeatability, and reproducibility.

Quantitative test methods are validated to demonstrate specificity, sensitivity, relative accuracy, positive and negative deviation, repeatability, reproducibility, and limit of determination.

For new methods where procedures are developing rapidly, especially for emergency situations, it may be necessary to circumvent normal validation procedures. Minimally, this must be a demonstrated recovery in replicate.

New test and/or calibration methods are documented prior to providing test and/or calibration results to customers and contain at least the following information:

- appropriate identification
- scope
- description of the type of item to be tested or calibrated
- parameters or quantities to be determined
- apparatus and equipment, including technical performance requirements
- reference standards and reference materials required
- environmental conditions required and any stabilization period needed
- description of the procedure, including:
  - affixing identification marks, handling, transporting, storing and preparing of items
  - ensuring checks are made before the work is started
  - checking that the equipment is working properly and, where required, calibrating and adjusting the equipment before each use
  - listing method of recording the observations and results
  - indicating any safety measures to be observed
- criteria and/or requirements for approval/rejection (quality control plan)
- data to be recorded and method of analysis and presentation
- uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods

5.4.5.1 Performance Characteristics

Policy:
Validation of a method establishes, by systematic laboratory studies, that the performance characteristics of the method meet the specifications related to the intended use of the test results.

Details:
The performance characteristics of a validation plan includes, as applicable:

- selectivity and specificity
- range
- linearity
- sensitivity
- limit of detection
- limit of quantitation
- accuracy
- precision
- reporting limit
- repeatability
- reproducibility
- recovery
- confirmation techniques
- criteria for the number of samples tested to validate method as per defined scope of method
- action levels where defined by regulation
- quality control incorporating statistics as applicable

Performance characteristics that are selected take into account the intended use of the method, whether for screening, confirmatory analysis, or quantitation.

The design, verification of the method and documentation procedures for validation are planned and conducted by qualified personnel, equipped with adequate resources.

This section lists a few acceptable validation procedures. The choice of the procedure depends on the extent of the deviation from the published method.

Validation of methodology is a value judgment in which the performance parameters of the method are compared with the requirements for the test data. A prerequisite for a valid method is that data produced by the method must attain a state of statistical control. Such a state is obtained when the mean value of a large number of individual values tends to approach a limiting value called the limiting mean.

Methods may be validated by one or more alternative procedures. Some of these procedures are described below. Apparent differences can be analyzed statistically to

confirm their significance. In all cases, the reasons for choosing one or more alternatives must be documented.

- analysis of standard reference materials (SRM) that are identical or almost identical to the test samples
- in the absence of suitable SRMs, analysis of reference materials that are similar in all respect to the test samples; the use and validity of this reference material must be documented
- using an alternative method to measure the same parameter provides a very high level of confidence if results are confirmed
- recovery studies by the addition of a known concentration of the parameter of interest to some of the replicates being measured

The parameters to be determined include:

- the scope of the method and any known interference
- detection limit
- the range of concentration where the method is valid
- precision and bias

Judgment is required to determine if some or all of the above is required. Requirements will depend largely on the extent of deviation from the original method.

Developments in methodology and techniques require methods to be changed from time to time. The difference in performance between revised and obsolete methods is established so that it is possible to compare old and new data.

Where a change in method involves only minor adjustments, such as sample size, or different reagents, the amended method is validated and the changes brought to the attention of the accreditation body at the next accreditation audit. Where the proposed change involves technology or methodology, the laboratory seeks the approval of the accreditation body.

Records are kept on all validation activities. The records include any of the performance characteristics chosen, reference procedures or guidance documents followed to validate the method or custom validation procedure, and a final confirmation (memo to file) that the method validation results are acceptable for continued use of the method. An example statement would be “This serves as record that the validation of the XYZ Test Method has been approved for use by [name and title of approver]”.

5.4.5.2 Fit for Use

Policy:
The laboratory validates non-standardized methods, laboratory-designed/developed methods, standardized methods used outside their intended range, and amplifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs in the given application or field of application (may include procedures for sampling, handling, and transportation). The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

Details and Procedure:
Validation records are kept as in section 5.4.5.1. Included in these records is the validation procedure. The procedure used for the validation is likely to vary between different methods. Therefore, the procedures included in the laboratory records are not as detailed as a typical SOP, but are sufficient enough to re-create how the method was validated.

The techniques used for the determination of the performance of a method, are one of, or a combination of, the following:

- calibration using reference standards or reference materials
- comparison of results achieved with other methods
- inter-laboratory comparisons
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience.

When changes are made in the validated non-standard method, the influence of such changes carried out is documented and if appropriate a new validation is performed.

5.4.5.3 Customer's Needs

Policy:
The range and accuracy of the values obtainable from validated methods (e.g., the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object) as assessed for the intended use is relevant to the customer's needs.

Details:
Validation includes the specification of the requirements, determination of the characteristics of the methods, the comparison of the requirements with the values of the characteristics of the method, and a statement on the validity.

As method development proceeds, regular review is required to verify that the needs of the customer are still being fulfilled. Changing requirements requiring modifications to the development plan are approved and authorized.

Validation is always a balance between costs, risks, and technical possibilities.

5.4.6 Uncertainty of Measurement

5.4.6.1 Calibration

Policy:
Physical, chemical, and biological standards are calibrated or characterized by qualified subcontractors.

Details and Procedures:
Repeatability and reproducibility data are components of measurement uncertainty and are determined as a first step towards producing estimates of this parameter. The uncertainty of measurement may be made available on the certificate of analysis or calibration certificate from a subcontractor.

Note – in-house calibrations include procedures for uncertainty of measurement estimates where practicable.

5.4.6.2 Testing

Policy:
The SOP# QSP 5-4-1 is utilized to estimate uncertainties of measurement in testing, except when the test methods preclude such rigorous calculations. In certain cases, it is not possible to undertake metrologically and statistically valid estimations of uncertainty of measurement. In these cases, the laboratory attempts to identify all the components of uncertainty and make the best possible estimation, and ensure that the form of reporting does not give an exaggerated impression of accuracy. Reasonable estimation is based on

knowledge of the performance of the method and on the measurement scope and makes use of previous experience and validation data.

Details:
The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

- requirement of the test method
- requirement by the customer
- if there are narrow limits on which decisions on conformity to a specification are based

In cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the estimation uncertainty of measurement by following the reporting instructions (see section 5.10).

5.4.6.3 Uncertainty Components

Policy:
When estimating the uncertainty of measurement, all uncertainty components that are of importance in the given situation are taken into account using accepted methods of analysis.

Details:
Sources contributing to the uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and equipment used, the environmental conditions, the item being tested or calibrated and the operator.

The predicted long-term behavior of the tested and/or calibrated item is normally not taken into account when estimating the measurement uncertainty.

For further information, see ISO 5725 and the Guide to Expression of Uncertainty in Measurement.

5.4.7 Control of Data

5.4.7.1 Calculations and Data Transfers

Policy:
Calculations and data transfers are subject to appropriate checks in a systematic manner.

Details:
Test data are approved through the following arrangements by the QM, supervisor, lab director, peer etc.:

- checks to determine accuracy of calculations, conversions, and data transfers
- checks for transcription errors, omissions, and mistakes
- checks to determine consistency with normal or expected values

For those analyses where manual data reduction is required, it is performed according to the instructions provided in the test method or SOP.

5.4.7.2 Computers and Automated Equipment

Policy:
When computers or automated equipment are used for the acquisition, processing, manipulation, recording, reporting, storage or retrieval of test or calibration data, the laboratory ensures that:

- computer software developed by the user is documented in sufficient detail and suitably validated or otherwise checked as being adequate for use
- procedures are established and implemented for protecting the integrity of data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing (see section 4.13.1.4)
- computers and automated equipment are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test and calibration data
- data is securely maintained by preventing unauthorized access to, and unauthorized amendment of, computer records

Details and Procedures:

Data generated using computer software programs that are interfaced directly to instruments incorporates all dilutions and calculations, thereby eliminating the need for manual data reduction.

Commercially developed software in general use within its designed application range may be considered sufficiently validated. Laboratory software configuration / modifications are validated as outlined in SOP# QSP 5-5-1.

It is the **stated goal** of Chemtech-Ford Laboratories to meet the requirement for Electronic records, electronic signatures, and handwritten signatures executed to electronic records as defined by 21 CFR. Part 11 (Docket No. 92NO251) RIN0910-AA29; Federal Register: March 20, 1997, Volume 62, Number 54), Rules and Regulations, pages 13429-13466. Chemtech-Ford is not now fully compliant, but records of compliance evaluation are maintained and can be inspected upon request.

For details of the requirement see:

http://www.fda.gov/ora/compliance_ref/part11/

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.5 Equipment

Section Synopsis

This section tells you to:

1. Identify information needs for accept / reject decisions
2. Install equipment capable of providing that information
3. Use the equipment in the proper environment
4. Periodically check the equipment calibration

Key Words

Required Equipment and Accuracy
Authorized Personnel
Unique Identification
Inventory
Maintenance
Procedures
Out of Service
Calibration Status
Re-verification
Checks
Correction Factors
Safeguards against Adjustment

Cross-references

ISO 17025:2005 Section 5.5

ISO 9001:2000 Section 4.2.1, 4.2.3, 5.1, 6.2.2, 6.3.1, 7.1, 7.4, 7.5.1, 7.5.2, 7.5.3, 7.6, 8.1, 8.2.3, 8.2.4

5.5.1 Required Equipment

Policy:
The laboratory is furnished with all items for sampling, measurement and test equipment required for the correct performance of the tests and/or calibrations (including sampling, preparation of test and/or calibration items, processing and analysis of test and/or calibration data). When equipment is used outside the laboratory's permanent control, it ensures that the requirements of this Quality Manual are met.

Details:
Equipment is used in an environment appropriate to its proper performance. All equipment required by a test is described in each method, including the equipment's tolerances.

A current list of equipment is maintained in Quality Manager.

5.5.2 Required Accuracy

Policy:
Equipment and software used for testing, calibration and sampling are capable of achieving the accuracy required and comply with specifications relevant to the tests and/or calibrations concerned. Calibration programs are established for key quantities or values of the instruments where these properties have a significant effect on the results. When received, equipment, including that used for sampling, is checked to establish that it meets the laboratory's specification requirements, complies with the relevant standard specifications, and is checked and/or calibrated in accordance with section 5.6 before use.

Details:
The procedures for checking newly received equipment are as determined by manufacturers' specification and/or those determined by the laboratory during procurement.

5.5.3 Authorized Personnel

Policy:
Equipment is operated by authorized personnel. Up-to-date instructions on the use and maintenance of equipment (including any relevant manuals provided by the manufacturer of the equipment) are readily available for use by the appropriate laboratory personnel.

Details:
Access to laboratory equipment is controlled to ensure that only authorized personnel use equipment.

5.5.4 Unique Identification

Policy:
Each item of equipment used for testing and calibration is uniquely identified when practicable.

Details:
Measuring and testing equipment is uniquely identified. Typical identification includes instrument type, make, model, serial number or other unique markings. Measuring and testing equipment includes any instrument that could affect the quality of test results. Components that can be interchanged between various instruments are tracked in equipment logbooks but are not assigned individual identification.

5.5.5 Inventory and Maintenance Records

Policy:
Records are maintained for each item of equipment significant to the tests and/or calibrations performed. The records include the following:

- identity of the item of equipment (and its software)
- manufacturer's name, type identification, and serial number and/or other unique identification
- Date received (if available)
- Date placed into service (if available)
- checks that equipment complies with the specification (see section 5.5.2)
- current location, where appropriate
- the manufacturer's instructions, if available, or reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and due date of next calibration
- maintenance carried out to date and the maintenance plan (includes calibration)
- damage, malfunction, modification or repair to the equipment
- Analysts initials

Details:
A database is used to capture the above inventory information. The above information related to service and maintenance is kept in Quality Manager. Other information recorded may include:

- date received and date placed in service
- condition when received (e.g., new, used, refurbished)
- dates and results of calibration and/or verification and date of next calibration and/or verification
- performance history, where appropriate (e.g., response time, drift, noise level)

5.5.6 Equipment Procedures

Policy:
The SOP# QSP 5-5-1 is utilized as an established plan for safe handling, transport, storage, use and maintenance (including calibration) of measuring equipment, and appropriate use of correction factors to ensure proper functioning and in order to prevent contamination or deterioration.

Note – additional procedures may be necessary when measuring equipment is used outside the permanent laboratory for tests, calibrations, or sampling (currently not applicable at our laboratory).

Details and Procedures:
The procedures for each piece of measuring equipment are located in the appropriate room where the equipment is located. These procedures detail any information for safe handling, transport, storage, use, and maintenance of measuring equipment.

5.5.7 Out of Service Equipment

Policy:
Equipment that has either been subjected to overloading or mishandling, or gives suspect results, or has been shown to be defective or outside specified limits, is taken out of service, clearly marked, and appropriately stored until it has been repaired and shown by calibration or test to perform correctly.

Details:
Routine testing work is completely discontinued on equipment that even shows minor nonconformances. Not only do we do this for ethical reasons in support of our customer, but minor nonconformances are often indicative of major breakdowns in expensive equipment. These breakdowns need to be avoided wherever possible.

Out of service equipment is clearly marked as outlined in section 5.5.8.

The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the “Control of Nonconforming Work” procedure as outlined in section 4.9.

5.5.8 Calibration Status

Policy:
Equipment requiring calibration is labeled to indicate the calibration status and/or operational status and the date when re-calibration is due when appropriate.

Details:
Calibration labels have a write-on surface and a pressure sensitive adhesive. The areas that are filled out include the person who performed the calibration, the date it was performed, the date it is due for re-calibration, and the equipment's identification number.

CALIBRATION
BY_____DATE_____
DUE_____ID#_____

Measuring equipment that has failed calibration or is deemed out of service is labeled with one of the following labels:

CALIBRATION VOID

DO NOT USE

OUT OF SERVICE

DO NOT USE

A piece of equipment that is not calibrated or checked is labeled with the following label:

5.5.9 Return to Service

FOR REFERENCE ONLY

Policy:
When equipment goes outside the direct control of the laboratory for a period, the laboratory ensures that the function and calibration status of the equipment are checked and validated and shown to be satisfactory before the equipment is returned to service.

Details and Procedures:
The procedures used to check and ensure that the function and calibration status of the equipment are satisfactory before the equipment is returned to service are outlined in the

manufacturer's equipment manual. Any additional quality control checks are outlined in the "Quality Control Plan" section of the appropriate test method.

5.5.10 Periodic Checks

Policy:
When intermediate checks are needed to maintain confidence in the calibration status of equipment, these checks are carried out periodically according to defined procedure.

Details and Procedures:
As stated in section 5.5.6, the procedures for each piece of measuring equipment are available on the laboratory computer network. SOP# QSP 5-5-1 outlines a general maintenance plan for equipment and includes various checks. Internal quality control checks are specified in individual test methods that are located in the appropriate laboratory areas thereby providing procedures for intermediate checks.

5.5.11 Correction Factors

Policy
Calibrations that give rise to a set of correction factors are updated along with all copies of this data (e.g., in computer software).

Details and Procedures:
The updating of correction factors, including all copies, is assured by following the appropriate test method or SOP. It is the responsibility of the QM to ensure that all copies are updated.

5.5.12 Safeguards against Adjustments

Policy:
Test and calibration equipment, including hardware and software, are safeguarded from adjustments that invalidate test and/or calibration results/status.

Details:
Safeguards against adjustment for laboratory equipment include:
- detailed SOPs and manufacturer's manuals on the operation of the equipment

- policies permitting only fully trained and competent personnel to operate equipment
- access to the laboratory is restricted to authorized personnel

Safeguards against adjustment for software includes:
- password protection for important files and packages
- access to the laboratory is restricted to authorized personnel
- An electronic audit trail is maintained on for the changes made in the LIMS software

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.6 Measurement Traceability

Section Synopsis

This section tells you:

1. Measurements are traceable to SI units (when applicable)
2. Reference Standards and Reference Materials are used

Key Words

Systemèm International
Reference Standard
Reference Material
Traceability

Cross-references

ISO 17025:2005 Section 5.6

ISO 9001:2000 Section 6.3.1, 7.1, 7.5.1, 7.6

5.6.1 General

Policy:
Test and/or calibration equipment for subsidiary measurements (e.g., for environmental conditions) having a significant effect on the accuracy or validity of the result of the test, calibration, or sampling are calibrated before being put into service. All measurement and test equipment having an effect on the accuracy or validity of tests is calibrated and/or verified before being put into service. As mentioned in section 5.5, the SOP# QSP 5-5-1 outlines an established program for the maintenance of equipment and includes calibration.

Details:
The program includes a system for selecting, using, calibrating, checking, controlling, and maintaining:

- measurement standards
- reference standards used as measurement standards
- measuring and test equipment used to perform tests and calibrations

Procedures are documented where appropriate. All measurements that play a defining role in testing accuracy are based directly or indirectly on reference standards, reference materials, certified reference materials, or other standards or materials having appropriate traceability.

Records are maintained in the LIMS for each standard. These records include, as applicable:

- supplier, grade, lot number, and concentration
- dates of preparation or verification
- measurement of weights, volumes, time intervals, temperatures, and pressures and related calculations
- relevant processes (e.g., pH adjustment, sterilization)
- verification results
- identification of personnel involved

Reagents prepared in the laboratory are labelled to identify substance, strength, solvent (where not water), and date of preparation and/or expiry. The person responsible for the preparation of the reagent is identified either from the label or from records.]

5.6.2 Specific Requirements

5.6.2.1 Calibration

Policy:
The program for calibration equipment is designed and operated to ensure that calibration measurements are traceable to the System International (SI) units of measurement.

Details:
Traceability of measurement is assured by the use of calibration services from laboratories that can demonstrate competence, measurement capability and traceability. The calibration certificates issued by these laboratories show that there is a link to a primary standard or to a natural constant realizing the SI unit by an unbroken chain of calibrations. The calibration certificates contain the measurement results including the measurement uncertainty and/or a statement of compliance with an identified metrological specification (see also section 5.10.4.2).

Calibration laboratories accredited to ISO 17025 are considered competent to provide the appropriate calibration services.

Traceability to SI units of measurement may be achieved by reference to an appropriate primary standard or by reference to a natural constant the value of which, in terms of the relevant SI unit, is known.

The term “identified metrological specification” means that it must be clear from the calibration certificate against which specification the measurements have been compared with, by including the specification or by giving an unambiguous reference to the specification.

When the terms “international standard” or “national standard” are used in connection with traceability, it is assumed that these standards fulfil the properties of primary standards for the realization of SI units.

Maintain certificates of all reference standards, measuring equipment, or certified reference material used in ensuring traceability. Where traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence of correlation

of results, for example by participation in a suitable program of inter-laboratory comparisons or proficiency testing.

Reference standards, such as thermometers and weights, are traceable to a national or international standard (e.g., NIST).

5.6.2.1.1 Instrument Performance Evaluation

5.6.2.1.1.1 General calibration of laboratory instruments falls into two categories: 1) calibration which is conducted on a routine basis as part of the analytical procedure prior to each use; and 2) periodic, scheduled calibration of instruments and gauges against known standards to ensure the continuing precision and accuracy of such instruments.

5.6.2.1.1.2 All instrumentation must be demonstrably calibrated and evaluated for appropriateness before analysis is initiated. Divergence from acceptable benchmark criteria requires correction before analyses may be performed. The instrument performance evaluation material may be a standard spiked into the solvent used for analysis, but it is not extracted as if it were a sample.

5.6.2.1.2 Calibration

5.6.2.1.2.1 Generally, as applicable to the method, calibration curves are established for each parameter using known concentrations of standards. At least three different concentrations in non-interfering matrices, that span the range of expected sample values are analyzed and plotted. Generally, a correlation coefficient of better than 0.995 constitutes an acceptable calibration.

5.6.2.1.2.2 Method-specific calibration requirements are included in individual SOPs. In this case, the analytical method will take precedence.

5.6.2.1.3 Continuing Calibration

5.6.2.1.3.1 Prior to use each day, the initial calibration must be verified. Typically, one of the mid-point calibration standards are analyzed and the results are compared to the expected results. If the results fall within the method acceptance limits, then analysis can proceed. If the results are not within the acceptance limits, then the problem must be corrected prior to analysis of samples. Some methods require that samples be bracketed by valid opening and closing

calibration standards. When bracketing is required, only results between valid calibration verification standards can be used.

5.6.2.1.3.2 Reportable analytical results are those within the calibration range of the parameter. In general, values above the highest standard are not reported. The lowest reportable value is the MRL. Instrumental calibration will be verified either initially and during sample analysis or at a rate that the established method requires. The continuing calibration (may be substituted by the check standard) is made with standards independent from that used for instrumental calibration. The calibration check must agree within established limits with the calibration or the instrument is re-celebrated. Continuing calibration standards must agree within established limits of calibration. If not, the cause of the discrepancy is identified, corrected, and documented.

5.6.2.1.4 Initial Calibration Verification (ICV)

5.6.2.1.4.1 An ICV is a well-characterized material that is run, at a minimum, with each calibration. The material, which is obtained from a documented second source. In order to assess the performance of the method, the ICV is run in the same manner as the other calibration standards. If the results are not within acceptable limits, the source of the problem is evaluated. Continual failure indicates there is a problem with the system, the ICV standard or the calibration standards. Prior to analysis, the ICV must pass method criteria. A calibration check solution or sample material should be analyzed at least each day of analysis to demonstrate that calibration and standardization of instrumentation is within acceptable limits.

5.6.2.1.5 Calibration Policy

5.6.2.1.5.1 The calibration policies and procedures set forth in this section apply to all instruments requiring scheduled calibrations against traceable standards, including: analytical and test equipment in the laboratory, flow rate (e.g., rotometers), volume (e.g., dry gas meters), temperature measurement equipment, balances, weights, thermometers, pH meters, SRM's, etc.

5.6.2.1.5.1.1 The standards used in the laboratory measurement system will be calibrated against higher-level, primary standards having certified accuracy. NIST or other equivalently-recognized standardization will certify these higher-level standards.

5.6.2.1.5.3 Calibration standard reagents purchased from commercial vendors will be required to have a certificate of analysis. Whenever a certified, calibration standard is available from NIST, commercial vendors will be required to establish traceability of the certificate of analysis to the certified standard.

5.6.2.2 Testing

5.6.2.2.1 Uncertainty

Policy:
The requirements given in section 5.6.2.1 apply to measuring and test equipment with measuring functions used, unless it has been established that the associated calibration uncertainty contributes little to the total uncertainty of the test result. When this situation arises, the laboratory ensures that equipment used can provide the accuracy of measurement needed.

Details:
The extent to which the requirements in section 5.6.2.1 are followed depends on the relative contribution of calibration uncertainty to the total uncertainty. If calibration is the dominant factor, the requirements are strictly followed. If, however, calibration is not one of the major contributors to the total uncertainty, other ways for providing confidence may be used, as given in section 5.6.2.2.2.

5.6.2.2.2 Traceability

Policy:
Where traceability to SI units of measurement is not possible and/or not relevant, other means for providing confidence in the results are applied such as:

- the use of suitable reference materials certified to give a reliable characterization of the material
- mutual-consent standards or methods which are clearly specified and agreed upon by all parties concerned
- participation in a suitable program of inter-laboratory comparisons or proficiency testing

Details:
Reliable characterization involves an estimate of recovery.

The laboratory participates in proficiency testing and/or check sample programs. The list of programs is maintained by the Quality Manager.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

Policy:
The SOP# QSP 5-6-1 outlines the program for the calibration of reference standards. Reference standards are obtained or calibrated by a body that can provide traceability as described in section 5.6.2.1. Such reference standards of measurement held by the laboratory are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

Details:
Reference standards are obtained from ISO certified vendors], if applicable.

5.6.3.2 Reference Materials

Policy:
Where possible, reference materials are traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable.

Details:
Reference materials, including calibration standards, used in chemical measurement are prepared so that the point of measurement is similar or equivalent to that of the samples. The matrix, prior to the addition of the analyte does not have a detectable concentration of the analyte. Reagents used in the preparation of reference materials, including calibration standards are of certified purity.

5.6.3.3 Intermediate Checks

Policy:
Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials are carried out according to defined procedures and schedules.

Details and Procedures:
The control check standards used to verify the accuracy of all the other standards are prepared independently from all the other standards used to establish the original calibration. These control check standards are preferably prepared from a separate lot # or source. It is the responsibility of the Quality Manager to establish and maintain the individual schedule for each SOP and/or test method. In some cases, where the first two source standards agree but the results are called into question, then it may be appropriate to obtain an additional source for verifications.

5.6.3.4 Transport and Storage

Policy:
The SOP# QSP 5-6-1 outlines safe handling, transport, storage and use of reference standards and reference materials in order to prevent contamination or deterioration and in order to protect their integrity.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.7 Sampling

Section Synopsis

This section tells you:

1. There must be a sampling plan and procedure
2. Appropriate records of sampling are kept
3. Deviations, additions, and exclusions from the plan or procedure are recorded

Key Words

Sampling Plan and Procedure
Deviation, Addition, or Exclusion

Cross-references

ISO 17025:2005 Section 5.7

ISO 9001:2000 Section 4.2.4, 7.5.1

5.7.1 Sampling Plan and Procedures

Chemtech-Ford, Inc. Does not currently perform sampling.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.8 Handling of Test and Calibration Items

Section Synopsis

This section tells you to:

1. Keep samples in good condition.

Key Words

Identification
Receipt
Protection

Cross-references

ISO 17025:2005 Section 5.8

ISO 9001:2000 Section 6.3, 6.4, 7.1, 7.4.3, 7.5, 8.2.4

5.8.1 Procedures

Policy:
The SOP# QSP 5-8-1 outlines the procedures for the transportation, receipt, handling, protection, storage, retention and/or disposal of test and/or calibration items, including all provisions necessary to protect the integrity of the test or calibration item, and the interests of the laboratory and the customer.

Details:
Samples, reagents, and standards are stored so as to ensure their integrity by preventing against deterioration, contamination, and loss of identity. It is recognized that this is a general statement, but details are elaborated upon in SOP# QSP 5-8-1.

5.8.2 Identification of Test and/or Calibration Items

Policy:
Test and/or calibration items are systematically identified as they arrive at the laboratory. The identification is retained throughout the life of the item in the laboratory. The system is designed and operated so as to ensure that items cannot be confused physically, or when referred to in records or other documents. The system accommodates a sub-division of groups of items and the transfer of items within and from the laboratory when appropriate.

Details:
Sample labelling indicates the unique identification and conforms to applicable legal requirements. The laboratory has established and documents a system for appropriate chain-of-custody.

5.8.3 Receipt

Policy:
Upon receipt of the test or calibration item, any abnormalities or departures from normal or specified conditions, as described in the relevant test or calibration method, are recorded. When there is any doubt as to the suitability of an item for test or calibration, or when an item does not conform to the description provided, or the test or calibration required is not specified in sufficient detail, the laboratory consults the customer for further instructions before proceeding and keeps a record of the discussion.

The Chemtech-Ford sample acceptance policy is detailed in document QSP 5-8-3.

Details:
Conform to applicable regulations or contractual arrangements. The condition of sample may include or relate to damage, quantity, preparation, packaging, or temperature. Preparation may include addition of chemical preservative, removal of moisture, isolation of portion of sample to be tested, homogenization, or subsampling.

Procedures are in place to document that the elapsed time between sampling and testing does not exceed test method specifications (holding time) once the sample is received in the laboratory.

5.8.4 Protection

Policy:
The SOP# QSP 5-8-1 outlines the procedures and appropriate facilities for avoiding deterioration, loss or damage to the test or calibration item during storage, handling and preparation and testing; instructions provided with the item are followed. When items have to be stored or conditioned under specified environmental conditions, these conditions are maintained, monitored, and recorded. Where a test item is to be held secure (e.g., for reasons of record, safety or value, or to enable complementary test and/or calibrations to be performed later), the laboratory has arrangements for storage and security that protect the condition and integrity of the secured item concerned.

Details:
A sampling procedure and information on storage and transport of samples, including all information that may influence the test or calibration result, is provided to those responsible for taking and transporting the samples.

The laboratory establishes whether the sample has received all necessary preparation or whether the customer requires preparation to be undertaken or arranged by the laboratory. Proper requirements for packaging, environmental conditions, and separation from incompatible materials are observed. Where samples have to be stored or conditioned under specific conditions, these conditions are maintained, monitored, and recorded, where necessary.

Where a sample, or portion of a sample, is to be held secure (e.g., for reasons of record, safety, or value, or to enable check tests to be performed later), the laboratory has storage and security arrangements that protect the condition and integrity of the sample.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.9 Assuring the Quality of Test Results

Section Synopsis

This section tells you:

1. That results are monitored
2. There is a plan for monitoring

Key Words

Internal Quality Control
Statistical Techniques
Inter-laboratory Comparisons
Proficiency Testing
Certified Reference Materials
Secondary Reference Material
Replicates
Re-testing
Correlation

Cross-references

ISO 17025:2005 Section 5.9

ISO 9001:2000 Section 6.3, 6.4, 7.1, 7.2.1, 7.2.2, 7.3, 7.4.3, 7.5.1, 7.5.2, 7.5.3, 7.5.5, 8.1, 8.2.3, 8.2.4, 8.4

5.9.1 Quality Control / Quality Assurance

Policy:
Quality control procedures are utilized to monitor the validity of test and/or calibration results. These procedures are for each test method utilized in the laboratory. The resulting data are recorded so that trends are detectable (and where practicable, statistical techniques are applied to the reviewing of the results). This monitoring is planned and reviewed and may include, but not limited to, the following:

- regular use of certified reference materials and/or internal quality control using secondary reference materials
- participation in inter-laboratory comparisons or proficiency testing programs
- replicate tests or calibrations using the same or different methods
- re-testing or re-calibration of retained items
- correlation of results for different characteristics of an item

Details:
The methods utilized from the above list will be appropriate for the type and volume of the work undertaken. Records are maintained of assurance activities and any actions taken.

As a guide, for routine analyses the level of internal quality control is typically 5% of the sample throughput. For more complex procedures, 20% is not unusual and on occasions even 50% may be required. For analyses performed infrequently, a full system validation is performed on each occasion. This may typically involve the use of a reference material containing a certified or known concentration of analyte, followed by replicate analyses of the sample and spiked sample. For analyses undertaken more frequently, systematic quality control procedures incorporating the use of control charts and check samples are implemented. These procedures are documented in the "Quality Control Plan" of each test method.

Proficiency testing helps to highlight not only repeatability and reproducibility performance between laboratories, but also systematic errors such as bias. It is important to monitor proficiency testing results as a means of checking quality assurance and take action as necessary.

The QM maintains a list of all the current proficiency testing programs the laboratory participates in, monitors the results, and notifies the appropriate personnel of both problematic and successful results.

Technical personnel use certified reference materials and reference materials to evaluate test performance on a daily basis and include daily process control checks. These data are used to evaluate the validity of the test results.

Replicate tests may be used if suitable reference material is available. These materials and proficiency test materials are available for improving repeatability.

Re-testing of test items is performed occasionally at the discretion of the supervisor or when test results seem anomalous.

5.9.1.1 Quality Control Procedures

The determination of precision and accuracy is an important analytical tool in evaluating the quality of generated data. Precision is defined as the ability to reproduce a value within defined limits. Accuracy is defined as producing the correct answer. Different methods are employed to measure each of these parameters.

5.9.1.1.1 ***Precision*** - Utilizing duplicate samples and comparing their respective results is the primary method for the analysis of precision. However, it has no bearing on accuracy. A result may be precise and inaccurate at the same time. One duplicate sample is analyzed for each matrix type and method, and for each sample batch, or for each sample batch containing 20 samples, whichever is less. The relative percent difference (RPD) for each component is then calculated and compared to the acceptance limits for the matrix and method.

5.9.1.1.2 ***Accuracy*** - Utilizing matrix-matched standards of known concentration and comparing them to the analyte of interest is the primary method for measuring accuracy. Participation in independent Performance Evaluation (PE) studies is also utilized to monitor accuracy of data in the laboratory.

5.9.1.1.3 ***Reproducibility*** - The tracking of reproducibility ensures that analyses performed at different times or by different individuals may be acceptably reproduced. This demonstrates that the method, instrumentation, and analytical technique are resilient enough to reproduce results within a specified range over time.

5.9.1.2 Quality Control Samples

The quality control principles contained in this section will be implemented consistently, dependent upon the type of analysis to be performed and any

associated, specific requirements of such analysis. In addition, the analyst is to use his/her best judgment to evaluate the use of additional QC bracketing samples which have a difficult matrix, react differently, or have distinctive client or reporting requirements. The additional QC can take the form of additional spikes, standards, and/or SRM's. Sufficient QC should be performed to insure that the analyst has performed due diligence with regard to QC while analyzing the sample.

5.9.1.2.1 ***Matrix Spike and Matrix Spike Duplicate*** - Matrix spikes are employed to monitor recoveries and maintain extraction and/or concentration techniques at acceptable levels. Compounds of interest are added to samples prior to extraction and analysis. Compound recoveries and reproducibility are then compared with tables of acceptance for each method. The established acceptance ranges are contained in each method SOP.

5.9.1.2.1.1 This QC procedure provides information about the effect of the sample matrix on the analyte in question. Generally, a ratio of one spike sample for each ten samples for drinking water and for each twenty samples for RCRA and wastewater analyzed must be maintained. In the event that an analytical run will have less than ten samples one spike shall accompany the batch. The method SOP should be consulted to determine the proper frequency. Solutions used to fortify samples should, when possible, be made from a source other than that from which the calibration standards are made. Percent recovery of matrix spikes is determined using the following:

Percent Recovery = (SSR-SR)/SA x 100

Where:
SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

5.9.1.2.1.2 **Spike Recoveries** - Percent spike recoveries range between $\pm$3 standard deviations (SD) of the historical percent recoveries when method-specified criteria are not available. It is recognized that this will not always be achievable due to matrix effects. In that case, the data will be reported and an explanation made concerning the problem.

5.9.1.2.1.3 **Laboratory matrix spikes and matrix spike duplicates** must be prepared and analyzed for each ten samples for drinking water and for each twenty

samples for RCRA and wastewater analyses. This procedure provides information regarding the precision of an analysis. (These sample types are not always possible due to the type of analysis, for example pH.) The relative difference between duplicate measurements is assessed using the following equation:

Relative Percent Difference (RPD) = $|D_1-D_2|/ ((D_1 + D_2)/2) \times 100$

Where:

D_1 = Sample Value

D_2 = Duplicate Sample Value

5.9.1.2.2 ***Laboratory Control Spikes*** - Compounds of interest are added to reagent blank samples prior to extraction and analysis, as required by each method SOP. Compound recoveries and reproducibility are then compared with tables of acceptance for each method.

5.9.1.2.3 ***Duplicates and Spike Duplicates*** - Both routine sample analysis and spiked samples are run in duplicate at a prescribed frequency. The relative percent difference between duplicate sample analysis or duplicate spike analysis must range between $\pm$ 2 standard deviations (SD) of historical relative percent difference (RPD), when method-specified criteria are not available. It is recognized that this will not always be achievable due to matrix effects. If a matrix effect is confirmed, the data will be reported and an explanation concerning the problem will be noted on the final report.

5.9.1.2.4 ***Surrogates*** - Surrogate spike compounds of interest are added to each sample prior to extraction and analysis. Compound recoveries and reproducibility are then compared with tables of acceptance for each method.

5.9.1.2.5 ***Method and Reagent Blanks*** - Method blanks must be prepared with each batch of samples and analyzed to ensure that sample contamination has not occurred. If blank analyses do not fall within acceptable limits, as noted in the method specific SOP, a modification of method reagents or cleaning of glassware may need to be implemented before further analysis is attempted. In addition to method blanks, reagent blanks shall be prepared whenever the lot number of a reagent used in the analysis has changed.

5.9.1.2.6 ***Internal Standards*** - Internal standards will be prepared from a solution containing a known amount of analyte and will be traceable to a certified reference solution. Internal standard levels spiked into the sample for analysis

will be according to method SOP protocol. During analysis, internal standard intensities will be monitored and compared to the intensities established in the calibration blank. In general, intensities should be within 60 – 135% of the original response in the calibration blank, or as otherwise specified in the method SOP.

5.9.1.2.7 ***Quality Control Check Samples*** - Quality control check samples will be prepared from a solution containing a known amount of analyte and will be traceable to a certified reference solution. These solutions will be prepared from a solution that is "second source" in difference from the calibration standards/tuning standards. These solutions will be used to verify the stability of the analytical curve established for the current analytical run.

5.9.1.2.7.1 After calibration and calibration verification, continued calibration blanks (CCB) and continued calibration verification samples (CCV) will typically be analyzed after every 10 samples and at the end of every analytical run. Control limits during analysis of these solutions will be subject to the QA protocol as defined by the method SOP.

5.9.1.2.7.2 Quality control check samples will be used to verify the efficacy of the sample preparation procedure via the analyses of preparation blanks (PB) and laboratory control samples (LCS) derived from a certified reagent traceable to a certified reference material or solution. Laboratory control samples must agree within $\pm$ 2 standard deviations of the historical data base or no greater than $\pm$ 20 percent of the true value. Where method specific ranges exist, they may be used.

5.9.1.2.8 ***Calibration Standards*** - Calibration Standards will be prepared from a solution containing a known amount of analyte and will be traceable to a certified reference solution. Calibration standards will be prepared from a solution that is "second source;" that is, different from the continued calibration verification (CCV) solution.

These solutions are to be utilized for the calibration/tuning of analytical instruments at the beginning of an analytical run and to be used for tuning frequency as required by the method SOP protocol. These solutions are also used to evaluate method MDL's and effective quantitative ranges (linearity).

When required, these samples will be analyzed as samples with control limits as required by the method QA SOP protocol. Selection of appropriate

formulae to reduce raw data to final results is included in the method analyte SOP

5.9.1.3 Other Quality Control Measures

5.9.1.3.1 **Control charts** can be produced by analyte for the evaluation of QA/QC data. The charts are produced by the LIMS software.

5.9.1.4 Out-of-Control Situations

On occasion, a quality control sample may fail; i.e., the recovery for one or more specific analytes may lie outside the acceptable range (creating an "out-of-control" situation). This failure may or may not affect the acceptability of the analytical run and the quality of associated generated data. Quality control guidelines, contained in Chemtech-Ford, Inc.'s Data Validation and Acceptance Procedure, have been established to be used in the evaluation of out-of-control data for each analytical SOP

5.9.2 Correction and Prevention

Policy and Details:
Quality control data are analyzed and, where they are found to be outside pre-defined criteria, planned action is taken to correct and to prevent incorrect results from being reported.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.

5.10 Reporting of Results

Section Synopsis

This section tells you:

1. What needs to be on a report
2. How to handle amendments to reports

Key Words

Specific Information
Required Information
Interpretation
Opinion
Subcontractor
Electronic Transmission of Results
Format
Amendments

Cross-references

ISO 17025:2005 Section 5.10
ISO 9001:2000 Section 6.1, 6.3.1, 7.1, 7.2.1, 7.2.2, 7.4.3, 7.5.1, 7.5.4, 7.5.5, 8.2.4

5.10.1 General

Policy:
The results of each test, or series of tests are reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test methods.

The results are reported, normally in a test report and include all the information requested by the customer and necessary for the interpretation of the test results and all information required by the method used. This information may include what is outlined in section 5.10.2, 5.10.3 and 5.10.4.

Details:
Test reports are issued as either hard copy or by electronic data transfer.

5.10.2 Test reports and certificates

Policy:
Test reports include the following information, as appropriate:

- a title (e.g., " Certificate of Analysis")
- name and address of laboratory, and location where tests were carried out if different from the address of the laboratory
- Unique identification of the test report, and on each page an identification in order to ensure that the page is recognized as a part of the test report
- name and address of the customer
- identification of the method used
- Description, condition, and unambiguous identification of the item(s) tested.
- date of receipt of test items (where this is critical to the validity and application of the results) and date(s) of performance of the analysis
- reference to sampling procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results
- test results with, where appropriate, units of measurement
- the name(s), function(s) and signature(s) or equivalent of person(s) authorizing the test report
- where relevant, a statement to the effect that the results relate only to the items tested

Details:
Signing authority for test reports is the responsibility of the Lab Director. Records for individuals with signing authority for test reports are approved by the Quality Manager and maintained by same.

Analytical reports include the individual page number and total number of report pages (Page 3 of 16).

A statement is included specifying that the test report is not to be reproduced except in full, without written approval of the laboratory. Data reported to the customer contains the appropriate significant digits for each test method. Low level data are identified as being below specified limits and are flagged with a 'J' flag indicating a value found between the MDL and MRL.

5.10.3 Test Reports

5.10.3.1

Policy and Details:
In addition to the requirements listed in section 5.10.2, test reports include the following, where necessary for the interpretation of results:

- deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions
- where relevant, a statement of compliance/non-compliance with requirements and/or specifications
- where applicable, a statement on the estimated uncertainty of measurement of the test result; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when uncertainty affects compliance to a specification limit
- where appropriate and needed opinions and interpretations (see section 5.10.5)
- additional information required by specific methods, customers, or groups of customers

5.10.3.2

Policy and Details:
In addition to the requirements listed in sections 5.10.2 and 5.10.3.1, test reports containing the results of sampling include the following, where necessary for the interpretation of test results:

- date of sampling
- unambiguous identification of substance, matrix, material or product sampled (including name of manufacturer and lot number as appropriate)
- location of sampling
- reference to sampling plan and procedures used
- details of any environmental condition during sampling that may affect the interpretation of the test results
- any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

5.10.4 Calibration Certificates

5.10.4.1

Policy:
The testing laboratory does not issue calibration certificates. However, the laboratory often receives calibration services from a calibration laboratory and needs to be familiar with the information on a calibration certificate.

Details:
In addition to the requirements listed in 5.10.2, the calibration certificate could include the following, where necessary for the interpretation of calibration results:

- the conditions (e.g., environmental) under which the calibrations were made that have an influence on the measurement results
- the uncertainty of measurement and/or a statement of compliance with an identified metrological specification or clauses thereof
- evidence that the measurements are traceable (see 5.6.2.1.1)

5.10.4.2

Policy:
This section is not applicable to a testing laboratory.

5.10.4.3

Policy:
This section is not applicable to a testing laboratory.

5.10.4.4

Policy:
A calibration certificate (or calibration label) shall not contain any recommendation on the calibration interval except where this has been agreed with the customer or it is to be used by the laboratory itself.

5.10.5 Opinions and Interpretations

Policy:
When opinions and interpretations are included in the test report, the basis upon which the opinions and interpretations have been made is documented. Opinions and interpretations are clearly marked as such in the test report.

Note - Opinions and interpretations should not be confused with inspections and product certifications as intended in ISO/IEC 17020 and ISO/IEC Guide 65.

Details:
Opinions and interpretations included in a test report may comprise, but not be limited to the following:

- opinion on conformity of the results with requirements
- fulfilment of contractual requirements
- recommendations on how to use the results
- guidance to be used for improvements

In many cases it is appropriate to communicate the opinions and interpretations by direct dialogue with the customer.

5.10.6 Testing and Calibration Results Obtained from Subcontractors

Policy and Details:
Test reports containing the results of tests performed by subcontractors are clearly identified for the subcontracted results. The subcontractor reports the results either in writing or electronically to our laboratory.

5.10.7 Electronic Transmission of Results

Policy:
In the case of transmission of test results by telephone, facsimile or other electronic or electromagnetic means, the requirements of the policies and procedures of this Quality Manual continue to apply (see also 5.2.7.1.2).

Details:
Signatures are recorded on file at the laboratory. Clients may request a hardcopy example of signatures.

5.10.8 Format of Reports

Policy:
The format of reports is designed to accommodate each type of test carried out and to minimize the possibility of misunderstanding or misuse.

Details:
The layout of the test report is such that the presentation of the test data facilitates ease of assimilation by the reader.

5.10.9 Amendments to Reports

Policy:
Material amendments to a test report after issue are made only in the form of a further document, or data transfer, which includes the statement "Amended Report". Such amendments meet all the requirements in this Quality Manual.

Details:
When it is necessary to issue a complete new test report, it is uniquely identified and contains a reference to the original that it replaces. A narrative accompanies the amended report which details the changes in the report as well as justifications for the change. Details for producing an amended report are located in document QSP-5-10-9.

Revision History

Changes from Revision 24
Revision 25 is a significant revision with numerous additions, deletions and corrections. These are not all documented in the revision history, rather all persons on the distribution list are required to read the entire document.