



CLOSURE PLAN: STATE TRUST LAND

RED BLUFF NO. 1 APE Abandoned Uranium Mine Cleanup Program McKinley County, New Mexico

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ABBREVIATIONS AND ACRONYMS

AML	Abandoned Mine Lands
APE	Area of Potential Effect
AUM	Abandoned Uranium Mine
BA/BE	Biological Assessment/Biological Evaluation
Bgs	Below Ground Surface
Bi-214	Bismuth-214 Isotope
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cm	Centimeters
cpm	Counts per Minute
cps	Counts per Second
CR	Cultural Resources
CY	Cubic Yard
DOT	Department of Transportation
DPT	Direct Push Tooling
EMNRD	Energy, Minerals & Natural Resources Department Mining
FY	Fiscal Year
ICP	Inductively Coupled Plasma
Km	Kilometer
MARP	Mining Act Reclamation Program
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
Mi	Mile
MMD	Mining and Minerals Division
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMSLO	New Mexico State Land Office
NOI	Notice of Intent
NORM	Naturally Occurring Radioactive Material
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
O&M	Operation and Maintenance
OSI	Office of Strategic Initiatives
Pb-210	Lead-210 Isotope
pCi/g	Pico curie per gram
pCi/m ² /s	Pico curie per meter squared per second
PRRL	Post-Reclamation Radiation Level
Ra-226	Radium-226 Isotope
RFP	Request for Proposal
RO	Reclamation Objective
ROCs	Radionuclides of Concern
SAP	Sampling and Analysis Plan
Sec.	Section
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
U	Uranium
U-238	Uranium-238 Isotope



Closure Plan: State Trust Land Parcel
Red Bluff No. 1 APE
Grants, NM

$\mu\text{R/hr}$	Micro Roentgen per hour
USEPA	United States Environmental Protection Agency
V	Vanadium

1.0 INTRODUCTION

This Closure Plan has been developed by ENTACT, LLC (ENTACT) to summarize the proposed design and reclamation plan for the New Mexico (NM) State Trust land parcel in the Red Bluff No. 1 (RB1) Area of Potential Effect (APE), located in McKinley County of the Grants Mining District. This Plan has been developed to meet the Stage 3 requirements of the Red Bluff No. 1 Abandoned Uranium Mine (AUM) Cleanup initiative under contract #26-667-2030-00005 with the State of New Mexico, New Mexico Environment Department (NMED).

This project is being performed under the New Mexico Legislative Appropriation for fiscal year 2026 (FY26), authorized by House Bill 2 (2025 Legislative Session), which is the New Mexico Uranium Mine Cleanup Initiative targeting abandoned uranium mine sites with no viable responsible party.

1.1 Oversight and Responsibilities

The NM Environmental Department (NMED) Office of Strategic Initiatives (OSI) is the regulatory body administering the reclamation program in collaboration with the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) Mining Act Reclamation Program (MARF) and Abandoned Mine Lands (AML) Program.

ENTACT is responsible for consulting and contracting services as outlined in the Abandoned Uranium Mine Cleanup in the Grants Mining District Request for Proposal Specifications and Detailed Scope of Work (dated April 22, 2025).

Land parcels within the RB1 APE include NM State Trust lands, managed by the NM State Land Office (SLO), federal land managed by the U.S. Department of the Interior Bureau of Land Management (BLM), and private landowners, AK1, LLC, and the Marquez family, as identified from title searches of the parcels and shown in Drawing G-100 attached. This Plan addresses remediation and reclamation activities for closure of AUMs on the SLO State Trust land parcel only.

1.2 Location and APE Sites

The RB1 APE is located approximately 19.3 km (12 mi) northwest of the city of Milan in McKinley County. More precisely, it is located approximately 1 mile northwest of the intersection of New Mexico State Highway 605 (formerly 334) and County Road 23. The northern and a portion of the eastern boundary of the APE runs along an existing fence line that parallels County Road 23. The western boundary of the APE is an existing fence line that extends north and south. The southern portion of the APE has a natural boundary of cliffs.

The RB1 mine is an abandoned uranium mine with the primary mine site located on the State Trust land parcel (PM23 T13N R10W, NE1/4 NE1/4 of Sec. 36) managed by NMSLO. Residual materials remaining from mining operations extend onto private property (AK1, LLC, private land parcel) to the east. The State Trust land parcel is approximately 7-acres and located in the southwestern portion of the APE and comprises the top and side slopes of a mesa outcropping. The existing topography is shown in Drawing G-102 attached. The State Trust land parcel has an existing three-strand barbed-wire fence that separates it from the private land parcels (Marquez and AK1, LLC) located to the east and north within the RB1 APE.

Access to the RB1 State Trust land parcel is limited. The APE can be reached by traveling approximately 1 mile northwest on County Road 23 to an existing gate on the Marquez private land parcel in the northeast portion of the APE. To proceed to the State Trust land parcel, equipment/vehicles must traverse a private access road for approximately 0.5 miles across the Marquez and AK1, LLC private parcels.

1.3 Conditions and Background

The APE Mines (i.e., Red Bluff No.1, Roundy Shaft, Roundy Manol Strip, and Haystack Section 31) are abandoned uranium mines located on state and private land, both of which are fenced. Approximate mine locations are shown in Figure 1 attached. The mines cover an area of approximately 53 acres on private land in a northwest to southeast direction in the middle of the APE (Sundance Consultants, LLC, 2025), and 7 acres encompassing most of the State Trust land portion of the APE. As part of the mining operations, approximately 58 waste rock piles are located throughout the APE. Both the waste rock piles and the open pit mines have been overgrown with native and non-native plant species. Debris associated with the mine workings is present on site and consists of sanitary cans, bottles, equipment fragments, filters, pieces of equipment, lumber, signage, as well as general trash and debris.

1.3.1 Mine History and Site Features

The Red Bluff No.1 mine is an abandoned uranium surface mine located on State Trust land, which is fenced. There is limited information available about the mine. Records indicate that the Red Bluff No.1 Mine operated between 1952 and 1962, producing both uranium (U) and vanadium (V). Approximately 1,435 tons of ore were mined from the Todilto Limestone formation. No other extant records were uncovered that would shed light on mine operations.

Surface mining is a method of extracting the uranium ore by removing overlying soil and rock near the Earth's surface. Two common methods of surface mining are strip mining and open pit mining, where strip mines are often long shallow strips, and open pits are wider and typically deeper. Surface mining covers an area of approximately 4.9 of the 7 acres on the State Trust land portion of the APE. As a result of the mining operations, waste rock piles are located throughout the property and adjacent to the strip mines/open pits. Both the waste rock piles and the open pits have been partially overgrown with native and non-native plant species. Debris associated with mining activities is also present on the State Trust land portion of the APE and consists of sanitary cans, bottles, equipment fragments, filters, pieces of equipment, lumber, signage, and general trash and debris.

1.3.2 Ecological, Historical, and Archaeological Setting

During the Stage 1 Site Assessment activities, a biological assessment and evaluation as well as a cultural resource inventory were performed by a third-party team, Sundance Consultants, LLC, and Resi Solutions.

A Biological Assessment/Biological Evaluation (BA/BE) was performed as part of the Stage 2 investigation (Sundance, 2025). During the BA/BE, 47 plant genera and species were identified. Seven non-native species of noxious weeds were observed, along with 12 bird species, 1 mammal, and 3 reptile sightings. The activities planned under the Proposed Action will cause some disturbance in the APE, but they are not likely to impact federally or state-listed species and other sensitive species. After conducting analyses

of the habitat needs and species-specific concerns, adverse effects to these species are highly unlikely. No wetlands were identified (Sundance, 2025). The surveys indicate the absence of sensitive species or habitats within the APE. Based on these considerations, the reclamation activities are anticipated to proceed with no restrictions other than a pre-construction nesting survey to reduce the potential of impacts to migratory birds, as provided in the BA/BE (Sundance Consultants, LLC, 2025).

A Cultural Resource (CR) Inventory was also performed across the entire APE as part of the Stage 2 investigation (Resi Solutions, 2025). The inventory identified 120 cultural resources within the APE, including 19 newly recorded sites and 101 isolated manifestations. CR sites exist within and adjacent to the proposed reclamation limits. Based on the results of the archeological survey, it was concluded that five CR sites in the APE warrant listing in the National Register of Historic Places (NRHP) for their research potential related to pre-contact components. One CR site is recommended as Unevaluated for NRHP. In total, seven CR sites are recommended for avoidance during construction activities, as shown on Drawing G-101. The State Trust land includes portions of the LA20759 recorded site, which was determined to not be eligible for listing on the National Register of Historic Places and no further management is recommended for the CR site (Resi, 2025). CR sites will be demarcated with orange fencing to prevent trespassing during the reclamation field activities.

1.3.3 Geology and Hydrology

Surface Geology

The geology of the APE is upper and middle Jurassic rocks that are widely distributed and include sedimentary, igneous, and metamorphic rocks. Middle Jurassic rock has a range of shallow-marine, fluvial, and deltaic settings, with significant carbonate and clastic sedimentation. In the western United States, upper Jurassic rock, particularly the Morrison Formation, is a clastic deposit of lacustrine and fluvial mudstone, siltstone, sandstone, and conglomerate. The APE is relatively flat with a few small hills. Several drainage areas showed significant erosion. The State Trust land, in the southern corner of the APE, has a granite rock outcrop (Vessilla complex) and a sandstone cliff face (Sundance Consultants, LLC, 2025).

Four soil classifications are present at the Project Area: Penistaja-Tintero complex, Todest fine sandy loam, Uranium mined lands, and rock outcrop - Vessilla complex. The Todest series of soils consist of moderately deep to limestone, well drained, moderately permeable soils on dip slopes of cuestras with slopes of 2 to 8% (EA Engineering, Science, and Technology, Inc., 2026). Penistaja series consists of very deep, well drained, moderately permeable soil that is formed in mixed alluvium, fan alluvium, slope alluvium and controlled landscapes where slopes range from 35 to 70%.

Hydrogeology

The APE is located in the San Mateo Creek Basin, which is part of the larger structural San Juan Basin. Aquifers within the San Juan Basin are primarily artesian based on the regional geologic structure. The major component of groundwater flow is through sandstone of relatively higher permeability than adjacent units. Finer grained units, including mudstones, shales, and silts, act as confining units [(Stone, 1983), (New Mexico Environment Department, 2008)].

Surface Water

The APE displays notable erosional features consisting of drainages that may have been excavated during mining operations, which now receive runoff from the surrounding terrain. Debris piles adjacent to these

drainages were an indication of past disturbance. Periodic heavy runoff has eroded the sand channel walls and created shallow canyons. Runoff occasionally accumulates in low areas located at the bottom of the channels.

Groundwater

Site-specific geologic observations and nearby domestic well records indicated that the geology and hydrogeology follow regionally observed patterns. Groundwater in the region generally flows with the dip of the lithology to the northeast in the San Mateo Creek Basin (U.S. EPA, 2018). The shallowest aquifer in the vicinity of the APE is the Wingate Formation, which is stratigraphically beneath the cliff forming Entrada Formation. Based on nearby domestic wells, local saturation of the Wingate Formation likely begins at a depth of approximately 280 feet below ground surface (bgs).

The top of the Wingate Formation is approximately 200 feet bgs adjacent to the “Boomerang” pit in the northwestern region of the APE. The Wingate Formation is therefore expected to be dry under most of the APE. Additionally, the Entrada Formation, Medial Silty Member, likely acts as the confining unit locally and is located at a depth of approximately 150-200 feet bgs adjacent to the “Boomerang” pit. Future work is planned to confirm the geology.

1.3.4 Land Use

The overall APE is ranchland used exclusively for cattle grazing. The surrounding area is also ranchland. The closest occupied residence is less than a mile away on private land. The APE lands may also be used for recreational purposes, specifically with the public in the State Trust land rocky outcropping portion.

There is no anticipated change in land use post-reclamation. NMSLO will continue to manage land use authorizations and leases for State Trust land.

2.0 SITE ASSESSMENT AND INVESTIGATION

ENTACT conducted the Red Bluff No. 1 APE Site Assessment (Stage 1) and Investigation (Stage 2) in accordance with the NM AUM Cleanup Detailed Scope of Work (dated April 22, 2025). Field activities to support the assessment and investigation were performed between August 2025 and January 2026. A summary of the assessment and investigation activities is provided below.

2.1 Site Characterization Activities

ENTACT performed site characterization that consisted of a site radiological walkover survey, and radioactive characterization sampling and analysis activities to characterize the radioactive material concentrations in soil and rocks to support reclamation design and ultimate AUM closure. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) area classifications (i.e., Class 1, Class 2, Class 3) (USEPA, 2001) and other areas requiring sampling bias were determined based upon the results of the gamma radiation level walkover survey (ENTACT, LLC, 2025a). This sampling plan was MARSSIM compliant.

Given its prior use as a uranium mine, multiple radionuclides were expected to be present in the soils and rocks at the Site. Gamma spectroscopy was used to identify and quantify them in the samples collected.

The selected analytical laboratory, Eberline Analytical Corporation (Eberline), used the gamma spectroscopic method Environmental Protection Agency (EPA) Method 901.1 Modified on all samples collected at the Site. The radionuclides reported are the gamma emitting progeny in the uranium-238 (Thorium-234, Radium-226, Lead-214, Bismuth-214 and thorium-232 (Radium-228, Actinium-228, Lead-212, Thallium-208) decay chains, and Potassium-40.

Some of these radionuclides, like U-238, are difficult to detect, while others, like bismuth-214 (Bi-214), are readily detectable with a variety of instrument types.

When a consistent mixture of radionuclides is present in an area, MARSSIM allows planners to select and use one radionuclide as a surrogate for all the radionuclide in the mixture to simplify calculations and remove duplication. In this mixture, thorium-234 (Th-234) is an easily detected surrogate for U-238 and either lead-214 (Pb-214) or Bi-214 is an easily detectable surrogate for Ra-226. Surrogates detected in samples acquired under this plan are reported as the isotope for which they are the surrogate for (i.e., Bi-214 was used as a surrogate for the Ra-226 activity and is reported as a Ra-226 concentration). Using Bi-214 as a surrogate for Ra-226 is permissible given proper sample hold times to allow for radon ingrowth.

Geologic considerations influenced the target depth of the samples, and a geologist was consulted as needed. The sampling activities were conducted, where possible, using a tracked Geoprobe™ - type direct push tooling (DPT) rig equipped with a 3" DT45 Geoprobe Dual Tube sampling system with MC7 liners. The Geoprobe proceeded to each marked borehole location and continuous soil cores were collected and logged. When the planned location could not be safely reached, the hole location-adjusted in consultation with an ENTACT Health Physicist as needed. At each boring location, the soil core was advanced through overburden fill and surface deposits, terminating at a maximum depth of 5 feet below ground surface or at bedrock, whichever was encountered first. If refusal was met, the borehole location was sometimes offset at the discretion of an ENTACT Health Physicist. The DPT rig was checked for contamination between borings and was decontaminated as needed.

Each sample borehole was logged to collect gamma radiation levels from the top 6 inches of soil and each additional 6-inch depth to acquire a depth profile of the radioactive materials in the soil and rock. The extracted sample core was taken to an area of the APE exhibiting a near-background ambient gamma radiation level and scanned to collect the gamma radiation profile along its length. The borehole log and core scan data was compared to select which depth layers to collect from the core for gamma spectroscopic analysis.

ENTACT utilized Eberline, which uses High Purity Germanium (HPGe) gamma spectroscopic systems capable of detecting minute amounts of gamma-emitting radioisotopes in various media. While their specific arrangement of equipment is proprietary, Eberline has demonstrated their systems perform well for the detection of radium and uranium in the quantities expected at the Site.

The field data (soil screening data, survey data, etc.) was recorded in bound logbooks with numbered pages and/or in electronic formats, such as Microsoft Word or Excel applications. Field data documents the date, location, sampler's full name and initials, sample IDs, and any anomalies related to the Sampling Plan. Paper records are maintained for future reference. Electronic files are maintained on a company-based cloud server for security and back-up/redundancy.

Analytical results were transmitted from the laboratories to ENTACT in an Excel spreadsheet or an equivalent, compatible format such as a comma-delimited file. Results were stored electronically. The laboratory reports and validation packets are maintained on the ENTACT cloud-based system and will be made available to NMED upon request.

The analytical results were used to plan remediation action in compliance with the 5/15 pCi/g standard remediation criteria (i.e., no more than 5 pCi/g above background in the top 15 cm (6-inches), and no more than 15 pCi/g above background for all depths below at 15 cm (6-inch) increments).

2.2 Summary of Findings – Exposure Pathways

2.2.1 Exposure Pathways

The conceptual exposure model identified in the State Trust land Alternatives Analysis (ENTACT, 2026), depicted the media and potential exposure pathways. The model traces common routes that environmental Naturally Occurring Radioactive Materials (NORM) or Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) may take in the local environment and identifies potential exposure mechanisms and routes that may result. Each complete exposure pathway evaluated was:

- a source (e.g., soil)
- an exposure mechanism (e.g., direct contact, food from local gardens)
- an exposure route (e.g., inhalation, ingestion)
- a potential receptor (e.g., resident or recreational user)

For some exposure pathways to be complete, additional elements are required, such as a release mechanism (e.g., wind, erosion) and/or a transport mechanism (e.g., root uptake). If any required element is missing, the exposure pathway under consideration is incomplete and no exposure can occur.

The basis for identifying complete exposure pathways from Radionuclides of Concern (ROCs) detected on the APE include the following assumptions:

- Currently, the land within the study area is partially vegetated, contains no homes or other structures, and is used primarily for cattle grazing.
- Surface water runoff within the study area is ephemeral and currently channeled to existing ditches and arroyos.

An exposure route describes how a ROC is delivered to the receptor. Generally, radiological exposures are divided into two types: direct external exposures and internal exposures.

Direct external radiation exposures occur when a person is irradiated by an external source. Exposures of this type do not require physical contact and can occur when a person is near gamma-emitting radionuclides. Increasing the distance between a radiation source and the receptor reduces the intensity of the radiation field at the point of exposure (the magnitude of exposure is inversely related to the distance of the receptor from the source). Direct radiation exposures can also be reduced when shielding, such as soil or water, is placed between the receptor and the source of radioactivity. Sources of direct

exposure may include gamma-emitting ROCs contained in soil, settled dust, surface water, and sediment, as well as in airborne particulates from disturbed soil or dust.

Internal radiation exposures occur when ROCs are introduced directly into the human body through, for example, inhalation, and inadvertent or intentional ingestion of soil, crops, or water. Once inside the body, these ROCs could irradiate organs and tissues. Based on their low permeability through human skin, dermal absorption of these ROCs through the skin was not considered to be a complete exposure pathway.

Several examples of potentially complete, media-specific exposure routes to be evaluated are presented below:

- **Soil:** A receptor can be exposed to radioactive materials in soil or rock via direct external radiation. In addition, a receptor may come into physical contact with soil or soil particulates in air and be internally exposed to ROCs via ingestion or inhalation. Also, a receptor can indirectly consume radioactive materials in soil via root uptake by fruits and vegetables, or by consuming the flesh of an animal that consumed the potentially contaminated plant matter.
- **Sediment:** A receptor may come into physical contact with sediment while on the APE and be internally exposed to ROCs via ingestion. As with other media, a receptor can be exposed via direct external radiation to radioactive materials in sediment. However, the sediment may also provide shielding between ROCs and a receptor.

There may be more than one complete exposure pathway for a hypothetical receptor. An example of a receptor with the potential to be exposed via multiple pathways is a recreational receptor who infrequently spends time within the APE. Potential complete pathways to a recreational receptor may include:

- **Inhalation:** Resuspension of soil.
- **Direct radiation:** Proximity to soil, sediment, or settled dust; submersion in air or surface water during recreation.
- **Ingestion:** Incidental or intentional ingestion of soil, sediment, or resuspended soil.

2.2.2 Radiological Walkover Survey

ENTACT's 2025 APE gamma walkover survey results were used to assign preliminary MARSSIM classifications to regions of the APE surface based on presumption of impacts, which is to be confirmed as removal is being performed during reclamation activities. The MARSSIM classification system has three categories: Class 1 (Impacted), Class 2 (Potentially Impacted) or Class 3 (Non-Impacted). The class descriptions were then utilized to guide development and implementation of ENTACT's 2025 Radiological Sampling and Analysis Plan (SAP) (ENTACT, LLC, 2026b).

Over 500,000 data points were collected during the 2025 ENTACT APE gamma walkover field survey (ENTACT, LLC, 2025a), and the median background count rate was statistically determined to be 17,000 counts per minute (cpm), which correlated to an exposure rate of 14.45 $\mu\text{R/hr}$ (See Equation in Table 2). The field survey cpm values are the measured values as recorded in counts per second (cps) and multiplied

by 60 to convert the time unit (See Equation in Table 2). The highest recorded exposure rate, as measured with the Ludlum Model 19, was 1,100 $\mu\text{R/hr}$. The lowest exposure rate, as measured, was 10 $\mu\text{R/hr}$.

2.2.3 Radiological Sampling and Analysis

Twenty samples were collected from the top 1.5 feet (approximately three 15 cm layers) from the background region, which was selected within one of the MARSSIM Class 3 areas exhibiting gamma radiation levels at or near the statistically determined background of 17,000 counts per minute (cpm) from the 2025 ENTACT gamma walkover (ENTACT, LLC, 2025a). The highest gamma radiation level detected within the chosen background region was 17,460 cpm. Radiological background soil concentrations in the samples collected from this designated background region average to 1.56 pCi/g radium-226 (Ra-226) with a standard deviation of 0.18 pCi/g Ra-226, which is similar to the 2 pCi/g Ra-226 estimated background at the nearby Schmitt Decline (EA Engineering, Science, and Technology, Inc., PBC, December 2025) and the 1.6 pCi/g Ra-226 average background at Old Church Rock Mine in the Eastern Abandoned Uranium Mine (AUM) Region of the Navajo Nation near Gallup, McKinley County, New Mexico (Tetra Tech, 2023).

Analytical sample data was validated, moisture corrected, and outlier screened as discussed in the ENTACT Red Bluff No. 1 and Roundy Characterization Report (ENTACT, LLC, 2026d). The resultant data set shows Ra-226 activity concentrations across the APE to vary from 0.22 pCi/g to a maximum of 426.82 pCi/g. The median activity concentration is 2.14 pCi/g with a standard deviation of the median of 1.46 pCi/g.

A correlation was developed to convert the 1.56 pCi/g background combined with the 5 pCi/g and 15 pCi/g remediation screening limits into cpm for direct comparison to the collected borehole logging data (See Equation in Table 2). This comparison revealed that fewer than 8% of the sample locations exceeded the 5 pCi/g + background on the surface and fewer than 3% of the sample location exceeded the 15 pCi/g + background below the first 15-cm layer.

An additional correlation was developed to convert the 1.56 pCi/g background combined with the 5 pCi/g and 15 pCi/g remediation screening limits into cpm using the collected gamma walkover data (See Equation in Table 2). The resultant correlation defined the screening criteria to ensure the site post-reclamation radiation level (PRRL) discussed below is met. A small conservative margin of 3% was applied to ensure all potentially impacted material is captured by the screening criteria given the random nature of radiation emission and detection. The screening criteria are as shown in Table 1.

Table 1. Surface Gamma Scanning Clearance Criteria

Surface Gamma Scanning Clearance Criteria	
5 pCi/g + background for removals from 0-15 cm depth (0-6 inches)	75,134 cpm
15 pCi/g + background for removals from >15 cm depth (> 6 inches)	200,134 cpm
Surface Gamma Scanning Clearance Criteria As Applied	
5 pCi/g + background for removals from 0-15 cm depth (0-6 inches)	73,000 cpm
15 pCi/g + background for removals from >15 cm depth (> 6 inches)	194,000 cpm

The surface gamma scanning clearance criteria in Table 1 above were applied to the gamma walkover data to delineate the known characterized limits above the surface scanning criteria, as shown in Figure 3.

Table 2. Site-Specific Unit Conversion and Correlation Equations

Site-Specific Unit Conversion and Correlation Equations		
Purpose	Equation	Equipment
Conversion of counts per second (cps) to counts per minute (cpm)	$\text{cpm} = \text{cps} * 60$	cps: ERG Rad Scout paired with Ludlum 3001 & 44-10 walking at ~0.5 m/s
Correlation of gamma walkover data (cpm) to 1-meter exposure rate ($\mu\text{R/hr}$)	$\text{uR/hr} = \text{cpm} * 0.0011 - 3.704$	cpm: ERG Rad Scout paired with Ludlum 3001 & 44-10 @ 1-ft above ground surface standing still (converted to cpm) average meter response $\mu\text{R/hr}$: Ludlum Model 19 @ 1-meter above ground surface average meter response
Correlation of borehole log (cpm) to Ra-226 soil activity concentration (pCi/g)	$\text{pCi/g} = \text{cpm} * 0.0005 - 0.1536$	cpm: Ludlum 2221 & 44-2 1-minute integrating count per 15cm layer pCi/g: Eberline HPGe 1-hour count per sample after 21-day Rn-222 ingrowth
Correlation of average gamma walkover data within 10-ft radius of sample point (cpm) to surficial Ra-226 soil activity concentration (pCi/g)	$\text{pCi/g} = \text{cpm} * 0.00008 + 0.6273$	cps: ERG Rad Scout paired with Ludlum 3001 & 44-10 @ 1-ft above ground surface walking at ~0.5 m/s (converted to cpm) pCi/g: Eberline HPGe 1-hour count per sample after 21-day Rn-222 ingrowth

2.3 Reclamation Objectives

Reclamation objectives (ROs) consist of media-specific goals for protecting human health and the environment that specify exposure pathways, including exposure routes and receptors, and acceptable radiological concentrations or radiological concentration ranges for each exposure pathway. The following three ROs were developed for the APE:

1. **Soils (RO1):** Reduce surface exposure consistent with the 2016 Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico:
 - (1) The concentration of Ra-226 in land averaged over any area of 100 square meters (m^2) shall not exceed the background level by more than -
 - (a) 5 pCi/g averaged over the first 15 cm of soil below the surface, and
 - (b) 15 pCi/g averaged over 15 cm thick layers of soil more than 15 cm below the surface.
 - (2) Site post-reclamation radiation level (PRRL) for gamma radiation should not exceed the site-specific value of gamma radiation that correlates to 5 pCi/g Ra-226 above background.

2. **Surface Water (RO2):** Divert/Reduce migration of surface water through exposed ore body, open pits, and waste rock piles.
3. **Groundwater (RO3):** Reduce potential impact of surface water to groundwater through exposed ore body, open pits, and waste rock piles.

2.4 Alternatives Analysis – Selected Remedy

ENTACT developed an Alternatives Analysis Report (dated March 27, 2026) (ENTACT, LLC, 2026a) for the Red Bluff No. 1 State Trust land parcel within the Red Bluff No. 1 APE. The report presented five alternatives: 1 – No Action, 2 – Off-Site Milling, 3 – Off-Site Disposal, 4 – Burial on State Trust Land, and 5 – Burial on Private Land.

The alternative selected by NMED and SLO was Alternative # 3: Off-Site Disposal. This remedy includes the removal of up to an estimated 1,700 CY (estimated between 2,500 to 2,800 tons) of waste rock on the State Trust land resulting from the Red Bluff No. 1 Mine and subsequent load-out for transportation and disposal off-site at the following facility:

Clean Harbors Deer Trail Landfill
108555 East Highway 36
Deer Trail, CO 80105
Phone: 970-386-2293
EPA ID: COD991300484

A copy of the facility's current radioactive materials license is provided as Appendix 3. Final acceptance by the disposal facility will be required.

The selected reclamation alternative will satisfy RO1, RO2 and RO3 for the RB1 State Trust land and will support the soil RO (RO1) through removal of impacted surface waste rock to reduce potential direct contact or exposure at the surface. The selected alternative will support the surface water and groundwater ROs (RO2 and RO3, respectively) by reducing the amount of waste rock piles exposed to precipitation and surface water run on, which could then infiltrate into groundwater.

3.0 RECLAMATION DESIGN

3.1 Regulatory Framework

The Red Bluff No. 1 APE is being managed under the State of New Mexico Abandoned Uranium Mines cleanup initiative authorized under House Bill 2 of the 2025 Legislative Session. Since the neglected mines within the Red Bluff No. 1 APE were operational prior to January 1, 1970, the New Mexico Mining Commission in Title 19, Chapter 10 of the New Mexico Administrative Code (NMAC 19.10), are not legally applicable. However, the NMMD and the NMED 2016 Joint Radiological Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico, is being utilized as a guide. Additionally, the NMED RFP (NMED, 2025) directed the site assessment process to follow a CERCLA-like process.

As such, without a directly applicable regulatory framework, NMED and EMNRD are overseeing the project through application of principles developed by other associated state and federal programs.

Permits to be obtained during site planning and preparation activities will include the following:

- McKinley County right-of-way permit to construct a new entrance with culvert and gate off of County Road 23 to access the State Trust land
- NM One-Call (811)
- NMED Ground Water Quality Board Notice of Intent (NOI) to Discharge
- USEPA Region 6 NPDES Construction General Permit electronic NOI

The U.S. Department of Transportation (DOT) shipping requirements for radioactive material under 49 CFR regulations were reviewed for off-site transportation of the waste. It was determined that the off-site shipment of waste rock from the State Trust land is not considered a DOT-regulated hazardous material. The basis of this determination is as follows: 1) The waste rock is considered unprocessed uranium ore. 2) As indicated in 49 CFR 173.401(b)(4), a 10x multiplier is allowed to be applied to activity concentrations for consideration of the exemption under 49 CFR 173.436. 3) The uranium and associated decay progeny concentrations are below 10x the 49 CFR 173.436 as applied in a sum of fractions (SOF) calculation in compliance with 49 CFR 173.433, and therefore, is exempt from the DOT requirements for Class 7 material. 4) In addition, all radionuclide consignment activities are below the 49 CFR 172.101 Appendix A "Lists of Hazardous Substance and Reportable Quantities" table values. Therefore, this material is unregulated by DOT.

3.2 Climate Change Evaluation

In accordance with the RFP package and Section 3.3 of New Mexico Executive Order 2019-003, the reclamation project has been evaluated for the impacts of climate change on the selected remedy. Factors to be considered are identified as drier climate and increased rainfall frequency and intensity challenges related to vegetation reestablishment. The list of impacts to be considered are:

- Lower streamflow and recharge because of increased aridity
- Greater inter annual variability in precipitation
- Hotter, more severe droughts
- Decreasing snowpack; earlier and diminishing snowmelt runoff
- Greater demands on groundwater
- Vegetation stress
- Increasing catastrophic forest fires and degraded air quality
- Increasing flooding/sediment transport
- Irreversible damage to soils through loss of vegetation and erosion
- Degraded quality of surface waters

Given the selected remedy of removal with off-site disposal and returning the Site to native conditions (e.g., bedrock), there is no anticipated change between pre- and post-reclamation conditions.

3.3 Conceptual Design

The conceptual design was developed based on the Stage 1 and State 2 site assessment and investigation data (site characterization). The site characterization activities developed the extents of impacted surface materials to define “removal limits.” Subsurface borehole data did not impact decisions on limits given the presence of bedrock at the surface within the State Trust land parcel.

Reclamation will be achieved through removal of surficial waste rock and waste rock piles associated with the historic mining operations that exceed acceptable radiological concentration ranges for soil (RO1). The proposed horizontal removal limits of the design are shown in Drawing C-100 attached. The vertical removal limits will be surficial (e.g., 6-inches +/- 6-inches) as the impacted material on the State Trust land is mostly comprised of large, fractured waste rocks cast off from mining operations on the top of the bluff that are now resting on the rocky natural surface of the bluff with few exceptions. The horizontal removal limits were determined based on the 2025 ENTACT Gamma Walkover results as the preliminary MARSSIM Class 1 areas discussed in prior reports and the assumption that waste rock may be resting in the inaccessible areas of the bluff face. Both the vertical and horizontal removal limits will be verified in the field by intra-lift radiation surveys and compared to the Surface Gamma Scanning Clearance Criteria as presented in Table 1 and discussed in Section 2.2.3 above. The inaccessible areas of the bluff face are planned to be surveyed using an unmanned sled assuming site conditions permit the attempt.

ENTACT has currently estimated up to 1,700 CY (est. 2,550 Tons) of surficial waste rock to be removed from the RB1 State Trust land parcel. This estimate was calculated by integrating an assumed 6-inch vertical removal depth over the horizontal extents of the proposed removal limits shown in Drawing C-100. The post-removal surface scan will document remaining site characteristics and verify if RO1 for soils has been achieved in areas that can be safely accessed. Removal of surface waste rock as a result of mining activities is planned to be removed; native/undisturbed subsurface soils and exposed rock with gamma emissions above the acceptance criteria are not planned to be removed as part of the scope of this project.

There was limited access to the “mid-slope” areas of the bluff face during the site characterization efforts due to safety reasons and equipment limitations. Based on observations of the terrain, elevation difference, visual indications, distribution of surficial waste rock, and similar gamma radiation levels above and below the missing sections of the bluff face, the waste rock that migrated from the mine on the top of the mesa to the bottom of the slope has been assumed to have a consistent radiological profile down the bluff face for design and planning purposes. Based on the geology of the bluff, the Todilto limestone on top is what was scraped to mine the uranium within it. The Entrada Formation Upper Sandstone comprises the majority of the bluff face below the layer at which the Todilto limestone had been. The Entrada Sandstone is not expected to contain elevated levels of radionuclides and thus not expected to exhibit elevated levels of radiation leaving the Todilto falling from the top as the likely culprit and cause of the detected gamma radiation fields (EA Engineering, Science, and Technology, Inc., 2026). During field implementation, ENTACT will utilize mobilized equipment or other methods to confirm the assumption through field screening and the MARSSIM Final Status Survey (FSS).

Restoration activities will be limited to grading within the removal limits and along the removal limit edges to mimic natural or existing grades.

4.0 RECLAMATION COMPONENTS

The selected alternative includes the following primary components to achieve closure:

- Removal and load-out of waste rock
- Off-site transportation and disposal
- Site Restoration and cleanup

Each reclamation component is summarized below. A reclamation work plan will be developed under separate cover by ENTACT to describe the means and methods planned to effectively implement the closure activities.

4.1 Waste Rock Removal

The impacted material located on the State Trust land is predominantly found on the slope of the mesa, as shown in Drawing C-100. To perform the reclamation activities, ENTACT will mobilize heavy equipment, including excavators and dozers, to perform the excavation of impacted material. Site haul roads will be delineated and new segments constructed to access the removal areas safely. The proposed site layout is provided in Drawing G-101 attached.

The equipment utilized will be equipped with GPS functionality to ensure that the material removed from the Site is located within the design removal limits. Excavators will pull the material from up the slope when positioned at the top, from down the slope when positioned at the bottom, or a combination of both. The surficial waste rock will be scraped from the top 6-inches +/- 6-inches. Radiation level surveys will be completed to confirm the successful removal of the waste rock between excavations or lifts within proper safety limitations. When possible, waste rock will be directly loaded into licensed over-the-road transport trucks. Temporary stockpiles may be staged within the APE while awaiting load-out based on transport scheduling. Temporary construction areas, such as staging, stockpiling and laydown areas will be strategically located outside of the CR sites and buffer zones. Best management practices (BMPs) and temporary controls will be implemented for soil erosion, sediment and dust. Soil stabilization products, such as Soilworks Gorilla-Snot or equivalent, may be utilized on haul roads and soil surfaces for dust control. Products will be applied in accordance with manufacturer guidelines. Spill response measures will be in place in the event there is a release.

Decontamination (dry) measures will be established to prevent radiological cross-contamination on the Site between removal areas, and to ensure trucks and equipment do not leave the Site with residual radiological contamination.

Due to the slope of the mesa, it is expected that there may be inaccessible areas where equipment and personnel cannot safely or feasibly gain access. These areas will be managed on a case-by-case basis. Field factors to be considered are length and steepness of slope, level of contamination at the top and bottom of slope, and equipment limitations. In addition, the rise and run of the slope will factor into the means and methods taken to remove the material safely and efficiently.

Following removal of impacted materials within the designed removal limits, a post-construction radiological survey will be performed using the same equipment from the site characterization gamma

walkover survey. The scintillation probe will be secured to a custom unmanned sled to be pulled up and down the slopes to document residual surface gamma emissions. The results will be compared to the site characterization data to verify the RO1 for surface soils is achieved in areas that can be safely accessed.

4.2 Transportation and Off-Site Disposal

A waste profile will be developed and signed by the generator for submission to the selected disposal facility for review and acceptance. The profile form and supplemental form(s) have been provided for reference in Attachment 2. Waste characterization sampling and analysis will be performed for generator waste determination during the profile process and for ultimate disposal facility acceptance. ENTACT will plan to perform the following testing on NORM at a minimum sampling rate of one per 300 CY.

- Gamma spectrum analysis with Peak identification, Ra-226 and Ra-228 quantization in pCi/g, 21-day ingrowth period for Ra-226 quantification by EPA Method 901.1.
- Pb-210 (pCi/g) via either gamma spectroscopy or other methods.
- Total Uranium (mg/kg) by ICP, EPA Method 6020A or Isotopic Uranium by Alpha Spectroscopy in pCi/g, method HASL 300.
- Total Thorium (mg/kg) by ICP, EPA Method 6020A or Isotopic Thorium by Alpha Spectroscopy in pCi/g, method HASL 300.
- Percent Moisture, if possible.

The Clean Harbors Deer Trail facility can accept TENORM waste with total activity concentrations up to 2000 pCi/g, inclusive of radium-226 up to 222 pCi/g. Upon receipt of waste, Clean Harbors will perform additional verification sampling and analysis of the waste stream for compliance with the facility permits. The facility full acceptance criteria are included in the facility radioactive materials license contained in Appendix 3.

To support transportation off-site for disposal, designated site access roads will be delineated, marked with signage and improved, where needed. The site routes will be selected based on ground level and grades, and to avoid traversing over impacted materials and entry into a CR area. The local travel routes off-site will be established as agreed upon by project stakeholders.

Prior to leaving the Site, loaded transport trucks will be inspected to ensure they are properly placarded, containers are closed and secured, and there is no residual waste that will be tracked onto the public right-of-way. Proper shipping papers, e.g., bills of lading (BOL), will be completed and signed by an authorized representative and the transport truck driver prior to leaving the Site. A waste tracking log will be maintained to track daily truck loads, estimated quantities, date it left the site, and driver/truck identification. Official quantity of waste will be based on the incoming load weights at the receiving facility. The log will be rectified against return BOLs received from the facility.

A gamma radiation level survey will be completed for each truck before it leaves the Site to ensure it complies with DOT regulations and no uncontained exterior contamination is found.

4.3 Site Restoration and Cleanup

Upon removal of the waste rock within the design removal limits and confirmation of the PRRL, the temporary access roads on the State Trust land will be removed. Post-reclamation surface water flow patterns are not anticipated to deviate significantly from the pre-reclamation surface water flow patterns. Grading will be performed as needed within the removal limits and along the removal limit edges to mimic natural or existing grades. The waste rock removal boundary edges may be graded and sloped where the surficial removal was thicker (e.g., > 1-foot) for smooth transition and promote drainage patterns to existing drainage channels. A topographic survey will be performed post-removal and grading to record elevations, generate final contours, and verify drainage patterns. There is no plan to replace the waste rock with topsoil or perform seeding of the steep slopes or bedrock. BMPs, temporary construction facilities and equipment will be removed from the Site. The Site gate, entrance culvert, cattle guard and temporary roads will remain installed for potential future use.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

The closure activities quality assurance program will follow ENTACT's Quality Assurance Project Plan (QAPP) for the Red Bluff No. 1 APE, version 1 (dated April 06, 2026) (ENTACT, LLC, 2026c) and ENTACT's Sampling and Analysis Plan (SAP): Methods to Measure Uranium Ore Concentrations, version 6 (dated April 06, 2026) (ENTACT, LLC, 2026b). These plans are provided at Appendices 1 and 2, respectively. The QAPP describes the policy, organization, functional activities, and quality assurance/quality control (QA/QC) protocols necessary to achieve the data quality objectives. The SAP serves as a field guidance document for radioactive screening, sampling and analysis activities to maintain established standards and requirements for generation of field data and samples. The two plans are attached as Appendices 1 and 2, respectively.

Construction quality control (CQC) tasks, including conducting inspections, tracking, testing and monitoring, will be planned into the execution of the closure activities. Tasks will include pre- and post-removal topographic surveys, post-removal radiological confirmation survey disposal truck gamma screening and inspection prior to leaving the site, air monitoring, waste management and tracking.

The Surface Gamma Scanning Clearance Criteria identified in Table 1 of Section 2.2.3 above will be utilized for the post-removal radiological survey to verify waste rock surface removal is complete and remaining surface soil/loose rock is below the site PRRL. Field screening is to be performed with the same equipment, a Ludlum 44-10 gamma scintillation probe with a 2-inch sodium iodide crystal or equivalent equipment. The RB1 site will have a gamma walkover performed and will mimic and compare to the site characterization walkover activities pursuant to the SAP. Surface soil samples from within the MARSSIM Class 1 and potentially Class 2 areas will be collected when possible based on field conditions (e.g., surface soil not bedrock). Sampling will be performed, consistent with the site characterization sampling activities, using hand collection methods (i.e., augur, trowels, etc.) on a random start triangular sampling grid. Final methodology, locations and results will be documented in ENTACT's Post-Reclamation Closeout Survey and Report.

Personnel and applicable subcontractors will adhere to the QA/QC plans during implementation. Revisions will be made on an as-needed basis and tracked for document control. Electronic copies of the plans will be available at the project site during implementation.

6.0 HEALTH AND SAFETY

A Health and Safety program will be implemented at the site for the reclamation activities. The site behavior-based safety program will follow the site-specific Health and Safety Plan (HASP), developed by ENTACT. The HASP addresses the safety and health hazards associated with each phase of operation and includes the requirements and procedures for construction worker protection. The HASP includes the minimum elements required by 29 CFR 1019.120(b)(4)(ii) and ENTACT's Radiological Protection Plan in compliance with the Texas Radiation Regulations (25 TAC 289) under which ENTACT's Radioactive Materials License is issued and governed.

For all the site personnel, the minimum required PPE is Level D (hard hat, safety glasses, high visibility safety vests, long sleeved shirts and sturdy shoes with ankle support). Safety hazards associated with performing the sitewide survey include slips, trips, and falls, heat exhaustion and biological hazards (i.e., insects, snakes, animals).

There is the potential for radiation exposure on-site. During any soil disturbance activities associated with this plan, the Field Radiological Safety Officer, Health Physicist, or other ENTACT safety representative may elect to increase the level of PPE or stop work if on-site monitoring indicates levels of concern. While a work stoppage due to radiological conditions is not expected based on the information acquired about the site during the characterization phase, the details of this determination are included in the project Health and Safety Plan.

ENTACT personnel will have appropriate Occupational Safety and Health Administration (OSHA) Hazardous Waste Operator (HAZWOPER) training, ENTACT's Radiological Worker Training, and participate in a medical surveillance program. All Site workers will receive site orientation prior to beginning work on-site. A dedicated Health and Safety Officer (HSO) will be on-site during closure activities to implement the site-specific HASP and ENTACT's corporate Behavior Based Safety System.

Work zones will be established and clearly delineated to include an exclusion zone (EZ), contamination reduction zone (CRZ), and support zone (SZ). Decontamination facilities will be established in the CRZ as a transition from the EZ. Safety "tailgate" meetings will be held a minimum of once each workday to review the planned activities for the day and the potential hazards which may be encountered. Major work tasks will be planned by preparing a Job Safety Analysis (JSA) that will be reviewed by personnel performing the task and will be updated or revised as needed to address changes in the workplace, equipment and personnel.

7.0 BUDGET

The estimated cost to perform the reclamation of the Red Bluff No. 1 mine on State Trust land parcel of the Red Bluff No. 1 APE is estimated at two million U.S. dollars (+/- \$2,000,000.00 USD).

A more detailed cost estimate will be developed under separate cover during the project planning phase to establish budgets by line item to perform the work as scoped. Factors that have been identified as risks to the final cost include the difficulty addressing the mid slope areas of the mesa, the final volume of impacted materials to be removed, as determined by post-removal radiological screening surveys, and fuel surcharges, i.e., the Fuel Index as published by the U.S. Energy Information Administration.

8.0 SCHEDULE

Closure of the RB1 Site on State Trust lands includes completion of Stage 1 – Site Assessment, Stage 2- Investigation, and Stage 3 – Reclamation and Restoration, as contracted in the Abandoned Uranium Mine Cleanup in the Grants Mining District Request for Proposal Specifications and Detailed Scope of Work (dated April 22, 2025), as well as the Joint Guidance for the Cleanup of Existing Uranium Mining Operations in New Mexico (March 2016) (EMNRD MMD and NMED, 2016).

The closure activities are anticipated to be complete by June 30, 2026, the end of the FY2025/26. ENTACT's mobilization to the field is planned for mid-May 2026, and with the total project duration of 35 to 40 days. ENTACT estimates the following durations for the reclamation schedule:

Task Name	Estimated Task Duration
Project Planning and Preparation, inclusive of this Closure Plan	21 days
Public Meeting	1 days
Notice to Proceed	1 day
Stage 3 – Reclamation	30 days
Mobilization and Site Preparation	5 days
Waste Rock Removal	4 days
Transportation and Off-site Disposal	17 days
Post-Reclamation Closeout Survey and Sampling	15 days
Site Cleanup and Restoration	5 days
Demobilization	3 days
Project Closeout and Record Submittals, inclusive of the Post-Reclamation Survey Report with laboratory reports.	60 days
Post-Construction Monitoring and Maintenance	4 days

A preliminary baseline project schedule is included in Attachment 1 to this plan. The schedule provides details on task organization, sequencing, durations and overlap. Standard working times are anticipated to be Monday through Saturday, 10 hours per day, which would typically occur between 07:00 a.m. to 05:00 p.m. local time, depending on the daylight schedule. Sundays and extended operational hours may be utilized to make up for weather and schedule delays.

9.0 MONITORING

There is no long-term monitoring for the Red Bluff No. 1 State Trust land once the remedy is verified as complete.

10.0 LAND USE RESTRICTIONS

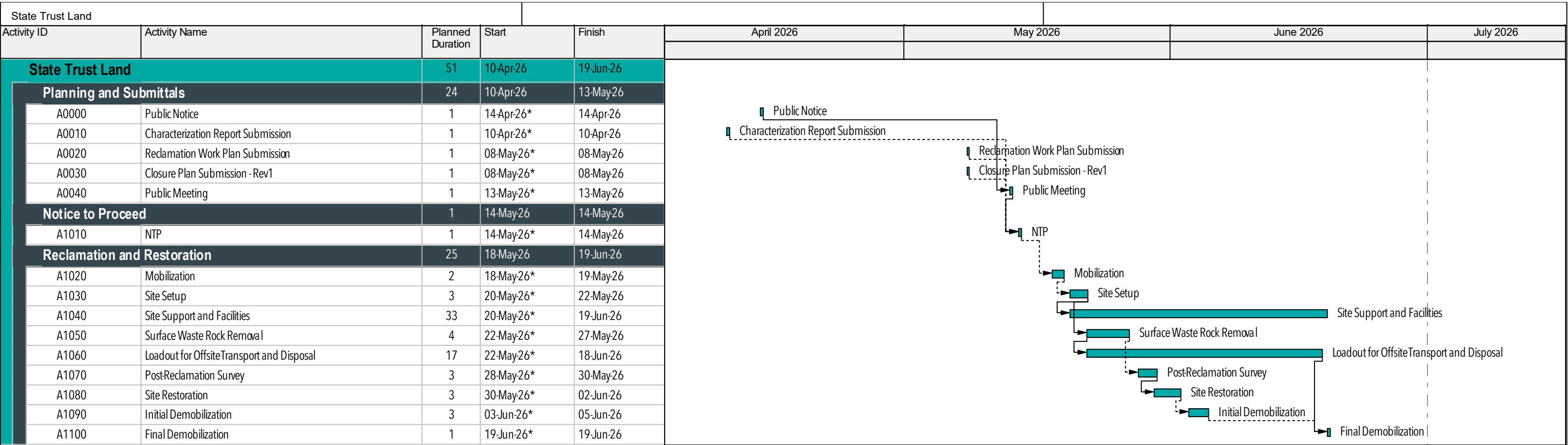
There will be no change to land use or land restrictions of the State Land Trust Parcel (PM23 T13N R10W, NE1/4 NE1/4 of Sec. 36) post-closure. NMSLO will continue to be the lead authority to oversee the land's surface and mineral rights.

11.0 REFERENCES

- EA Engineering, Science, and Technology, Inc. (2026, January 6). *Red Bluff No. 1 Mine Geological Observations, McKinly County, New Mexico.*
- EA Engineering, Science, and Technology, Inc. (2026). *Red Bluff No.1 and Roundy Abandoned Uranium Mines Geology and Hydrogeology Desktop Study, McKinley County, New Mexico.*
- EA Engineering, Science, and Technology, Inc., PBC. (December 2025). *Uranium Mine Cleanup Analysis and Proposal for Alternative Methods of Disposal (Feasibility Study) Schmitt Decline Abandoned Uranium Mine McKinley County, New Mexico.*
- EMNRD MMD and NMED. (2016). *Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico.*
- ENTACT, LLC. (2025a). *Site Radiological Survey Report: Red Bluff No. 1 and Roundy Site.*
- ENTACT, LLC. (2026a). *Sampling and Analysis Plan: Methods to Measure Uranium Ore Concentrations - Red Bluff No. 1 and Roundy Site.*
- ENTACT, LLC. (2026b). *QUALITY ASSURANCE PROJECT PLAN: RED BLUFF No 1. AND ROUNDY SITE - McKinley County, New Mexico.*
- ENTACT, LLC. (2026c). *Site Radiological Characterization Report: Red Bluff No. 1 and Roundy Site, McKinley County, New Mexico.*
- New Mexico Environment Department. (2008). *Preliminary Assessment Report: San Mateo Creek Legacy Uranium Sites.*
- Resi Solutions. (2025). *A Class III Cultural Resource Inventory for the Red Bluff AUM Project in McKinley County, New Mexico.*
- Stone, W. L. (1983). *Hydrogeology and water resources of the San Juan Basin, New Mexico - Hydrologic Report 6.* New Mexico Bureau of Mines and Mineral Resources, a Division of New Mexico Institute of Mining and Technology.
- Sundance Consultants, LLC. (2025). *Biological Assessment/Biological Evaluation for.* Albuquerque, NM.
- Tetra Tech. (2023). *Old Church Rock Mine Eastern Abandoned Uranium Mine Region OCRM Removal Assessment Appendix H: Background Investigation Report.*
- U.S. EPA. (2018). *Phase 2 Ground-Water Investigation Report for the San Mateo Creek Basin Legacy Uranium Mines Site, Cibola and McKinley Counties, New Mexico, Revision 1.* US EPA Region 6.
- USEPA. (2001). *Multi-Agency Radiation Survey and Site Investigation Manual, Revision 1.*

ATTACHMENTS

ATTACHMENTS





WASTE MATERIAL PROFILE SHEET

Clean Harbors Profile No. CH3177003

A. GENERAL INFORMATION

GENERATOR EPA ID #/REGISTRATION #
GENERATOR CODE (Assigned by Clean Harbors)
ADDRESS **884 County Road 23**
CUSTOMER CODE (Assigned by Clean Harbors)
ADDRESS **1010 Executive Court Suite 280**

PENDING
EN303569

GENERATOR NAME:
CITY **Prewitt**
CUSTOMER NAME:
CITY **Westmont**

Entact - Grants Mining District - Red Bluff
STATE/PROVINCE **NM** ZIP/POSTAL CODE **87045**
PHONE: **(832) 459-4084**
Entact
STATE/PROVINCE **IL** ZIP/POSTAL CODE **60559**

B. CUSTOMER WASTE DESCRIPTION

CUSTOMER WASTE DESCRIPTION: **NORM Waste with soil**

PROCESS GENERATING WASTE: **NORM Waste with soil**

IS THIS WASTE CONTAINED IN SMALL PACKAGING CONTAINED WITHIN A LARGER SHIPPING CONTAINER ? **No**

SHIPPING CONTAINER TYPE

CONTAINERIZED

BULK LIQUID

☒ BULK SOLID

C. PHYSICAL PROPERTIES (at 25C or 77F)

PHYSICAL STATE ☒ SOLID WITHOUT FREE LIQUID POWDER MONOLITHIC SOLID LIQUID WITH NO SOLIDS LIQUID/SOLID MIXTURE % FREE LIQUID % SETTLED SOLID GAS/AEROSOL SLUDGE GAS/AEROSOL	NUMBER OF PHASES/LAYERS				THICKNESS (VISCOSITY)		COLOR
	1	2	3	TOP	1 - 100 (e.g. Water)		
	% BY VOLUME (Approx.)			MIDDLE	101 - 500 (e.g. Motor Oil)		
				BOTTOM	501 - 10,000 (e.g. Molasses)		
		DOES THIS WASTE HAVE A STRONG ODOR (INTENSE/OVERPOWERING)?		BOILING POINT °F (°C)		MELTING POINT °F (°C)	TOTAL ORGANIC CARBON (%)
		☒ NO YES Describe:		<= 95 (<=35) 95 - 100 (35-38) 101 - 129 (38-54) >= 130 (>54)		< 140 (<60) 140-200 (60-93) > 200 (>93)	<= 1 >1 - <10 >= 10
FLASH POINT °F (°C)	pH	SPECIFIC GRAVITY		ASH		BTU/LB (MJ/kg)	
< 73 (<23)	<= 2	< 0.8 (e.g. Gasoline)		< 0.1		< 2,000 (<4.6)	
73 - 100 (23-38)	2.1 - 6.9	0.8-1.0 (e.g. Ethanol)		0.1 - 1.0		>=2,000-4,999 (>=4.6-11.62)	
101 -140 (38-60)	7 (Neutral)	☒ 1.0 (e.g. Water)		1.1 - 5.0		>=5,000-10,000 (>=11.63-23.2)	
141 -200 (60-93)	7.1 - 12.4	1.0-1.2 (e.g. Antifreeze)		5.1 - 20.0		> 10,000 (>23.2)	
> 200 (>93)	>= 12.5	> 1.2 (e.g. Methylene Chloride)				Actual:	

D. COMPOSITION&WASTE DETAILS

(List the complete composition of the waste, include any inert components and/or debris. Ranges for individual components are acceptable. If a trade name is used, please supply an MSDS. Please do not use abbreviations.)

CHEMICAL	MIN	--	MAX	UOM
SOIL	90.0000000	--	100.0000000	%
URANIUM	1.0000000	--	2.0000000	%



YES ☒ NO USEPA HAZARDOUS WASTE?
DO ANY STATE WASTE CODES APPLY?
Texas Waste Code
YES ☒ NO DO ANY CANADIAN PROVINCIAL WASTE CODES APPLY?

DOES THIS WASTE CONTAIN ANY HEAVY GAUGE METAL DEBRIS OR OTHER LARGE OBJECTS ? YES ☒ NO

If yes, describe, including dimensions:

DOES THIS WASTE CONTAIN ANY METALS IN POWDERED OR OTHER FINELY DIVIDED FORM? YES ☒ NO

DOES THIS WASTE CONTAIN OR HAS IT CONTACTED ANY OF THE FOLLOWING; ANIMAL WASTES, HUMAN BLOOD, BLOOD PRODUCTS, BODY FLUIDS, MICROBIOLOGICAL WASTE, PATHOLOGICAL WASTE, HUMAN OR ANIMAL DERIVED SERUMS OR PROTEINS OR ANY OTHER POTENTIALLY INFECTIOUS MATERIAL? YES ☒ NO

I acknowledge that this waste material is neither infectious nor does it contain any organism known to be a threat to human health. This certification is based on my knowledge of the material. Select the answer below that applies:

The waste was never exposed to potentially infectious material. YES ☒ NO

Chemical disinfection or some other form of sterilization has been applied to the waste. YES ☒ NO

I ACKNOWLEDGE THAT THIS PROFILE MEETS THE CLEAN HARBORS BATTERY PACKAGING REQUIREMENTS. YES ☒ NO

I ACKNOWLEDGE THAT MY FRIABLE ASBESTOS WASTE IS DOUBLE BAGGED AND WETTED. YES ☒ NO

SPECIFY THE SOURCE CODE ASSOCIATED WITH THE WASTE. SPECIFY THE FORM CODE ASSOCIATED WITH THE WASTE.

Are these values based on testing or knowledge? Knowledge Testing

If constituent concentrations are based on analytical testing, analysis must be provided. Please attach document(s) using the link on the Submit tab.

HALOGENATED ORGANIC COMPOUNDS	POLYCHLORINATED BIPHENYLS (PCB's)
☒ NONE	NONE
< 1000 PPM	< 50 PPM
>= 1000 PPM	>=50 PPM
	IF PCBs ARE PRESENT, IS THE WASTE REGULATED BY TSCA 40 CFR 761?
	YES NO

ADDITIONAL HAZARDS

DOES THIS WASTE HAVE ANY PRIOR INCIDENTS ASSOCIATED WITH IT, WHICH COULD AFFECT THE WAY IT SHOULD BE HANDLED?

YES ☒ NO (If yes, explain)

CHOOSE ALL THAT APPLY

DEA REGULATED SUBSTANCES EXPLOSIVE FUMING OSHA REGULATED CARCINOGENS
POLYMERIZABLE RADIOACTIVE REACTIVE MATERIAL ☒ NONE OF THE ABOVE

Please indicate which constituents below apply. Concentrations must be entered when applicable to assist in accurate review and expedited approval of your waste profile. Please note that the total regulated metals and other constituents sections require answers.

RCRA	REGULATED METALS	REGULATORY LEVEL (mg/l)	TCLP mg/l	TOTAL	UOM	NOT APPLICABLE
D004	ARSENIC	5.0				☒
D005	BARIUM	100.0				☒
D006	CADMIUM	1.0				☒
D007	CHROMIUM	5.0				☒
D008	LEAD	5.0				☒
D009	MERCURY	0.2				☒
D010	SELENIUM	1.0				☒
D011	SILVER	5.0				☒
VOLATILE COMPOUNDS				OTHER CONSTITUENTS	MAX	UOM
D018	BENZENE	0.5				☒
D019	CARBON TETRACHLORIDE	0.5		BROMINE		☒
D021	CHLOROBENZENE	100.0		CHLORINE		☒
D022	CHLOROFORM	6.0		FLUORINE		☒
D028	1,2-DICHLOROETHANE	0.5		IODINE		☒
D029	1,1-DICHLOROETHYLENE	0.7		SULFUR		☒
D035	METHYL ETHYL KETONE	200.0		POTASSIUM		☒
D039	TETRACHLOROETHYLENE	0.7		SODIUM		☒
D040	TRICHLOROETHYLENE	0.5		AMMONIA		☒
D043	VINYL CHLORIDE	0.2		CYANIDE AMENABLE		☒
SEMI-VOLATILE COMPOUNDS				CYANIDE REACTIVE		☒
D023	o-CRESOL	200.0		CYANIDE TOTAL		☒
D024	m-CRESOL	200.0		SULFIDE REACTIVE		☒
D025	p-CRESOL	200.0				
D026	CRESOL (TOTAL)	200.0				
D027	1,4-DICHLOROBENZENE	7.5				
D030	2,4-DINITROTOLUENE	0.13				
D032	HEXACHLOROBENZENE	0.13				
D033	HEXACHLOROBUTADIENE	0.5				
D034	HEXACHLOROETHANE	3.0				
D036	NITROBENZENE	2.0				
D037	PENTACHLOROPHENOL	100.0				
D038	PYRIDINE	5.0				
D041	2,4,5-TRICHLOROPHENOL	400.0				
D042	2,4,6-TRICHLOROPHENOL	2.0				
PESTICIDES AND HERBICIDES						
D012	ENDRIN	0.02				
D013	LINDANE	0.4				
D014	METHOXYCHLOR	10.0				
D015	TOXAPHENE	0.5				
D016	2,4-D	10.0				
D017	2,4,5-TP (SILVEX)	1.0				
D020	CHLORDANE	0.03				
D031	HEPTACHLOR (AND ITS EPOXIDE)	0.008				

**E. REGULATORY**

YES	☒	NO	IS THIS WASTE PROHIBITED FROM LAND DISPOSAL WITHOUT FURTHER TREATMENT PER 40 CFR PART 268?
			LDR CATEGORY:
			VARIANCE INFO:
YES	☒	NO	IS THIS A UNIVERSAL WASTE?
YES	☒	NO	IS THE GENERATOR OF THE WASTE CLASSIFIED AS A VERY SMALL QUANTITY GENERATOR (VSQG) OR A STATE EQUIVALENT DESIGNATION?
YES	☒	NO	IS THIS MATERIAL GOING TO BE MANAGED AS A RCRA EXEMPT COMMERCIAL PRODUCT, WHICH IS FUEL (40 CFR 261.2 (C)(2)(II))?
YES	☒	NO	PROCESSES SUCH AS ELECTROPLATING, METAL ETCHING, ELECTROCHEMICAL MACHINING, OR MILLING WILL GENERATE EPA F006 OR F019 LISTED SLUDGE AFTER TREATMENT. DO YOUR WASTES ORIGINATE FROM ANY OF THESE PROCESSES?
YES	☒	NO	IS THIS WASTE STREAM PROHIBITED FROM INCINERATION BASED ON THE INORGANIC METAL BEARING WASTE PROHIBITION FOUND AT 40 CFR 268.3(C)?
YES	☒	NO	IS THIS WASTE STREAM "USED OIL" WHICH IS TO BE MANAGED UNDER 40 CFR PART 279 - STANDARDS FOR THE MANAGEMENT OF USED OIL?
YES	☒	NO	DOES THIS WASTE CONTAIN VOC'S IN CONCENTRATIONS >=500 PPM?
YES	☒	NO	DOES THE WASTE CONTAIN GREATER THAN 20% OF ORGANIC CONSTITUENTS WITH A VAPOR PRESSURE >= .3KPA (.044 PSIA)?
YES	☒	NO	DOES THIS WASTE CONTAIN AN ORGANIC CONSTITUENT WHICH IN ITS PURE FORM HAS A VAPOR PRESSURE > 76.6 KPA (11.1 PSIA)?
YES	☒	NO	WAS THIS WASTE GENERATED AT A REGULATED SUPERFUND SITE?
YES	☒	NO	IS THE WASTE SUBJECT TO ONE OF THE FOLLOWING NESHAP RULES?
			Hazardous Organic NESHAP (HON) rule (subpart G) Pharmaceuticals production (subpart GGG)
YES	☒	NO	IF THIS IS A US EPA HAZARDOUS WASTE, DOES THIS WASTE STREAM CONTAIN BENZENE?
YES	☒	NO	Does the waste stream come from a facility with one of the SIC codes listed under benzene NESHAP or is this waste regulated under the benzene NESHAP rules because the original source of the waste is from a chemical manufacturing, coke by-product recovery, or petroleum refinery process?
YES	☒	NO	Is the generating source of this waste stream a facility with Total Annual Benzene (TAB) >10 Mg/year?
			What is the TAB quantity for your facility? Megagram/year (1 Mg = 2,200 lbs)
			The basis for this determination is: Knowledge of the Waste Or Test Data Knowledge Testing
			Describe the knowledge :

F. DOT/TDG INFORMATION

DOT/TDG PROPER SHIPPING NAME:

G. GENERATOR CERTIFICATION**GENERATOR'S CERTIFICATION**

I certify that I am authorized to execute this document as an authorized agent. I hereby certify that all information submitted in this and attached documents is correct to the best of my knowledge. I also certify that any samples submitted are representative of the actual waste. If Clean Harbors discovers a discrepancy during the approval process, Generator grants Clean Harbors the authority to amend the profile, as Clean Harbors deems necessary, to reflect the discrepancy.

AUTHORIZED SIGNATURE

NAME (PRINT)

TITLE

DATE



Addendum

D. COMPOSITION

F. REGULATORY STATUS

SUPPLEMENTAL INFORMATION

1. Site and Generator Information		Waste Profile Number	
Waste Description:			
Generator Name:			
Site Addresses:			
Waste Quantity: (Tons per year)			
Comments:			

2. Regulatory Information					
	Yes	No		Yes	No
Does the waste contain NORM (Naturally Occurring Radioactive Material)?	☐	☐	Does the waste contain TENORM (Technologically Enhanced NORM)?	☒	☐
Was the waste produced in conjunction with oil and gas exploration, production and transport activities?	☐	☐	Was the waste produced from petroleum, gas or propane refining, filtration or pipeline maintenance?	☐	☒
Does the waste have radium contamination derived from purposely concentrated radium	☐	☐	Does the waste contain uranium or thorium > 0.05% (500 µg/g) by weight?	☐	☒
Does the waste contain man-made or artificial radionuclides above background fallout levels?	☐	☐	Does the waste contain byproduct material?	☐	☒
Does the waste contain depleted uranium?	☐	☒	Does the waste contain special nuclear material?	☐	☒
Is the waste subject to an NRC, state or other radioactive materials license?	☐	☒	If yes license number:		
Please describe the process which produced the waste:					

3. Radiological Information						
What is the maximum gamma exposure rate at the surface of the waste (microR/hour)?						
Please list the isotope, average specific activity, and maximum specific activity for each radionuclide present						
Isotope	Ave (pCi/g)	Max pCi/g)		Isotope	Ave (pCi/g)	Max (pCi/g)

<i>Waste Profile Number</i>	
-----------------------------	--

4. Sampling and Analysis Information		
<i>Please list sampling and analytical methods used to characterize the waste.</i>	Yes	No
a. Sampling and laboratory analysis	☒	☐
b. Surface Exposure Rate Surveys: Non-pipe oil and gas field waste and debris	☐	☒
c. Surface Exposure Rate Surveys: Oil and Gas Pipe and Scale	☐	☒
<i>For Oil and Gas Pipe and Scale, please list : pipe size, pipe schedule, and scale thickness</i> Pipe size (in) N/A , Schedule N/A , Ave. Scale Thickness (cm) N/A		
<i>Please attach representative lab analysis data from a NELAC certified lab per NORM Waste Approval Instructions and/or completed exposure rate surveys per Oil and Gas Field Survey Procedures.</i>		

5. Generator's Certification	
<i>I hereby certify that all information submitted in this and attached documents is correct to the best of my knowledge. I also certify that any samples submitted are representative of the actual waste. I also certify that the Specific Activity (radioactivity per gram) of waste prepared for shipment to the facility meets the acceptance criteria for Regulated Waste at the Facility.</i>	
<i>Authorized Signature</i>	<i>Title</i>
<i>Name (Print)</i>	<i>Date</i>

6. Generators Outside the Rocky Mtn. Compact Region (CO, NM, NV) Certification	
<i>I hereby certify that the generator is licensed or permitted to, and agrees to, receive back the waste and residues if they cannot be disposed of. (In the case of oil and gas waste collectors/processors, this certification may be signed by the processor/collector.) I agree to provide the Clean Harbors Deer Trail Facility written or e-mail notification at least five days in advance of the initial shipment of waste.</i>	
<i>Authorized Signature</i>	<i>Title</i>
<i>Name (Print)</i>	<i>Date</i>

NORM Waste Approval Instructions for Clean Harbors Deer Trail Sample-able Wastes

Deer Trail NORM Waste Acceptance Limits

- For oil and gas field wastes: combined radium (Ra-226 plus Ra-228) is limited to 12,200 pCi/g in pipe scale, or 6,000 pCi/g in other waste forms. Pb-210 is limited to 10,000 pCi/g. Oil and gas field waste include waste generated from exploration, production, transmission, transportation, filtration and refining of oil and natural gas and gas fractions. Oil and gas field wastes received for disposal per year shall not exceed 50,000 tons.
- For other wastes (non-oil and gas field wastes): total activity is limited to 2,000 pCi/g and combined radium (Ra-226 plus Ra-228) is limited to 222 pCi/g. Pb-210 is limited to 666 pCi/g.
- For all wastes: total uranium and thorium content shall be less than 0.05% by weight (500 mg/Kg).

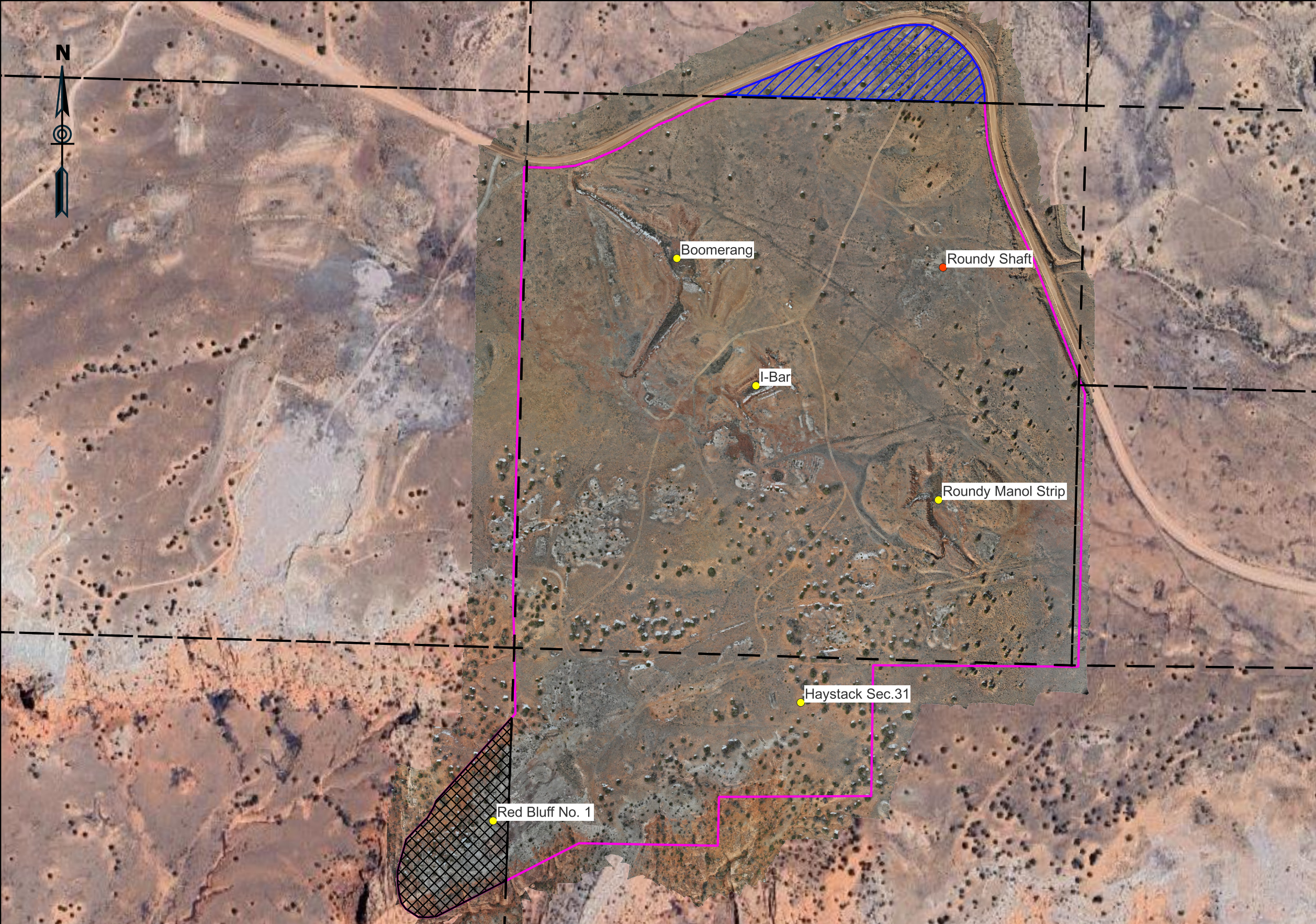
Instructions for Approval – Sample-able Wastes

1. Complete a preliminary Clean Harbors Waste Profile. Please check the box under Section E. Constituents – Additional Hazards – Radioactive - YES. The waste profile cannot depict units of activity. All radionuclides should be listed using units of “trace”
2. Complete a NORM Questionnaire using the Clean Harbors Profile number. (Use Supplemental NORM Questionnaire Rev 3 only).
3. Attach radiochemical lab analysis from a NELAC certified lab to the Clean Harbors Profile. Gamma Spectrum analysis including quantitation of Radium 226 and other detects is needed as well as total Uranium and Thorium. Clean Harbors Deer Trail does not require a confirmatory sample of the waste as long as all the required analytes are included.

Required Analysis

- Total Uranium (mg/kg) by ICP; alternate Isotopic Uranium by Alpha Spec.
- Total Thorium (mg/kg) by ICP; alternate Isotopic Thorium by Alpha Spec.
- Gamma spectrum analysis with peak identification and Ra-226 quantization (pCi/g)
- Pb-210 by gamma spectroscopy if it is the only parent radionuclide present (pCi/g) (Natural Gas Processing Waste Only)
- Percent Moisture

FIGURES



LEGEND

PROPERTY LINES
AndersonEngineeringSurvey_12-3-25

AREA DESIGNATIONS

Mine Labels

Shaft Mines

Strip/Pit Mines

NM State Land

BLM land

Area of Potential Effect - NMED

2026 UAS 2cm Ortho Imaging

Google Earth

SOURCES:
2026 Google Earth Imaging
2026 UAS Aerial Imaging
NMED & EMNRD - APE
2025 Anderson Engineering Survey



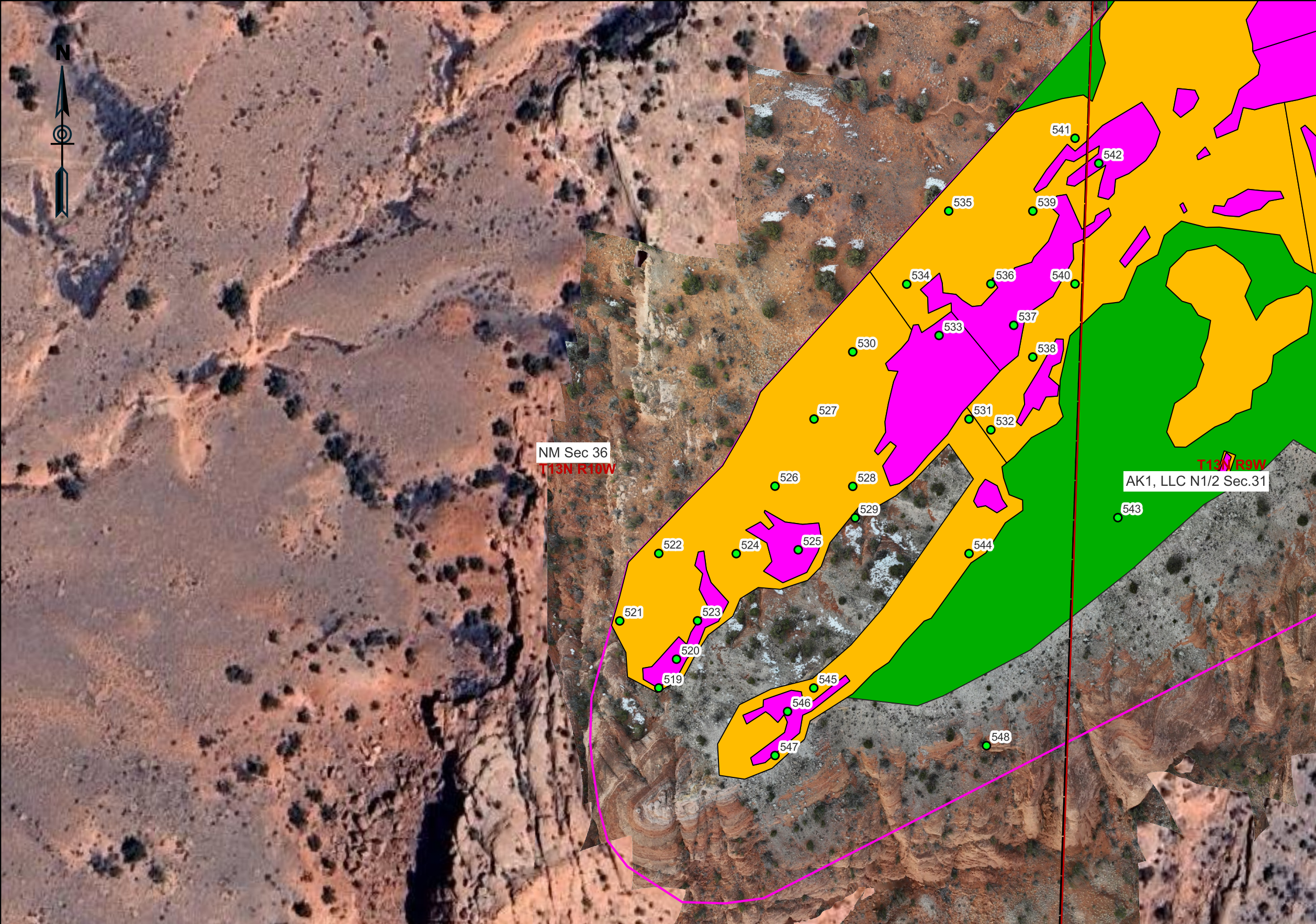
REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION



PREPARED FOR:



					
DRAWING NAME Mine Feature Locations within the Area of Potential Effect					
PROJECT NAME & LOCATION Red Bluff No.1 & Roundy McKinley County, NM					
DRAWN BY	E. Fruchtnicht	APPROVED BY		DRAWING NO.	
DATE	05/04/2026	DATE		PROJECT NO.	E9462



LEGEND

Sampling
2026MobPhase2Sampling

PROPERTY LINES
Land Status - NMSLO
AndersonEngineeringSurvey_12-3-25

AREA DESIGNATIONS

MARSSIM AREAS
MARSSIM Class 1 areas
MARSSIM Class 2 areas
MARSSIM Class 3 areas
Area of Potential Effect - NMED
2026 UAS_2cm Ortho Imaging
Google Earth

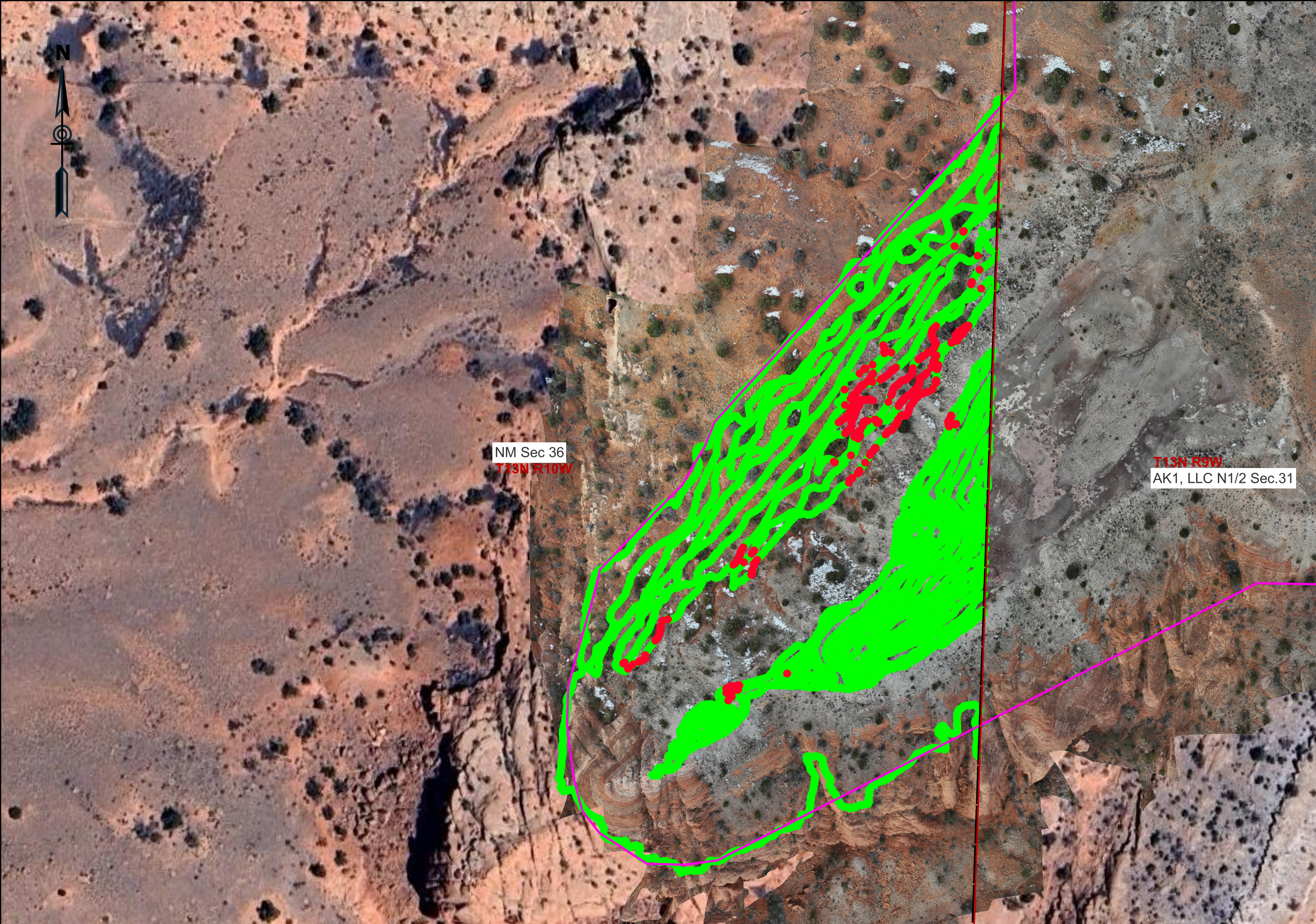
NOTES:
*PLSS is NM PM23 T13N

SOURCES:
2026 Google Earth Imaging
2026 UAS Aerial Imaging
NMED & EMNRD - APE
2025 Anderson Engineering Survey

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

PREPARED FOR:

DRAWING NAME Site Characterization Results					
PROJECT NAME & LOCATION Red Bluff No.1 & Roundy McKinley County, NM					
DRAWN BY	E. Fruchtnicht	APPROVED BY		DRAWING NO.	
DATE	05/04/2026	DATE		PROJECT NO.	E9462



LEGEND

PROPERTY LINES

Land Status - NMSLO

AndersonEngineeringSurvey_12-3-25

AREA DESIGNATIONS

Area of Potential Effect - NMED

Phase 1 Walkover

StateLand_AboveSurfaceScreeningCriteria

0.0 - 73000.0

73000.0 - Max

2026 UAS_2cm Ortho Imaging

Google Earth

NOTES:

*PLSS is NM PM23 T13N

SOURCES:

2025 ENTACT Gamma Walkover

2026 Google Earth Imaging

2026 UAS Aerial Imaging

NMED & EMNRD - APE

2025 Anderson Engineering Survey

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

PREPARED FOR:

STATE OF NEW MEXICO
DIVISION OF MINING AND MINERALS

NEW MEXICO
ENVIRONMENT DEPARTMENT

ENTACT					
DRAWING NAME Known Characterized Limits Above the Surface Scanning Criteria					
PROJECT NAME & LOCATION Red Bluff No.1 & Roundy McKinley County, NM					
DRAWN BY	E. Fruchtnicht	APPROVED BY		DRAWING NO.	
DATE	05/08/2026	DATE		PROJECT NO.	E9462



Closure Plan: State Trust Land Parcel
Red Bluff No. 1 APE
Grants, NM

DRAWINGS

PREPARED BY: ENTACT LLC
63 INVERNESS DRIVE E
SUITE 101
ENGLEWOOD, CO 80112

PREPARED FOR: NEW MEXICO ENVIRONMENT DEPARTMENT
121 TIJERAS AVE NE
SUITE 1000
ALBUQUERQUE, NM 87102



<u>PAGE</u> <u>NUMBER</u>	<u>SHEET NAME</u>
G-001	TITLE SHEET
G-100	RED BLUFF NO. 1 AREA OF POTENTIAL EFFECT
G-101	SITE LAYOUT - RED BLUFF NO. 1
G-102	STATE TRUST LAND TOPOGRAPHY
C-100	PROPOSED REMOVAL LIMITS



ENTACT.

1	05/04/26	MF	WORKZONE CALLOUT, ROAD LABEL CLARIFICATION
REV	DATE	APR'VD	DESCRIPTION

Date _____

 NEW MEXICO ENVIRONMENT DEPARTMENT	DESIGNED BY: DATE:		APPROVED BY: DATE:	
	MS	04/16/26	MF	04/16/26
	DRAWN BY: DATE:		FILE NAME:	
	MS	04/16/26	G-001	
 ENTACT, LLC. 63 INVERNESS DRIVE E SUITE 101 ENGLEWOOD, CO 80112		REVIEWED BY: DATE:		
		MF	04/16/26	

ABANDONED URANIUM MINE CLEAN UP
GRANTS, NM

NM SEC. 36
RED BLUFF NO. 1 STATE TRUST LAND
CLOSURE PLAN

TITLE SHEET

G-001
SHEET 1 OF 5



LEGEND

AREA OF POTENTIAL EFFECT	
PROPERTY LINE	
MAJOR CONTOUR	
MINOR CONTOUR	

NOTES

- THE DATA DEPICTED HEREIN ARE BASED ON NORTH AMERICAN DATUM OF 1983 (NAD83) FOR HORIZONTAL AND GEOMETRIC CONTROL DATUM AND NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).
- COORDINATE SYSTEM UTILIZED IS NM83-WF, US SURVEY FEET.
- PROPERTY OWNERSHIP INVESTIGATED BY ANDERSON ENGINEERING IN NOVEMBER, 2025.
- CONTOUR INTERVAL FOR STATE TRUST LAND WORK AREA IS 2 FT MINOR X 10 FT MAJOR. CONTOUR INTERVAL FOR REMAINING SITE IS 5 FT MINOR X 25 FT MAJOR.
- EXISTING CONDITIONS SURVEY PERFORMED BY UAS, INC IN 2025.
- PUBLIC LAND SURVEY SYSTEM (PLSS) NEW MEXICO (NM) PRIME MERIDIAN (PM) 23 TOWNSHIP 13 NORTH (T13N) RANGE 9 WEST (R9W) SECTIONS 30 & 31, AND R10W SECTION 36.



REV	DATE	APR'VD	DESCRIPTION

Date_____

DESIGNED BY: DATE: MS 04/16/26

DRAWN BY: DATE: MS 04/16/26

REVIEWED BY: DATE: MF 04/16/26

APPROVED BY: DATE: MF 04/16/26

FILE NAME: G-102



NEW MEXICO
ENVIRONMENT
DEPARTMENT

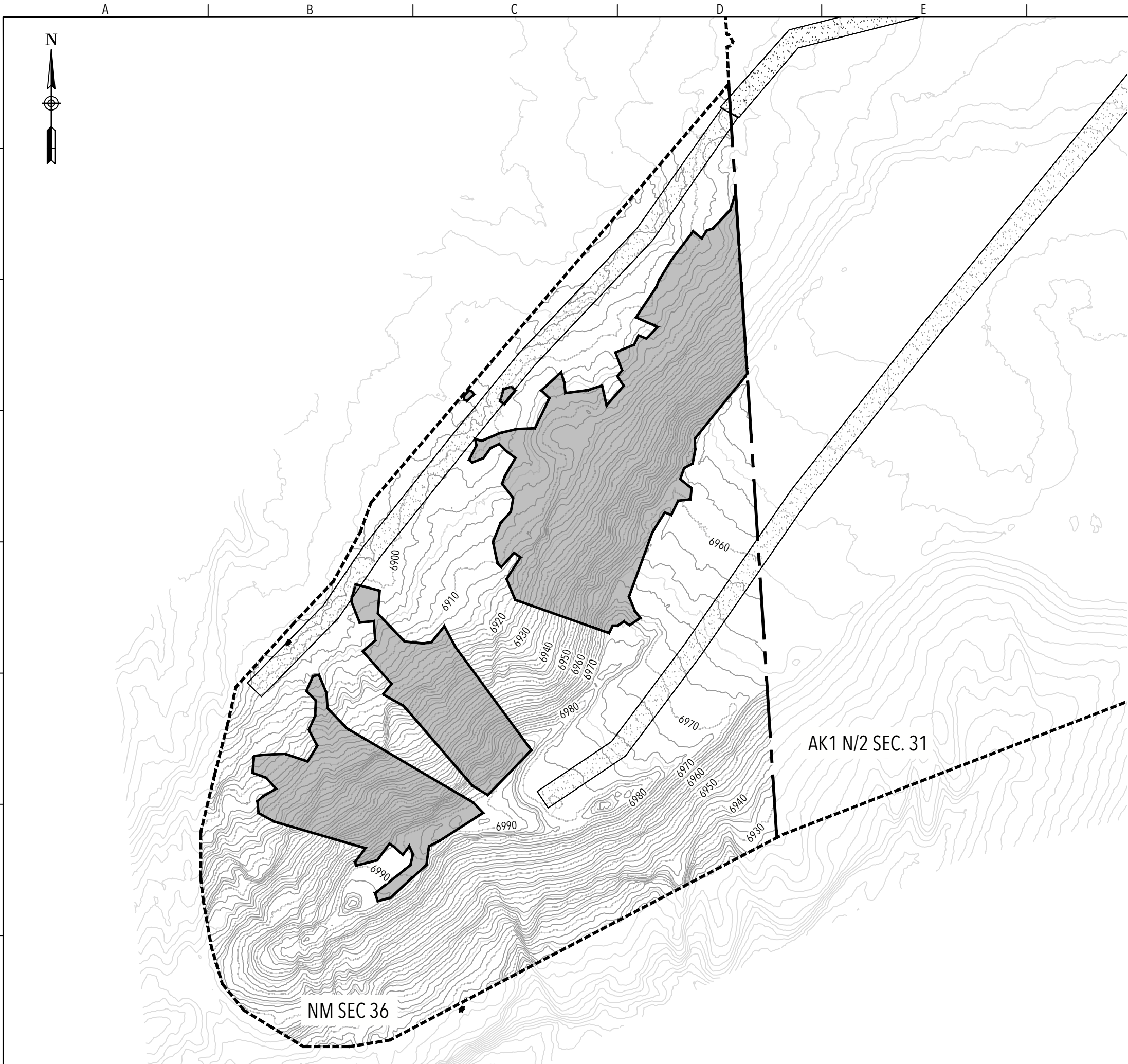


ENTACT, LLC
63 INVERNESS DRIVE E
SUITE 101
ENGLEWOOD, CO 80112

ABANDONED URANIUM MINE CLEAN UP
GRANTS, NM

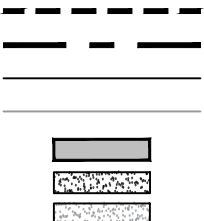
NM SEC. 36
RED BLUFF NO. 1 STATE TRUST LAND
CLOSURE PLAN

STATE TRUST LAND TOPOGRAPHY



LEGEND

- AREA OF POTENTIAL EFFECT
- PROPERTY LINE
- MAJOR CONTOUR
- MINOR CONTOUR
- PROPOSED REMOVAL LIMITS
- HISTORIC ACCESS ROAD
- PROPOSED ACCESS ROAD



NOTES

- THE DATA DEPICTED HEREIN ARE BASED ON NORTH AMERICAN DATUM OF 1983 (NAD83) FOR HORIZONTAL AND GEOMETRIC CONTROL DATUM AND NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).
- LINEWORK AND DATA DERIVED FROM GIS SOFTWARE.
- GAMMA WALKOVER PERFORMED BY ENTACT FROM 09/15/25-10/03/25.
- VERTICAL REMOVAL IS EXPECTED TO CONSIST OF A SURFACE SCRAPE APPROXIMATELY 0.5 TO 1.0 FT THICK DOWN TO BEDROCK. SUBSURFACE FEATURES ON THE MESA SLOPE FACE HAVE NOT BEEN VERIFIED AND WILL BE VERIFIED IN THE FIELD DURING CONSTRUCTION.
- STATE LAND SURFACE CONTOURS SPACED AT 2-FT MINOR X 10-FT MAJOR INTERVAL SURROUNDING GRADE CONTOURS SPACED AT 5 FT MINOR X 25 FT MAJOR INTERVAL.
- PUBLIC LAND SURVEY SYSTEM (PLSS) NEW MEXICO (NM) PRIME MERIDIAN (PM) 23 TOWNSHIP 13 NORTH (T13N) RANGE 9 WEST (R9W) SECTIONS 30 & 31, AND R10W SECTION 36.



ADDED KNOWN CHARACTERIZED LIMITS ABOVE SURFACE SCANNING CRITERIA ON TO MAP

1	05/08/26	MF								REV	DATE	APR'VD	DESCRIPTION



DESIGNED BY: DATE: MS 05/08/26
APPROVED BY: DATE: MF 05/08/26
DRAWN BY: DATE: MS 05/08/26
REVIEWED BY: DATE: MF 05/08/26
FILE NAME: C-100



NEW MEXICO
ENVIRONMENT
DEPARTMENT



ENTACT, LLC
63 INVERNESS DRIVE E
SUITE 101
ENGLEWOOD, CO 80112

ABANDONED URANIUM MINE CLEAN UP
GRANTS, NM

NM SEC. 36
RED BLUFF NO. 1 STATE TRUST LAND
CLOSURE PLAN
PROPOSED REMOVAL LIMITS

NOT FOR CONSTRUCTION

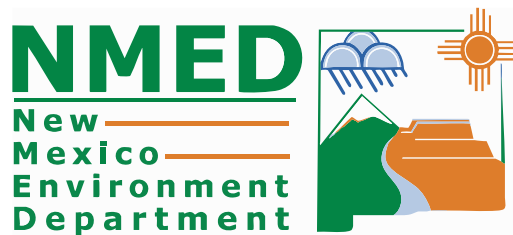
C-100

SHEET 5 OF 5

APPENDICES

QUALITY ASSURANCE PROJECT PLAN RED BLUFF NO 1. AND ROUNDY SITE MCKINLEY COUNTY, NEW MEXICO

PREPARED FOR:



New Mexico Environment Department-Office of the Secretary
Office of Strategic Initiatives
121 Tijeras Ave NE, Suite 11000
Albuquerque, NM 87102

SUBMITTED BY:



ENTACT, LLC
63 Inverness Drive, Suite 101
Englewood, CO 80112

DATE REVISED:

April 6, 2026

Original DATE:

November 7, 2025

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ABBREVIATIONS AND ACRONYMS

APE	Area of Potential Effect
AOC.....	Area of Concern
COC.....	Constituents of Concern
DO	Duplicate Original
DQO.....	Data Quality Objectives
DUP	Duplicate
Eberline	Eberline Services, Inc.
EMNRD	Energy, Minerals & Natural Resources Department
EPA.....	U.S. Environmental Protection Agency
ERA	Environmental Resource Agency
GEL.....	GEL Laboratories, LLC
MAPEP	Mixed Analyte Performance Evaluation Program
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols Manual
MARSSIM.....	Multi-Agency Radiation Survey and Site Investigation Manual
MDC.....	Minimum Detectable Concentration
NMED	New Mexico Environmental Department
PARCC.....	precision, accuracy, representativeness, completeness, and comparability
QA	Quality Assurance
QAPP.....	Quality Assurance Project Plan
QC.....	Quality Control
RPD.....	relative percent difference
SAP	Sampling and Analysis Plan
TPU	Total Propagated Uncertainty

1. INTRODUCTION

This Quality Assurance Project Plan ("Plan") describes the activities and quality requirements associated with the radiological survey and site investigation activities which will be performed at the Red Bluff No. 1 in McKinley County, New Mexico. The activities implemented under this Plan are intended to assess the radiological status of the Red Bluff No. 1 and Roundy site ("the Site") for the purposes evaluating risk of radiation exposure to occupants and the public.

1.1 PURPOSE AND SCOPE

The purpose of this Plan is to describe and establish the quality objectives for survey and sampling activities. This Plan includes all required elements for a Quality Assurance Project Plan (QAPP). The scope of this Plan was developed following applicable United States Environmental Protection Agency (EPA) protocols outlined in EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 (EPA 2001)¹.

This Plan describes the survey objectives, sampling objectives, data quality objectives (DQO), approach to sampling, and measurement methods to support the assessment.

1.2 SITE DESCRIPTION

The Site is located north of Milan, NM approximately 1 mile west of State Highway 605 on County Road 23. The area of concern (AOC) is the entire 192-acre area of potential effect (APE) as provided by the New Mexico Environment Department (NMED) and the Energy, Minerals & Natural Resources Department, Mining & Minerals Division, Abandoned Mine Land Program (EMNRD) in McKinley County, NM. (See Attachment 1).

1.3 PROJECT/TASK ORGANIZATION

The project team will consist of field and project staff from ENTACT, LLC (ENTACT) who will coordinate the work. ENTACT will also be responsible for preparation of plans and reports and overall coordination of the final report for the radiological assessment.

1.3.1 Project Tasks Covered Under This Plan

This QAPP applies to and covers activities described in the Site specific:

- Site Radiological Survey Plan²,
- Sampling and Analysis Plan (SAP)³, and
- Future remediation work plans not yet developed.

1.4 CONSTITUENTS OF CONCERN

As discussed in the SAP³, the Site contains multiple former uranium mine sites. As such, the constituents of concern (COCs) sampled for under this Plan include the isotopes that make up uranium-238 (U-238) and thorium-232 (Th-232) decay chains: uranium, radium, thorium, and their radioactive decay products.

The combination of radium-226 (Ra-226) and radium-228 (Ra-228) and their decay products produces a relatively strong gamma signal that is readily measurable by hand-held gamma instrumentation. Some of the other radionuclides associated with the decay of U-238 and Th-232 are not detectable by hand-held gamma instruments.

When a consistent mixture of radionuclides is present in an area, the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)⁴ allows planners to select and use one radionuclide as a surrogate for all the radionuclide in the mixture to simplify calculations and remove duplication. In this mixture in the U-238 decay chain, thorium-234 (Th-234) is an easily detected surrogate for U-238 and either lead-214 (Pb-214) or bismuth-214 (Bi-214) is an easily detectable surrogate for Ra-226. In this mixture in the Th-232 decay chain, actinium-228 (Ac-228) is an easily detected surrogate for (Th-232) and lead-212 (Pb-212) and thallium-208 (Tl-208) are easily detectable surrogates for radium-224 (Ra-224).

Surrogates detected in samples acquired under this plan will be designated as the isotope they are being used to detect (e.g., Bi-214 and/or Pb-214 will be used to confirm the detected Ra-226 activity, Ac-228 will be used to confirm detected Th-232 activity).

It is not expected that the Th-232 decay chain radioisotopes will be in concentrations sufficient to be considered COCs, but they will be investigated for completeness. The COCs for this project are U-238 and Ra-226.

¹ (USEPA, 2002)

² (ENTACT, LLC, 2025)

³ (ENTACT, LLC, 2025)

⁴ (USEPA, 2001)

2. DATA QUALITY OBJECTIVES

The Data Quality Objective (DQO) process improves the survey effectiveness and efficiency, and improves the defensibility of decisions. DQOs are developed to clarify the radiological survey objective, define the data that should be collected to satisfy the objective, define performance requirements, and specify limits on decision errors to ensure that quality information is obtained from the data.

2.1 STEP 1: STATE THE PROBLEM

As discussed above, the Site is an approximate 192-acre area where uranium mining is known to have taken place.

2.2 STEP 2: IDENTIFY THE DECISION

The purpose of this step is to establish the principal questions, the decisions to be made, and measurements inputs.

The principal questions to be addressed in this Project include:

1. What portable radiological survey instrumentation response is considered 2 times the median response to gamma radiation in a non-impacted area,
2. Are there any areas within the impacted area with a gamma signal greater than 2 times the median response in the non-impacted area, and
3. If soil samples are collected, are the concentrations of COCs in soil in the impacted area within the agreed upon remediation parameters.

2.3 STEP 3: IDENTIFY THE INPUTS TO THE DECISION

This step identifies the information and measurements needed to resolve the decision statements. The data needed to achieve the objectives of this effort consist of accurate and reliable radiological survey information. The following sections identify key attributes of the data needed for this effort.

The following types of inputs are needed:

1. Results of radiological surveys paired with GPS location data in a non-impacted area,
2. Results of radiological surveys paired with GPS location data in the AOC, and
3. Results of soil samples (if necessary).

2.4 STEP 4: DEFINE THE STUDY BOUNDARIES

This step establishes the study boundaries, defines the population of interest, and defines the geographical area.

2.4.1 Media

The media of interest are surface and near-surface soils (0-6 in).

2.4.2 Geographical Areas

The geographical area under consideration is the entire 192-acre site.

2.4.3 Time Frame

The non-impacted and impacted areas will be surveyed and sampled during the fall months between September and November of 2025.

2.4.4 Scale of Decision Making

Decisions relative to whether surface radiation above acceptable levels is present will be based on surveys performed with portable instrumentation in accessible areas as compared to known background levels of radiation.

Concentrations of U-238 and Th-232 decay chain radioisotopes in soil from the AOC will be compared to the selected cleanup criteria once decided upon by the project stakeholders.

2.4.5 Constraints on Decision Making

Adverse weather conditions could impact all aspects of the project.

2.5 STEP 5: DEVELOP A DECISION RULE

In Step 5, a decision rule is developed that defines the conditions that would cause the decision-maker to choose among alternative actions. Activities include: specifying the statistical parameter that characterizes the population; specifying an action level for the decision; confirming that detection limits will allow reliable comparison with the action level; and stating the decision rule.

2.5.1 *Characterized Parameter*

The primary parameter of interest is the portable instrument response to surface gamma emitting material that is considered statistically different from background levels of radiation.

2.5.2 *Action Level*

Action levels will be established based on background levels of radiation determined as discussed in the Site Radiological Survey Plan⁵. Concentrations of U-238 and Th-232 decay chain radioisotopes in soil will be compared to the remediation criteria once decided upon by the project stakeholders.

2.5.3 *Detection Limits*

The reporting limits for critical parameters will be lower than the action levels unless technically not feasible considering routine analytical techniques.

2.5.4 *Decision Rules*

If the response of portable radiation detection instrumentation is greater than two times median background as determined by statistical analysis of the population of data, those areas of elevated detector response will be subdivided into MARSSIM Class 1, 2, and 3 areas based on the presumed surface soil concentrations of COCs and soil samples will be planned and collected appropriately to determine the surface and subsurface concentrations of the COCs in each area.

2.6 STEP 6: SPECIFY LIMITS ON DECISION ERRORS

Measurement errors for portable instrumentation will be minimized by performing quality control checks of instrument response prior to and after use.

Measurement error for analytical data will be minimized by replicate analysis of the same sample. Measurement errors will be assessed by reviewing precision, accuracy, representativeness, completeness, and comparability as discussed in Section 3.

3. ANALYTICAL DATA QUALITY OBJECTIVES

The primary goal of this Plan is to ensure that survey data combined with soil sample results result in adequate coverage of the site to allow for proper remediation planning. Data must be of known and acceptable quality and must have sufficient sensitivity to confidently detect target parameters at or below action levels, as determined from the survey data and, if necessary, soil sample results from the reference area.

Data quality objectives (DQOs) for analytical data are defined in terms of precision, accuracy, representativeness, completeness, and comparability of the data. Quantification and detection limit, bias, precision, completeness, and holding time DQOs are presented in Table 1. This will ensure that the data collected are sufficient and of adequate quality for their intended uses. Data that do not meet DQOs will be qualified during data validation, and their limitations will be noted (where possible given the time constraints). Adequate quantities of sample will be collected to ensure that all necessary analyses can be conducted (e.g., field duplicate analysis and laboratory QC analyses), to meet minimum detectable activity goals, and where possible, to provide archived samples for possible future reanalysis or as replacements for the possible loss of original samples.

DQOs for precision in Table 1 and shown in Appendix B: Laboratory Specifications are based on EPA or equivalent method QC acceptance criteria. Detection limits identified in the Laboratory Specifications are based on feasible analytical methods and detection limit requirements. Analyses will be performed using approved analytical techniques by qualified individuals using industry standard methods such as EPA 901.1 (gamma spectroscopy). The laboratory must also successfully participate in annual performance testing such as that conducted by Environmental Resource Agency (ERA) or the Department of Energy (i.e. the Mixed Analyte Performance Evaluation Program or MAPEP). A summary of auditable aspects of the sampling QA/QC approach is provided in Table 1.

⁵ (ENTACT, LLC, 2025)

Parameter	Value
Matrix type	Soil
Number of samples to be collected	TBD
Number of samples to be analyzed	TBD
Number of field, equipment and trip blanks	NA
Analyte (Radionuclide of Interest)	Isotopic gamma emitting daughters of uranium, thorium or radium
Analytical methods	For soil samples, gamma spec with 21-day ingrowth period for radium isotopes and other unspecified gamma emitters.
Number and type of matrix spikes (MS)	NA
Number and type of duplicate samples	5% for soil
Number and type of split samples	Number and type not currently known. Samples may be split as requested by other parties.

Table 1- Analytical Methods/Quality Assurance Table

3.1 SAMPLE ANALYSIS

Gamma spectroscopy will be performed on all soil samples sent to either Eberline Services in Oak Ridge, TN (Eberline) or GEL Laboratories, LLC in Charleston, SC (GEL). The target analytes of the gamma spectroscopy will be radium isotopes, Ac-228 (Ra-228, and thus Th-232) and Bi-214 (Ra-226); but a full report on all gamma emitters will be requested.

3.1.1 Laboratory Quality Control

The quality of the laboratory data is assessed by precision, accuracy, representativeness, completeness, and comparability (the "PARCC" parameters), and detection limits. Definitions of these parameters and the applicable quality control procedures are described below. The Laboratory Quality Assurance Program Manual is included in Appendix A and is incorporated by reference.

3.1.1.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability (precision) of two or more measurements compared to their average values. Precision is calculated from results of duplicate sample analyses. The duplicate samples will consist of one or more of the following: co-located samples, field replicates, analytical laboratory replicate, and/or laboratory instrument replicate. Laboratory replicate samples will be analyzed at a minimum frequency of one per twenty samples (five percent) per matrix analyzed. Laboratory replicate precision for radionuclides is quantitatively expressed as the absolute or relative percent difference (RPD). These measures are then compared to control limits based on the required or relative method uncertainties.

3.1.1.2 Accuracy

Accuracy is a measure of the closeness (bias) of the measured value to the true value. The accuracy of laboratory test results can be assessed by analyzing a reference material, third-party performance evaluation samples, or "spiking" samples in the laboratory with known standards (surrogates or matrix spikes) and determining the percent recovery.

Laboratory control samples (spikes) for radiological analyses will be carried out in accordance with SW846⁶ requirements for organic analyses at a minimum frequency of one in 20 samples (five percent) per matrix analyzed.

The accuracy of sample results can also be affected by sample contamination. Sample contamination can occur because of improperly cleaned sampling equipment, or because of high radiation levels in the laboratory. To ascertain that the samples are not contaminated by laboratory activities, blank samples will be analyzed at a minimum frequency of one in 20 samples (five percent) per matrix analyzed.

3.1.1.3 Representativeness

Representativeness is a qualitative measure of how closely the measured results reflect the actual concentration or distribution of the constituent concentrations in the matrix sampled. The sampling plan design, sampling collection techniques, sample handling protocols, sample analysis methods, and data review procedures have been developed to assure the results obtained are representative of onsite conditions.

⁶(USEPA, 1992)

3.1.1.4 Completeness

Completeness is defined as the percentage of measurements judged to be valid. Results will be considered valid if they are not rejected during data validation. The target completeness goal for this work will be 90 percent.

3.1.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard methods and procedures for both sample collection and laboratory analysis ensure comparability of data.

3.1.1.6 Detection Limits

The laboratory will be requested to provide full documentation of the analysis performed which will include detection limits for the procedure followed. These documents will be reviewed for completeness and maintained in the project files.

3.2 CERTIFICATION AND SPECIAL TRAINING

Certification in the National Environmental Laboratory Accreditation Program for the radioanalytical laboratories is required.

3.4 DOCUMENTS AND RECORDS

A summary report will be submitted at the end of the project and will include all sampling and analytical results. A map will be provided showing sample locations; survey maps generated from portable survey results married with GPS location data, field and analytical data tables, and data validation summaries. The most current version of this Plan will be maintained by the Project Health Physicist. Bound notebooks or electronic field sampling forms are utilized by field personnel for entering field data. Records and documentation procedures are discussed in detail in the Standard Operating Procedures. Analytical laboratory documentation, case narratives and all supporting documentation for a Level IV package deliverable will be provided in the laboratory data package.

Digital copies of all field notebooks, chain-of-custody (COC) records, field data sheets, and lab reports will be filed and stored on ENTACT's cloud environment.

4. DATA GENERATION AND ACQUISITION

4.1 NON-DIRECT MEASUREMENTS

Acquisition of non-direct data is not anticipated for this project.

4.2 ASSESSMENTS AND OVERSIGHT

Assessments and oversight over both laboratory and field activities ensure that this Plan is implemented as intended and that field activities are on track.

4.2.1 Readiness Review

A readiness review assesses field team preparations prior to starting field activities. The Project Health Physicist is responsible for reviewing all field equipment, instruments, and paperwork in advance of all site-related activities. Site work cannot commence until all issues are resolved to the Project Health Physicist's satisfaction.

4.2.2 Field Assessments and Surveillances

The Project Health Physicist will be responsible for periodic field assessments during the duration of the site work. During these assessments, the Project Health Physicist will review paperwork, observe performance of field personnel, and ensure that all operations are being conducted in a manner that is consistent with this Plan.

4.2.3 Corrective Action Procedures

Corrective actions are developed on a case-by-case basis and are initiated whenever control limits are exceeded, or when results of other system audits or inter-laboratory results indicate an analysis is outside of control limits. Corrective action is taken to determine the cause, and a decision is made on the acceptability of the data collected for that lot of samples. The Laboratory Quality Assurance Program Manual is included in Appendix A.

Situations that may result in corrective action in the analytical laboratory or the field laboratory include:

- Hold times are exceeded;
- A blank has exceeded the limit of quantitation;
- An instrument has failed a calibration check;
- A performance or check sample result is outside control limits; or
- A laboratory control sample result has exceeded the control limits.

4.2.4 Data Management

The laboratory will supply Level IV CLP-like data reports with all analytical results to ENTACT. The laboratory will also supply analytical results in electronic spreadsheet format to the ENTACT Project Health Physicist.

5. DATA VALIDATION AND USABILITY

5.1 DATA VERIFICATION, VALIDATION, QUALITY ASSESSMENT, AND DELIVERY

The primary goal of data verification and validation (V&V) is to ensure that decisions are supported by data of the type and quality needed and expected for the intended use. Data verification is the process of evaluating the completeness, correctness, and consistency of a laboratory package or final data to assure that laboratory conditions and operations are compliant with project plan documents. Data validation addresses the reliability of the data. Results are evaluated to determine the presence or absence of an analyte and the uncertainty of the measurement process for contaminants of concern. Finally, scientific and statistical evaluation of the data may be required to determine if the quality of the data can support its intended use⁷. V&V and summary reports may be generated and submitted to the client upon request. The ENTACT Project Manager will coordinate with the client to determine the formats and schedules desired for transmittal of the laboratory results, validation and summary reports.

ENTACT will review all radiological data for completeness and accuracy, and to determine if the project QA/QC goals have been achieved. Field operations will be fully documented, reviewed and audited on an annual basis at a minimum. Findings and observations will be reported to the client for assessment and corrective action, if applicable. The quality of field and laboratory data will be evaluated based on precision, accuracy, representativeness, completeness, and comparability of the data generated by each type of analysis.

The validator will review all laboratory submittals to verify that the data package is complete, including checks to verify:

- Package contains Chain of Custody;
- Sample numbers and analyses match the Chain of Custody;
- All analyses requested were performed;
- The following analytical parameters are included for each sample:
 - » The Result,
 - » The Total Propagated Uncertainty (also called the Combined Propagated Uncertainty),
 - » The Minimum Quantifiable Concentration (also called the Minimum Detectable Concentration or Limit of Quantitation) and
 - » the Critical Level (also called the Critical Value or Decision Level).
- Laboratory applied data qualifiers (if applicable);
- Case narrative identifies problems (if applicable), including explanation of data qualifiers;
- Sample hold times are met;
- Instrument performance checks have been performed and are acceptable;
- QA/QC samples are present at proper frequency;
- Reports for QA/QC samples; and
- Describe in detail any off-normal conditions or difficulties.

The completeness, correctness and conformance/compliance of the data will be verified and validated against the method, procedural and contractual requirements. One hundred percent of the laboratory data will be verified and validated.

Guidance for data verification/validation is provided in the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)⁸ for radiological constituents. Qualifiers will be applied to the analytical data according to the guidance contained in these documents.

⁷ (USEPA, 2004)

⁸ (USEPA, 2004)

Examples of the Validation Qualifiers that may be used from MARLAP8 Chapter 8:

- "-" A dash indicates the validation is complete and no qualifying conditions were found.
- "E" Missing documentation. No critical value provided (also called the critical level or decision level, "SC" in MARLAP)
- "J" The analyte was positively identified (above the critical value); the associated numerical value is the approximate concentration of the analyte in the sample, and the result can be used with confidence that the true concentration is below the stated quantitation limit or Minimum Detectable Concentration (MDC).
- "Q" Value representing the Total Propagated Uncertainty (TPU) of the measurement exceeds the reported result.
- "R" A rejected result: the analytical problems (quantitative or qualitative) are so severe that the data cannot be used.
- "U" A normal, not detected (less than the critical value) result.
- "B" A BLANK from this sample set exceeds the BLANK MDC, or BLANK MDC + TPU for U-238, Th-234 (U-238 surrogate), or Pb-214 (not used as Ra-226 surrogate).
- "Z" Data for this result has been superseded by the higher isotope activity reported for the duplicate (DUP) or duplicate original (DO).

5.2 CORRECTIVE ACTIONS

Corrective actions are developed on a case-by-case basis and are initiated whenever control limits are exceeded, or when results of other system audits or inter-laboratory results indicate an analysis is outside of control limits. Corrective action is taken to determine the cause, and a decision is made on the acceptability of the data collected for that lot of samples. Laboratory Quality Assurance Program Manuals and specifications are included in Appendices A and B.

Situations that may result in corrective action in the analytical laboratory or the field laboratory include:

- Hold times are exceeded;
- A blank has exceeded the limit of quantitation;
- An instrument has failed a calibration check;
- A performance or check sample result is outside control limits; or
- A laboratory control sample result has exceeded the control limits.

5.3 COMPLETION OF REVIEW

Once all data within the data set are determined to be acceptable, the Project Health Physicist will approve the data set. If not, the Project Health Physicist will determine what further action is necessary. Further action could include re-sampling, reanalyzing archived samples, or eliminating the questionable data from consideration.

6. REFERENCES

- ENTACT, LLC. (2025). Sampling and Analysis Plan: Methods to Measure Uranium Ore Concentrations - Red Bluff No. 1 and Roundy Site.
- ENTACT, LLC. (2025). SITE RADIOLOGICAL SURVEY PLAN.
- USEPA. (1992). Hazardous Waste Test Methods / SW-846.
- USEPA. (2001). Multi-Agency Radiation Survey and Site Investigation Manual, Revision 1.
- USEPA. (2002). Guidance for Quality Assurance Project Plans, EPA QA/G-5.
- USEPA. (2004). Multi-Agency Radiological Laboratory Analytical Protocols Manual.

Attachment B

Eberline Analytical QA Manual



LEGEND

AREA DESIGNATIONS

- NM State Land 
- BLM land 
- Area of Potential Effect - NMED 

PropertyLines

- AndersonEngineeringSurvey_12-3-25 

SOURCES:

Google Earth Aerial Imagery
NMED & EMNRD - APE
2025 Anderson Engineering Property Survey

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

Signature

PREPARED FOR:



					
DRAWING NAME Red Bluff No. 1 & Roundy Area of Potential Effect (APE) with Property Lines					
PROJECT NAME & LOCATION Red Bluff No.1 & Roundy McKinley County, NM					
DRAWN BY E. Fruchtnicht		APPROVED BY		DRAWING NO.	
DATE 12/10/2025		DATE		PROJECT NO. E9462	

APPENDICES:

Appendix A: GEL Laboratories Quality Assurance Plan

Appendix B: Eberline Analytical QA Manual

Appendix C: Laboratory Specifications

APPENDIX A:

GEL Laboratories Quality Assurance Plan

GEL LABORATORIES, LLC

QUALITY ASSURANCE PLAN

(GL-QS-B-001 REVISION 40)

PROPRIETARY INFORMATION

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SECTION 1
INTRODUCTION**Section 1 - Introduction**

GEL Laboratories, LLC (GEL) is a privately owned environmental laboratory dedicated to providing personalized client services of the highest quality. Our mission is to be the "Analytical Firm of First Choice."

GEL was established as an analytical testing laboratory in 1981. Now a full-service lab, our analytical divisions use state of the art equipment and methods to provide a comprehensive array of organic, inorganic, radiochemical, and radiobioassay analyses and related support services to meet the needs of our clients.

This Quality Assurance Plan (QAP) provides an overview of our quality assurance program for analytical services. Outlined in this plan are the responsibilities, policies, and processes essential to maintaining client satisfaction and our high quality of performance. The Director of Quality Systems is responsible for revising, controlling, and distributing the QAP. It is reviewed and revised at least annually.

Everyone on our staff is expected to understand the policies, objectives, and procedures that are described in this plan and to fully appreciate our commitment to quality and their respective roles and responsibilities with regard to quality. We also expect any analytical subcontractors we employ to perform in accordance with the quality assurance requirements delineated in this plan. All GEL employees are required to participate in Annual Quality Systems training.

This Quality Assurance Plan (QAP) has been prepared according to the standards and requirements of the US Environmental Protection Agency (EPA), ANSI/ISO/IEC 17025-2017, and the TNI (The NELAP Institute).

1.1 Quality Policy

GEL's policy is "to provide high quality, personalized analytical services that enable our clients to meet their environmental needs cost effectively."

We define quality as "consistently meeting the needs and exceeding the expectations of our clients." As such, we consistently strive to:

- meet or exceed client and regulatory requirements
- be technically correct and accurate
- be defensible within contract specifications
- provide services in a cost-effective, timely and efficient manner

At GEL, quality is emphasized at every level—from the Chairman and President to the newest of employees. Management's ongoing commitment to good professional practice and to the quality of our testing services to our customers is demonstrated by their dedication of personnel and resources to develop, implement, assess, and improve our technical and management operations.

The purpose of GEL's quality assurance program is to establish policies, procedures, and processes to meet or exceed the expectations of our clients. To achieve this, all personnel that support these services to our clients are introduced to the program and policies during their initial orientation, and annually thereafter during company-wide training sessions.

GEL's management is committed to compliance with and continual improvement of our quality assurance program. The program is designed to comply with the guidelines and specifications outlined in the following:

- TNI 2016
- ASME/NQA-1
- ISO/IEC 17025-2017
- QAPPs, U.S. EPA QA/R5
- Department of Energy Order 414.D
- ANSI N42.23-1996 Measurement and Associated Instrument Quality Assurance for Radiobioassay Laboratories
- ISO 28218-2010 Performance Criteria for Radiobioassay
- DOE STD 1212-2019 Explosives Safety
- ANSI N13.30-2011 Performance Criteria for Radiobioassay.
- Energy Reorganization Act, 1974, Section 206, 10 CFR, Part 21
- MARLAP

- U.S. Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality System Manual (QSM) for Environmental Laboratories, Version 6.0, December 2023.
- 10 CFR Part 21- Reporting of Defects and Noncompliance
- 10 CFR Part 61- Licensing Requirements for Land Disposal of Radioactive Waste
- NRC REG Guide 4.15
- The development and implementation of good laboratory and standard operating procedures (SOPs).
- Ability to customize quality assurance procedures to meet a client's specific requirements for data quality.
- Good control of instruments, services, and chemical procurement.
- A continuously capable Laboratory Information Management System (LIMS).
- Validated and documented computer hardware and software.
- All employees who have access to the LIMS system are required to participate in computer security awareness training annually to various SOPs and semiannually to a 3rd party training modules.

1.2 Quality Goals

GEL's primary goals are to:

- Ensure that all measurement data generated are scientifically and legally defensible, of known and acceptable quality per the data quality objectives (DQOs), and thoroughly documented to provide sound support for environmental decisions.
- Ensure compliance with all contractual requirements, environmental standards, and regulations established by local, state, and federal authorities.

Additional goals include:

- A comprehensive quality assurance program to ensure the timely and effective completion of each measurement effort.
- A commitment to excellence and improvement at all levels of the organization.
- Early detection of deficiencies that might adversely affect data quality.
- Adequate document control.
- Effective quality assurance objectives for measurement systems and for quality data in terms of accuracy, precision, completeness, and comparability through the use of proven methods.
- The establishment of procedures that demonstrate that the analytical systems are in a state of statistical control.
- The implementation of corrective actions and improvements to ensure the integrity of data.
- Reduction of data entry errors through comprehensive automated data handling procedures.
- An independent quality assurance (QA) validation and Quality Systems Department.
- A formal quality policy and QAP.
- Management review.
- Stated DQOs.
- A comprehensive employee training program.
- Ethics policy and education program.
- Internal audits and self-evaluations.
- A closed-loop corrective action program.
- State-of-the-art facilities and instruments.
- Adherence to standard operating procedures.
- EPA/NIST traceable reference materials.
- Electronically based document control.
- CoCs and electronic sample tracking.
- Inter-laboratory comparison programs.
- Formal laboratory accreditations.
- The evaluation of subcontractor laboratories.
- Statistical controls for analytical precision and accuracy.

1.3 Key Quality Elements

A sound quality assurance program is essential to our ability to provide data and services that consistently meet our high standards of integrity. The key features of our program are:

- Replicate, method blank, matrix spike, tracer yield, internal standards, and surrogate measurements.
- The preventive maintenance of instrumentation and equipment.
- Independently prepared blind standard reference materials.
- Multi-level review processes.
- Focus on client satisfaction.
- Electronic tracking of client commitments, nonconformances and corrective actions.
- Trend analysis of nonconforming items.

1.4 Management Reviews

The effectiveness of the Quality System is reviewed at least annually by Senior Management. These reviews address issues that impact quality, and the results of the reviews are used to develop and implement improvements to the system. Records of the review meetings are maintained as quality documents.

1.5 Disposition of Client Records

In the event that the laboratory should change ownership, the responsibility for the maintenance and disposition of client records shall transfer to the new owners. In the unlikely event that the laboratory ceases to conduct business, clients shall be notified and asked to provide instructions as to how their records should be returned or disposed. If a client does not provide instructions, those records will be maintained and disposed of in a manner consistent with regulations and good laboratory practices for quality records.

1.6 Supporting Documents

Our laboratory operations and the quality of our analytical data comply with the specifications described in the documents listed in Appendix A.

1.7 Definitions

Applicable definitions are listed in Appendix B.

SECTION 2

ORGANIZATION, MANAGEMENT, AND PERSONNEL

Section 2 - Organization, Management, and Personnel

The chart found in Appendix C depicts our corporate organization, chain of command and flow of responsibility. The illustration in this appendix is designed to ensure the overall quality and cost efficiency of our company's analytical products and services.

Our structure is based on customer-focused divisions that follow a project from the point of initial contact to the final invoicing of work. These divisions include expertise in project management, sample receipt and custody, sample preparation and analysis, data review, and data packaging. An independent Quality Systems Management Department monitors the adherence of these divisions to the Quality Assurance Program.

The laboratory's technical manager(s), however named, and/or his/her designee(s) shall: If absent for a period of time exceeding fifteen (15) consecutive calendar days shall designate another full-time staff member meeting the qualifications of the technical manager(s) to temporarily perform this function. If this absence exceeds thirty-five (35) calendar days, the primary accreditation body shall be notified in writing.

The general responsibilities associated with the following position levels are discussed in this section:

- Chairman
- President and CEO
- Chief Operating Officer (COO)
- Chief Financial Officer (CFO)
- Quality Systems Director
- Laboratory Directors
- Project Managers
- Group Leaders
- Laboratory and Technical Staff
- Information Systems Manager
- Environmental Manager

- Radiation Safety Officer
- Director of Human Resources

An overview of GEL's employee training protocol is also provided in Section 2.12.

2.1 Chairman, President, Chief Financial Officer and Chief Operating Officer

Operational responsibility rests with GEL's owners, CFO and COO. James M. Stelling and Joseph M. Hodgson Jr. are owners and serve respectively as Chairman and President and CEO. Carey J. Bocklet occupies the position of COO. Laurie Herrington occupies the position of CFO. As the highest-level executives, their philosophical approach to quality, technology and customer service keeps GEL unique. They are also part of a Leadership Team that works to create a workplace environment that attracts and retains highly qualified professionals.

As Chairman, Mr. Stelling oversees the Executive Committee and leads management in implementing corporate initiatives, establishing strategic direction/vision and ensuring the committee is focused on the long-term goals for The GEL Group, Inc. Mr. Stelling holds a Bachelor of Science in Commerce from the University of Virginia.

Joseph M. Hodgson Jr. is GEL's President and CEO. As President and CEO, Mr. Hodgson has overall operational responsibility for implementing GEL's vision and ensuring goals are achieved for the LLCs of The GEL Group, Inc. In this role, he provides leadership and guidance to the laboratory for strategic planning, allocation of resources, and compliance with corporate policies. He also directs GEL's budgetary and financial activities and is responsible for the financial health of the organization. Mr. Hodgson Jr. holds a Bachelor of Science in Business from Wake Forest University.

The Chief Operating Officer is Carey J. Bocklet. Ms. Bocklet is responsible for overall laboratory operations, contracts administration, support services and business development. In this role, she ensures the strategic initiatives for the laboratories are achieved and that the

laboratories are operating in compliance with all applicable regulations. Ms. Bocklet holds a Bachelor of Science in Chemical Engineering, and a Master of Science in Business Administration, both from Clemson University.

Laurie Herrington is GEL's Chief Financial Officer and oversees GEL's financial management. She is responsible for invoicing, purchasing, payroll, accounts payable, and receivable, inventory control, property control and financial forecasting. Ms. Herrington holds a Bachelor of Science in Accounting and Business Administration from the College of Charleston. Ms. Herrington also has her licenses as a Certified Public Accountant and a Certified Fraud Examiner.

Together, the Chairman, President and CEO, COO and CFO form GEL's Executive Committee. Their responsibilities include the following:

- Ensuring that the individuals who staff our technical and quality positions have the necessary education, training, and experience to competently perform their jobs.
- Ensuring that all staff members receive ancillary training, as needed, to enhance performance in assigned positions.
- Budgeting, staffing, managing, and equipping the laboratory to meet current and future analytical program requirements.
- Overseeing the implementation and overall effectiveness of our Quality Assurance Plan, health and safety initiatives, and environmental programs.
- Managing production and cost control activities.
- Ensuring development of capabilities in response to new or revised regulations, instrumentation and procedures, and quality assurance initiatives.

2.2 Laboratory Co-Directors

To enhance our responsiveness to clients through dedicated expertise and teamwork, our laboratory is divided into two major divisions, Chemistry and Radiochemistry, each with its own Laboratory Director.

The Laboratory Directors report to the Executive Committee and are ultimately responsible for the technical content and quality of work performed within

each division. They are also responsible for strategic planning, profitability and growth, personnel management and business development. Other responsibilities include:

- Monitoring and meeting profitability and growth objectives of the division.
- Establishing and implementing short and long range objectives and policies that support GEL's goals.
- Defining the minimum level of qualification, experience, and skills necessary for positions in their divisions.
- Establishing and implementing policies and procedures that support our quality standards.
- Ensuring that technical laboratory staff demonstrates initial and continuing proficiency in the activities for which they are responsible.
- Documenting all analytical and operational activities of the laboratory.
- Supervising all personnel employed in the division.
- Ensuring that all sample acceptance criteria are verified and that samples are logged into the sample tracking system, properly labeled, and stored.
- Documenting the quality of all data reported by the division.
- Developing internal mechanisms and measurements to improve efficiency.
- Overseeing activities designed to ensure compliance with laboratory health and safety requirements.
- Allocating the resources necessary to support an effective and ongoing quality assurance program.
- Representing the company to the public and to clients.
- Ensuring the appropriate delegation of authorities during periods of absence.
- Ensuring compliance to the ISO 17025:2017 Standard.

2.3 Quality Systems Director

Our Quality Systems Director (QSD) reports directly to the Chief Operating Officer (COO), the highest-ranking position within GEL Laboratories, LLC. The QSD is part of the laboratory's Leadership Team and has direct and immediate access to the highest level of management of the GEL Group Inc. The QSD manages the design, implementation and maintenance of our quality systems in a timely, accurate, and consistent manner.

In addition to having responsibility for the initiation and recommendation of corrective and preventive actions, the QSD is responsible for:

- Establishing, documenting, and maintaining comprehensive and effective quality systems.
- Developing and evaluating quality assurance policies and procedures pertinent to our laboratory functions and communicating these with the division directors and managers.
- Ensuring that the operations of the lab are in conformance with the Quality Assurance Plan and meet the quality requirements specific to each analytical method.
- Ensuring that laboratory activities are in compliance with local, state, and federal environmental laws and regulations.
- Reviewing project-specific quality assurance plans.
- Ensuring that quality control limits are established and followed for critical points in all measurement processes.
- Initiating internal performance evaluation studies using commercially purchased certified, high-purity standard reference materials.
- Performing independent quality reviews of randomly selected data reports.
- Conducting periodic audits to ensure method compliance.
- Conducting or arranging periodic technical system evaluations of facilities, instruments and operations.
- Overseeing and monitoring the progress of nonconformances and corrective actions.
- Communicating system deficiencies, recommending corrective action to improve the system, and defining the validity of data generated during out of control situations.
- Preparing and updating quality assurance documents and reports to management.
- Coordinating inter-laboratory reviews and comparison studies.
- Overseeing Stop Work Orders in out-of-control situations.
- Administering accreditation and licensing.
- Administering our document control system.
- Providing guidance and training to laboratory staff as requested.
- Evaluating subcontractors and vendors that provide analytical and calibration services.
- Designating quality systems authorities in times of absence to one or more appropriately knowledgeable individuals.
- Overseeing notification if required for compliance with Energy Reorganization Act, 1974, 10 CFR, Part 21, should data recall be necessary.
- Ensuring that the laboratory has policies to avoid involvement in activities or relationships which might negatively affect confidence in the laboratory's competence, impartiality, judgement or operational integrity.
- Ensuring that management and personnel are free from undue internal and external pressures and influences that may adversely affect their impartiality, affecting the quality of their work, by mitigating pressures.
- Ensuring that employee competence measurements are established and monitored.

2.4 Quality Systems Review

The effectiveness of the Quality System is reviewed on a regular basis during operational meetings with the Leadership Team, which may be as often as weekly, but not less than quarterly. These meetings address issues that impact quality, and the subsequent discussions are used to design and implement improvements to the system. At least annually, a management assessment of

GEL's Quality System is conducted and reported. The QSD maintains records of these assessments.

2.5 Manager of Client and Support Services

Project Managers (PMs) serve as primary liaisons to our clients. PMs, under the guidance of the Manager of Client and Support Services, manage the company's interaction with clients. They are the client's first point of contact and have responsibility for client satisfaction and for communicating project specifications and changes to the appropriate laboratory areas.

Additional responsibilities include:

- Retaining clients and soliciting new work.
- Managing multiple sample delivery orders and preparing quotes.
- Working with clients to define analytical methodologies, quality assurance requirements, reports, deliverables, and pricing.
- Overseeing sample management and informing laboratory staff of the anticipated arrival of samples for analysis.
- Conducting a review of client documents (i.e. quotes, invoices, routine and specialized reports).
- Working with the accounting team on invoicing and collection issues.
- Working with the Laboratory Directors, Production Manager, and Group Leaders to project workloads and determine schedules.

2.6 Group Leaders

Group Leaders are a critical link between project management, lab personnel, and support staff. They report to the Laboratory Director and have the following responsibilities:

- Planning and coordinating the operations of their groups to meet client expectations.
- Scheduling sample preparation and analyses according to holding times, quality criteria, and client due dates.
- Ensuring a multi-level review of 100% of data generated by their groups.

- Coordinating nonconformances and corrective actions in conjunction with the Quality Systems Management team.
- Serving as technical resources to their groups, including data review.
- Managing special projects, reviewing new work proposals, and overseeing the successful implementation of new methods.
- Monitoring and controlling expenses incurred within their groups such as overtime and consumables.
- Providing performance and career development feedback to their group members.

2.7 Laboratory and Technical Staff - General Requirements

At GEL, every effort is made to ensure that the laboratory is sufficiently staffed with personnel who have the training, education, and skills to perform their assigned jobs competently.

Depending upon the specific position, laboratory personnel are responsible for:

- Complying with quality assurance and quality control requirements that pertain to their group and/or technical function.
- Demonstrating a specific knowledge of their particular function and a general knowledge of laboratory operations.
- Understanding analytical test methods and standard operating procedures that are applicable to their job function.
- Documenting their activities and sample interactions in accordance with analytical methods and standard operating procedures.
- Implementing the quality assurance program as it pertains to their respective job functions.
- Identifying potential sources of error and reporting any observed substandard conditions or practices.
- Identifying and correcting any problems affecting the quality of analytical data.

- Identifying and performing all client specific requirements outlined in the special requirements on the pull sheet of every batch.
- Job descriptions for Analyst I,II,III and Senior Chemists are maintained in Human Resources

2.8 Information Systems Manager

The Information Systems Manager reports directly to a Laboratory Director. The responsibilities of this position include management of the Computer Services Team and LIMS, our laboratory information management system.

The combined responsibilities of the Information Systems Team, performing under the leadership of the Information Systems Manager, include the:

- Development and maintenance of all software and hardware.
- Translation and interpretation of routines for special projects.
- Interpretation of general data and quality control routines.
- Optimization of processes through better software and hardware utilization.
- Customization, testing and modification of database applications.
- Maintenance and modification of our computer modeling, bar coding, CAD, statistical process control, project management, and data packaging systems.
- Development and maintenance of client and internal electronic data deliverables.
- Validation and documentation of software used in processing analytical data.
- System Security and Virus Protection by use of such tools as Virtual Private Network, (VPN), firewall restrictions and Secure Service Gateway.

2.9 Environmental Health and Safety Manager

The Environmental Health and Safety Manager oversees our physical facility, laboratory and radiation safety programs, and instrumentation. This position reports to the COO and manages and supervises the functions and staff assigned to these areas.

Responsibilities of the Environmental Manager include:

- Planning, evaluating, and making recommendations for facility maintenance, additions and renovations.
- Overseeing building renovations and new construction activities.
- Implementation of the Chemical Hygiene and Radiation Safety programs.
- Installing, maintaining, repairing, and modifying analytical instrumentation.
- Providing technical expertise and training in instrumentation operation, calibration, and maintenance.
- Monitoring and ensuring regulatory compliance for waste management operations and off-site disposal.

2.10 Radiation Safety Officer

The Radiation Safety Officer (RSO) reports to the EHSM. The RSO is responsible for the administration and execution of GEL's Radiation Protection Program. This person provides technical guidance and leadership for all issues concerning radiation health and safety as well as direct operations to ensure compliance with South Carolina Department of Environmental Services (SCDES) regulations for radioactive materials.

Responsibilities of the RSO include:

- Establishing and enforcing policies consistent with the principles and practices designated to maintain all exposure to ionizing radiation As Low As Reasonably Achievable-(ALARA).
- Supervising Radiation Protection Specialists in the execution of radiological surveys and maintenance of the Radioactive Material License inventory.
- Executing the Personal Dosimetry, Air Effluent Monitoring, and Sealed Radioactive Source Leak Test Programs.
- Developing procedures and protocols to establish and maintain compliance.

- Providing training for staff in proper radiation protection practices.

2.11 Director of Human Resources

The Director of Human Resources reports directly to the President. The DHR manages the design, implementation, and ongoing development of our Human Resources. Responsibilities of the DHR include:

- Administration, orientation, and indoctrination of all new employees.
- Administration and compliance with Federal, State, and Local employment regulations.
- Sourcing candidates for all functional positions to maintain and strengthen the technical services provided by GEL.
- Management of occupational health and safety as it relates to Federal, State, and OSHA regulations.

2.12 Employee Training

To ensure that our clients receive the highest quality services possible, we train our employees in the general policies and practices of the company, as well as the specific operating procedures relative to their positions. We conduct and document this training according to GL-HR-E-002 for Employee Training and GL-QS-E-017 for Maintaining Technical Training Records.

New employees participate in a company orientation shortly after they are hired. During orientation they receive information on quality systems, ethics/data integrity, laboratory safety, and employment practices. Each new employee is also provided a manual that reiterates our policies on equal opportunity, benefits, leave, conflicts of interest, employee performance, and disciplinary action. Employees can access standard operating procedures, the Quality Assurance Plan, Safety, Health, and Chemical Hygiene Plan, and the Laboratory Waste Management Plan on GEL's Intranet.

Other training provided on an ongoing basis may include:

- Demonstration of initial proficiency in analytical methods and training to SOPs conducted by a trainer who has been documented as qualified and proficient in the process for which training is being provided.
- Demonstration of continued analyst proficiency is updated continuously, using the most recent data available in LIMS. Proficiency is demonstrated using the same processes as those used for initial Demonstration of Capability. (Refer to Section 8.3.1.)
- Company-wide, onsite training.
- Courses or workshops on specific equipment and analytical techniques.
- University courses.
- Professional and trade association conferences, seminars, and courses.

Documentation of employee training is the joint responsibility of the employee and the applicable Group Leader. If an SOP is revised during the course of the year, training to the revised SOP must be documented.

2.13 Ethics and Data Integrity

As our corporate vision statement explains, "We are a company that values: Excellence as a way of life, Quality Service, a Can-Do attitude, and a fundamental commitment to Ethical Standards." Employees attend ethics education programs that focus on the high standards of data integrity and ethical behavior mandated by our company and expected by our clients.

The annual ethics training includes:

- Specific examples of unethical behaviors for the industry and for the laboratory.
- Explanation of Internal Auditing for unethical behaviors and practices.
- GEL uses electronic audit functions using instrument and LIMS software.
- Explanation of GEL's Ombudsman policy for reporting inappropriate activities.
- Examples of consequences of inappropriate or unethical behaviors/practices.
- Examples of impartiality from commercial, financial or other pressures, both external and internal.

All investigations resulting from data integrity issues are conducted in a confidential manner until they are completed. These investigations are documented, as well as any notifications made to clients receiving any affected data. The laboratory will report any instances of inappropriate and prohibited laboratory practices, as detailed in the DoD/DOE QSM, to their Accrediting Body (AB) within 15 business days of discovery. Discovery includes finding such inappropriate practices by laboratory staff or customers stakeholders. DoD ELAP laboratories, and DOECAP-AP laboratories, must submit records of associated corrections taken or proposed corrective actions to their AB within 30 business days of discovery. The respective AB will then have the responsibility of informing the EDQW (for DoD-ELAP) and/or ASPM (for DOECAP-AP) of the laboratory's deviation from the requirements of the DoD/DOE QSM. The respective ABs, DOE, and EDQW deem these infractions quite serious and appreciate the cooperation from all the involved parties.

All employees sign an Ethics and Data Integrity Agreement that reflects their commitment to always perform their duties with these high standards. (Refer to Appendix F) During the initial and continuing Ethics and Data Integrity training, GEL's policy on confidential reporting of potential integrity issues is thoroughly discussed. Potential business or data integrity issues are handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. All investigations are confidentially processed by GEL's QSD, or other members of GEL's Laboratory Management staff under the direction of the QSD. All investigations that result in finding of inappropriate activity are properly documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients. The QSD is responsible for updating GEL's Executive Committee on the progress of integrity investigations during regularly scheduled meetings.

2.14 Confidentiality

The laboratory maintains the confidentiality and proprietary rights of information including the type of work performed and results of analysis. Laboratory

personnel and staff are informed of this policy and sign a confidentiality agreement.

A confidentiality statement accompanies the electronic transfer of data from GEL via telefacsimile (fax) or electronic mail systems (email). Government affiliated auditing agencies have access to pertinent laboratory records. However, contract, third party, and client auditors have access only to those records that may be applicable to their inspection and shall not be granted access to client records that may be considered in conflict with their interests, unless prior authorization has been given by the submitting client. Confidential information may be redacted by the laboratory to remove references to client identity, project details, and/or sample identification, allowing records to be shared with external parties (e.g., auditors) for review..

When the laboratory is required by law or authorized by contractual arrangements to release confidential information, the customer or individual concerned shall, unless prohibited by law, be notified of the information provided. Information about the customer obtained from a source other than the customer (e.g., complainant, regulators) shall be confidential between the customer and the laboratory. The provider (source) of this information shall be confidential to the laboratory and shall not be shared with the customer, unless agreed by the source. Personnel, including acting committee members, contractors, personnel of external bodies, or individuals acting on the laboratory's behalf, shall keep confidential all information obtained or created during the performance of laboratory activities, except as required by law.

2.15 Impartiality

The laboratory is committed to Impartiality in producing valid results derived under its range of activities or scope of work. Results are provided accurately, objectively, clearly and in a report format which includes all the information necessary for the interpretation of the results. All information required by the method used and agreed with the customer is reported. The laboratory strives to maintain impartiality from commercial, financial or other pressures which might compromise impartiality. In addition to the internal management structure mitigating undue pressures on employees, the laboratory reviews

requests and tenders for possible risks to impartiality prior to bidding on work.

Our Core Values, along with procedures, plans, and policies outlined in this Quality Assurance Plan, scheduled management meetings, and monitoring of key performance indicators help in the management of risks on an on-going basis.

SECTION 3 QUALITY SYSTEMS

Section 3 - Quality Systems

Our Quality Systems include all quality assurance (QA) policies and quality control (QC) procedures necessary to plan, implement, and assess the work we perform. GEL's QA Program establishes a quality management system (QMS) that governs all of the activities of our organization.

GEL's quality management system is designed to conform to the requirements specified in the standards referenced in Appendix A. Essential elements of our quality management system are described in this section and Appendix E.

3.1 Quality Systems Team

The Quality Systems Team monitors risks to impartiality, confidentiality and other undue influences which could adversely affect confidence in the laboratory's competence, judgement, or operational integrity. This team monitors conformity to the range of activity under which it performs. Risks which may affect the validity of results are identified, monitored, and assessed as to the potential impact on the validity of the results. This group is responsible for recording and managing customer complaints through the laboratory non-conformance reporting system.

The following is a summary of the responsibilities of each position, in addition to the duties discussed in section 2.3.

3.1.1 Quality Systems Director

- Reports to the COO
- Demonstrates strict adherence to and support of the company ethics policy
- Serves as management's representative for quality
- Responsible for the implementation and maintenance of the QMS
- Supervises the Quality Systems Team and their functions
- Initiates and recommends preventive action and solutions to quality problems

- Implements appropriate action to control quality problems until solutions are implemented and verified to be effective.
- Verifies that effective solutions are implemented
- Demonstrates knowledge of the Quality System as defined by NELAC, TNI, NUPIC, ISO/IEC 17025, DOECAP DoD ELAP, and DOELAP.

3.1.2 Quality Systems Lead Auditor

- Reports to the Quality Systems Director
- Demonstrates strict adherence to and support of the company ethics policy.
- Demonstrates knowledge of the Quality System defined under NELAC, TNI, DOECAP, DoD ELAP, DOELAP, NUPIC and other quality standards such as ISO/IEC 17025-2017.
- Plans, schedules and participates in GEL's client audits, internal audits, and subcontractor audits
- Conducts conformance audits as necessary to verify implementation and closure of audit action items
- Serves as liaison to client and third-party auditors
- Coordinates laboratory responses to audit reports and prepares final response
- Monitors progress of corrective actions
- Prepares and monitors progress of internal and subcontractor audit reports

3.1.3 Quality Assurance Officers

- Report to the Quality Systems Director
- Demonstrate strict adherence to and support of the company ethics policy.
- Demonstrate the ability to evaluate data objectively without outside influence
- Have documented training and/or experience in QA/QC procedures and knowledge of the Quality system as defined under NELAC, TNI and ISO 17025.
- Have knowledge of analytical methods

- Assist in the conduct of internal and supplier audits and requests for pricing reviews
- Administer corrective actions and nonconformances
- Monitor and respond to client -identified nonconformances and technical inquiries
- Implement and maintain statistical process control (SPC) system
- Ensure the monitoring of balances and weights, and temperature regulation of ovens, water baths, hot blocks, incubators, freezers and refrigerators
- Coordinate the monitoring of DI water system and volatile organics storage coolers
- Maintain Method Detection Limit studies
- Write or review quality documents and standard operating procedures under the direction of the QS Director
- Provide training in quality systems and good laboratory practices.
- Manage laboratory certification processes
- Coordinate the receipt and disposition of external and internal performance evaluation samples.

NOTE: Once proficiency testing (PT) samples have been prepared in accordance with the vendor's instructions, they are incorporated into the standard sample preparation workflow and treated as routine environmental samples. All preparation, analysis, and reporting are performed using the same procedures applied to typical client samples, with no special handling or separate processes.

3.1.4 Quality Systems Specialists/Document Control Officer

- Reports to the Quality Systems Director
- Demonstrates strict adherence to and support of the company ethics policy.
- Assist the team as directed with respect to Records Management, Document Control, Laboratory Certification, temperature and weight calibrations, logbook review, training documentation, and nonconformances, etc.

3.2 Quality Documents

Our Quality Systems policies and procedures are documented in this and other supporting documents. GEL's management approves all company quality

documents. Pre-approval is secured for any departures from such documents that may affect quality.

In addition, to the QAP, Quality Systems allows for QA Project Plans (QAPjP) and includes standard operating procedures and any other quality assurance program requirements defined by individual contracts. The QAP describes the quality standards that we apply to our laboratory operations. We use Quality Assurance Project Plans to specify individual project requirements. The QAP and supporting documents are verified to be understood and are implemented throughout the laboratories to which they apply.

Finally, SOPs are used to describe in detail those activities that affect quality. SOPs are prepared, authorized, changed, revised released, and retired in accordance with GL-ADM-E-001. SOPs are accessible electronically via GEL's Intranet.

3.3 Document Control

The control of quality documents is critical to the effective implementation of our Quality Program. We define and control this process in accordance with GL-DC-E-001 for Document Control. Responsibilities for document control are divided between the Group Leaders and the Document Control Officer (DCO).

Group Leaders are responsible for:

- Supporting the development and maintenance of controlled documents that apply to their respective departments.
- Reviewing all quality documents annually for continued validity.
- Ensuring documentation that the affected employees are aware of revisions to documents or manuals.

The Computer Services Team is responsible for:

- Electronic maintenance of all records required for control, re-creation, and maintenance of analytical documentation.
- Maintenance of electronic copies of archived data and the electronic log of how they were determined.

The DCO is responsible for:

- Demonstrating strict adherence to and support of the company ethics policy.
- Managing the system for the preparation, authorization, change, revision, release, and

retirement of the Quality Manual, QAP, project plans, and standard operating procedures.

- Ensuring that current controlled documents are accessible via GEL's Intranet.
- Managing a system to document current revision numbers and revision dates for all distributed documents and manuals.
- Managing a system to identify the nature of document revisions.
- Maintaining hard or electronic copies of obsolete documents.
- Maintaining electronic or hard copy originals of all controlled documents.

Revisions to controlled quality documents are made by replacing individual sections or the entire document, as determined by the DCO.

3.4 Controlled Document Review

Internally generated controlled documents undergo a multi-level review and approval process before they are issued. These levels include a procedural review, technical and/or quality review and final authorization of the appropriate manager or director if necessary. To ensure that new or revised standard operating procedures are not implemented prematurely, SOPs are effective upon the date of the final approval signature.

3.5 Quality Records

Quality records provide evidence that specified quality requirements have been met and documented. We generate them in accordance with applicable procedures, programs, and contracts. Quality records include but are not limited to:

- Observations
- Calculations
- Calibration data
- Certificates of analysis
- Certification records
- Chains of custody
- Audit records
- Run logs, instrument data, and analytical logbooks
- Instrument, equipment, and building maintenance logs
- Material requisition forms
- Monitoring logs

- Nonconformance reports and corrective actions
- Method development and start-up procedures including method detection limit studies
- Technical training records
- Waste management records
- Standard logs
- Software validation documentation
- SOPs
- Sample collection and field data

Our quality records are:

- Documented in a legible manner.
- Indexed and filed in a manner conducive to ready retrieval.
- Stored in a manner that protects them from loss, damage, and unauthorized alterations.
- Accessible to the client for whom the record was generated.
- Retained and disposed in the identified time period.

The generation, validation, indexing, storage, retrieval, and disposition of our quality records are detailed in GL-QS-E-008 for Quality Records Management and Disposition. The quality records of subcontracted services are also required to meet the conditions established in this SOP.

3.6 Internal and Supplier Quality Audits

We conduct internal audits annually to verify that our operations comply with the requirements of our QA program and those of our clients. We perform supplier audits as necessary to ensure that they too meet the requirements of these programs. Both internal and supplier audits are conducted in accordance with GL-QS-E-001 for the Conduct of Quality Audits.

3.6.1 Audit Frequency

Internal audits are conducted at least annually in accordance with a schedule approved by the Quality Systems Director (QSD). Supplier audits are contingent upon the categorization of the supplier and may or may not be conducted prior to the use of a supplier or subcontractor (Refer to GL-QS-E-001.) Type I suppliers and subcontractors, regardless of how they were initially qualified, are re-evaluated at least once every three years.

Additional internal and supplier audits may be scheduled if deemed necessary.

3.6.2 *Audit Team Responsibilities*

Internal and supplier audits are conducted by qualified staff under the direction of the Lead Auditor or QSD. A qualified audit team member shall have the technical expertise to examine the assigned activities.

We do not allow staff to audit activities for which they are responsible or in which they are directly involved. It is the responsibility of the Lead Auditor to ensure that such conflicts of interest are avoided when the audit team is assembled.

The Leadership Team has a significant role in the internal audit process, including:

- Provision of audit personnel
- Empowerment of the audit team with authority to make the audit effective
- Development and implementation of timely corrective action plans

3.6.3 *Identification and verification of Opportunities for Improvement*

Opportunities for Improvement (OFIs) are identified conditions that have the potential to improve the quality of products or services. Several examples of objective evidence are used to support an OFI, which might be classified as an observation, and/or recommendation.

The Lead Auditor may initiate an OFI and may reference a Nonconformance Report (NCR) or Corrective Action Request and Report (CARR). The OFI is then entered into the NCR system per GL-QS-E-012-Client NCR Database Operation.

Implementation of any changes or action is verified as effective prior to implementation. The OFI may be verified for continued effective implementation during the next scheduled audit.

3.7 **Managerial and Audit Review**

Our Leadership Team reviews the audit process at least annually. This ensures the effectiveness of the corrective action plan and provides the opportunity to introduce changes and improvements.

We document all review findings and corrective actions. Implementation plans and schedules are monitored by the Quality Systems Team.

3.8 **Nonconformances**

Processes, materials, and services that do not meet specifications or requirements are defined as nonconforming. Such nonconformances can include items developed in-house or purchased from vendors, samples received from clients, work in progress, and client reports.

At GEL, we have a nonconformance reporting system (NCR) that helps us prevent the entry of defective goods and services into our processes and the release of nonconforming goods and services to our clients. Our NCR system provides a means for documenting the disposition of nonconforming items and for communicating these to the persons involved in the process affected by the adverse condition(s).

Nonconformances are documented according to GL-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items. We regularly review SOPs, client complaints, and quality records, including completed NCRs, to promptly identify conditions that might result in situations or services that do not conform to specified quality requirements.

Our Quality Group processes, categorizes and trends nonconformances. Trending information may be provided to the Leadership Team and Group Leaders of the affected areas.

3.9 **Corrective Action**

There are two categories of corrective action at GEL. One is corrective action implemented at the analytical and data review level in accordance with the analytical SOP. The other is formal corrective action documented by the Quality Systems Team in accordance with GL-QS-E-002; this would include the investigation of performance testing samples evaluated as non-acceptable in SOP GL-QS-E-019. Formal corrective actions are initiated when a nonconformance recurs or is so significant that permanent elimination or prevention of the problem is required.

We include quality requirements in most analytical SOPs to ensure that data are reported only if the quality control criteria are met or the quality control measures that did not meet the acceptance criteria are documented.

Formal corrective actions are implemented according to GL-QS-E-002-Conducting

Corrective/Preventive Action and Identifying Opportunities for Improvement and documented according to GL-QS-E-012-Client NCR Database Operation.

Any employee at GEL can identify and report a nonconformance and request that a corrective action be taken. Any GEL employee can participate in a corrective action team as requested by the QS team or Group Leaders. The steps for conducting corrective action are detailed in GL-QS-E-002.

In the event that correctness or validity of the laboratory's test results is doubted, the laboratory will take corrective action. If investigations show that the results have been impacted, affected clients will be informed of the issue in writing within 5 calendar days of the discovery.

GEL will notify all affected customers of any data quality issues resulting from nonconforming work within 15 business days of discovery. GEL will provide and submit records of the corrective actions to resolve the nonconformance(s) to the customer(s) within 30 business days. This procedure will also be followed to notify GEL's accrediting body if the laboratory experiences any instances of inappropriate and prohibited laboratory practices. GEL will perform these procedures in accordance with SOP GL-QS-E-002-Conducting Corrective/Preventative Action and Identifying Opportunities for Improvement.

3.10 Performance Audits

In addition to internal and client audits, our laboratory participates in annual performance evaluation studies conducted by independent providers. We routinely participate in the following types of performance audits:

- Proficiency testing and other inter-laboratory comparisons.
- Performance requirements necessary to retain certification (Appendix D).
- Evaluation of recoveries of certified reference and in-house secondary reference materials using statistical process control data.
- Evaluation of relative percent difference between measurements through SPC data.

We also participate in a number of proficiency testing programs for federal and state agencies and as required by contracts. It is our policy that no proficiency evaluation samples be analyzed in any special manner.

Our annual performance evaluation participation generally includes a combination of studies that support the following:

- US Environmental Protection Agency Discharge Monitoring Report, Quality Assurance Program (DMR-QA). Annual national program sponsored by EPA for laboratories engaged in the analysis of samples associated with the NPDES monitoring program. Participation is mandatory for all holders of NPDES permits. The permit holder must analyze for all the parameters listed on the discharge permit. Parameters include general chemistry, metals, BOD/COD, oil and grease, ammonia, nitrates, etc.
- Department of Energy Mixed Analyte Performance Evaluation Program (MAPEP). A semiannual program developed by DOE in support of DOE contractors performing waste analyses.
- ERA's MRAD-Multimedia Radiochemistry Proficiency test program. This program is for labs seeking certification for radionuclides in wastewater and solid waste. The program is conducted in strict compliance with USEPA National Standards for Water Proficiency study.
- ERA's InterLaB RadChem Proficiency Testing Program for radiological analyses. This program completes the process of replacing the USEPA EMSL-LV Nuclear Radiation Assessment Division program discontinued in 1998. Laboratories seeking certification for radionuclide analysis in drinking water also use the study. This program is conducted in strict compliance with the USEPA National Standards for Water Proficiency Testing Studies.
- Water Pollution (WP). Biannual program for waste methodologies. Parameters include both organic and inorganic analytes.
- Water Supply (WS): Biannual program for drinking water methodologies. Both organic and inorganic parameters are included.

At GEL, we also evaluate our analytical performance on a regular basis through statistical process control acceptance criteria. Where feasible, this criterion is

applied to both measures of precision and accuracy and is specific to sample matrix. GEL can also measure precision through the use of matrix duplicates and/or matrix spike duplicates when the quality control samples are required by the method.

We establish environmental process control limits at least annually. In Radiochemistry, quality control evaluation is based on static limits rather than those that are statistically derived, unless specified by regulatory programs such as Drinking Water. Our current process control limits are maintained in LIMS. GEL maintains client-specific and program-specific control limits and reporting requirements in LIMS. Examples of client or program specific limits may be found in documents such as the DoD QSM tables in Appendices B and C of DoD-DOE QSM Version 6.0, and in the HASQARD Standard which are available as Quality Systems documents.

We also measure precision through the use of matrix duplicates and/or matrix spike duplicates. The upper and lower control limits (UCL and LCL respectively) for precision are plus or minus three times the standard deviation from the mean of a series of relative percent differences. The static precision criteria for radiochemical analyses are 0 – 20% for activity levels exceeding the contract required detection limit (CRDL).

Accuracy is measured through laboratory control samples and/or matrix spikes, as well as surrogates and internal standards. The UCLs and LCLs for accuracy are plus or minus three times the standard deviation from the mean of a series of recoveries. The static limit for radiochemical analyses is 75 – 125%, except as specified by the Drinking Water regulations. Specific Instructions for out-of-control situations are provided in the applicable analytical SOP.

3.11 Control Charts

Per the U.S. Department of Energy, Quality Systems for Analytical Services (DOE QSAS): Control charts are a graphical representation of data taken from a repetitive measurement or process. Control charts may be developed for various characteristics, (e.g. mean, standard deviation, range, etc.) of the data. Per MARLAP "A control chart has two basic uses:

- As a tool to judge if a process was in control.

- As an aid in achieving and maintaining statistical control.

For applications related to radiation detection instrumentation or radiochemical processes, the mean (center line) value of a historical characteristic (e.g. mean detector response), subsequent data values and control limits placed symmetrically above and below the center line are displayed on a control chart."

For GEL's Chemistry, Radiochemistry, and Radiobioassay laboratories, the Computer Services Team (CST) developed a program where Group Leaders can review LCS failures by compound/analyte name. This assists the Group Leader with monitoring out of control situations due to laboratory contamination or analyst error. Statistically determined SPC limits are evaluated at least every 2 years. Specific methods require additional frequencies in SPC determinations.

Each Group Leader may utilize programs in LIMS where they can review trending data as control charts by work order or by the SPC program.

GEL's QA Officer or designee shall review control charts during the period when the LIMS SPC program queries data points for analyses that require dynamic SPC limits for quality control parameters. At this time, any out of control conditions will be identified and a corrective action initiated. The QA Officer shall be able to stop unsatisfactory work or prevent the reporting of results generated from this program.

Dynamic SPC limits for control parameters are generally developed when more than 20 data points are available for review. Data points may be determined as outliers based on the process knowledge of the procedure being evaluated and the professional opinion of the data reviewer.

During their annual system review, management will evaluate the need to consolidate any redundant procedures and/or policies to help eliminate any confusion for work processes.

3.12 Essential Quality Control Measures

Some quality control measures are method specific. There are, however, general quality control measures that are essential to our quality system. These quality measures include:

- Monitoring of negative and positive controls
- Defining variability and reproducibility through duplicates

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- Ensuring the accuracy of test data including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, etc.
- Evaluating test performance using method detection limits and quantitation limits or range of applicability such as linearity
- Selecting the appropriate method of data reduction
- A copy of GEL's Ethics and Integrity Agreement is provided in Appendix F.

**SECTION 4
FACILITIES****Section 4 – Facilities**

Our laboratory is designed with a full-service approach to handling environmental needs. The layout provides dedicated space for radiochemical analyses, radiobioassay analysis, organic extractions, semi-volatile organic analyses, volatile organic analyses, metals analyses, general chemistry analyses, and air analyses.

The laboratory and support offices occupy approximately 85,000 square feet engineered to meet the stringent quality control and utility requirements of the modern environmental laboratory. The diagram in Appendix H depicts the layout of the laboratories.

Discussed in this section are:

- Facility security
- Utility services and deionized water
- Prevention of contamination
- Assessment of contamination

4.1 Facility Security

Our facility features secured laboratory and storage areas. Restricted entry assures sample integrity and client confidentiality, which satisfies clients and potential national security interests.

Visitors cannot gain entry without being escorted through the laboratory by authorized personnel. This process is discussed in SOP GL-FC-E-001, Facility Security.

4.2 Utility Services

Each defined laboratory area is equipped with the following utilities:

- Cold water
- Hot water
- Deionized water
- Compressed air
- Natural gas
- Vacuum
- 110 Volt AC
- 208 Volt AC (at selected stations)
- Specialty gases (as required)

4.2.1 Deionized Water

We have two independent deionized water (DI) systems. One serves radiochemistry while the other serves the remaining laboratories. DI water is made from city water flowing through a reverse osmosis system and a deionization system capable of producing 5 gallons per minute of Type I laboratory water.

We monitor compliance according to GL-LB-E-016 for The Collection and Monitoring of the DI Water Systems. Our monitoring activities and frequencies can be found in Table 1 of the SOP.

4.2.2 Specialty Gases

The specialty compressed gases may be required by specific analytical systems. Each specialty compressed gas system is monitored for background contamination that would negatively impact the efficiency of the operating system. Monitoring is generally conducted through the use of routine instrument control samples which are introduced to the operating system prior to instrument calibrations and throughout the analytical process. Requirements for the purity of the gases are identified in the instrument operating manuals and standard operating procedures.

4.3 Prevention of Contamination

Work areas that are free of sample contaminants, constituents and measurement interferences are important to the generation of quality data. With this in mind, we designed our laboratories to prevent contamination and reinforce this design with good laboratory practices.

In addition to keeping our work areas free of dust and dirt accumulations, policies and features that prevent or minimize contamination include:

- An air conditioning system that controls the environment of individual laboratories for optimum performance of sensitive instruments and to eliminate potential cross contamination.
- Segregation of volatile and semi-volatile laboratories to minimize potential contamination associated with the use of commonly required solvents.

- Negative and positive pressure air locks to isolate selected laboratories to prevent the entry of airborne contaminants.
- Fume hoods to remove fumes and reduce the risk of aerosol and airborne contaminants and personal safety hazards are monitored in accordance with GL-FC-E-003 for Local Exhaust Ventilation Systems.
- Restricted access to the volatiles laboratory (authorized personnel only).
- Designated area for glassware preparation wherein all glassware used in sample prep and analysis are cleaned accordance with SOP GL-LB-E-003 for Glassware Preparation.
- Segregated storage areas for volatiles and radioactive samples.
- Production, use, and monitoring of Type I DI water.
- Tracking and trending of any significant sample and/or reagent spills using the LIMS NCR system, allowing efficient analysis of any potential contamination.

4.4 Assessment of Contamination Levels

We evaluate contamination resulting from the following sources on the basis of quality assurance and quality control data derived from the analytical method and method blanks.

- Sample containers
- Reagent water
- Reagents and solvents
- Sample storage
- Chemical and physical interference
- Constituent carryover during analysis

Contamination in each of the volatile storage coolers is monitored by the weekly analysis of water blanks. SOP GL-OA-E-058, Volatile Storage Blanks discusses these practices in detail.

SECTION 5

EQUIPMENT AND REFERENCE MATERIALS

Section 5 – Equipment and Reference Materials

GEL's ability to efficiently generate data that is reproducible, accurate, and legally defensible is attributable to our use of high-quality instruments, equipment, and reference materials.

Provided in this section are:

- GEL's policies governing instruments, equipment, and reference materials
- Identification of instrumentation and support equipment
- Procurement protocol

5.1 General Policies

It is our policy to purchase instrumentation, equipment and high-quality reference materials that meet or exceed the method and regulatory requirements for the analyses for which we are accredited. If we need to use instruments or equipment not under our permanent control, we ensure that it also meets these standards.

Instrumentation and equipment are placed into service on the basis of ability to meet method or regulatory specified operating conditions such as range and accuracy. All laboratory instrumentation and testing equipment is maintained in accordance with standard operating procedures (SOPs).

Instrumentation and equipment are used in a manner that assures, where possible, that measurement uncertainty is known and consistent with specified quality requirements. Instruments and equipment are taken out of service and segregated or labeled as such under the following conditions:

- Mishandling and/or overloading
- Results produced are suspect
- Demonstrated defect or malfunction

Tagged or segregated instruments and equipment remain out of service until repaired and shown by test, calibration, or verification to perform satisfactorily. Instruments that are in service and normally calibrated

prior to and during use are not tagged. The laboratory maintains a list of approved vendors for instrumentation maintenance beyond the parts and supplies maintained on site at the laboratory.

Each item of equipment, including reference materials is, if appropriate, labeled, marked or otherwise identified to indicate its calibration status. We maintain records for each major item of equipment, instrumentation, and all reference materials significant to quality performance. These records are often in the form of maintenance logs, which are kept in accordance with GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices.

Documentation included in these records may include but is not limited to:

- Equipment name
- Manufacturer's name
- Type identification
- Serial number or other unique identification
- Date received and date placed in service (if pertinent)
- Current location
- Condition when received (if known)
- Manufacturer's instruction, where available
- Dates and results of calibrations and or verifications
- Date of next calibration and/or verification, where written procedures do not specify frequency
- Details of maintenance carried out to date and planned for the future
- History of any damage, malfunction, modification or repair

5.2 Instrumentation and Support Equipment

Appendix G lists the instruments we use for the analysis of environmental, radiochemical and radiobioassay samples. Where feasible, our instruments are equipped with autosamplers that improve efficiency and facilitate consistent sample introduction to the sample detector. They are also connected to an area network to facilitate data transfer.

Devices that may not be the actual test instrument but are necessary to support laboratory operations are referred to as support equipment. We also maintain this

equipment in proper working order. Support equipment utilized at GEL includes:

- balances
- ovens
- refrigerators
- freezers
- incubators
- water baths
- temperature measuring devices
- volumetric dispensing devices
- muffle furnaces
- distillation apparatus
- grinders and homogenizers
- hot plates and heating mantles
- ultraviolet sterilizers.

Guidelines for the required calibration and evaluation of this equipment are discussed in Section 7.

We perform radiochemical and radiobioassay analytical services in accordance with the instrumentation and reference methods approved by the Department of Energy (DOE), the Environmental Measurements Lab (EML), the Environmental Protection Agency (EPA), ASTM, and Los Alamos Health and Environmental Chemistry (LAHEC). Modifications to these methods may be appropriate as a result of Performance Based Measurement Systems (PBMS).

SOPs are used to describe our procedures for all routine analyses performed by our labs. These procedures include step-by-step instructions for sample collection, storage, preparation, analysis, instrument calibration, quality control, disposal, and data reporting.

5.3 Procurement and Control of Purchased Items

Materials, equipment, and services that affect the quality of our products are designated as Quality Materials, Equipment, and Services and are only purchased from approved suppliers. We approve and document suppliers according to GL-QS-E-001 for the Conduct of Quality Audits.

At GEL, we maintain documentation of specific quality requirements for Quality Materials and Services. Records that document the quality of a product or service may include:

- certificates of analysis and traceability
- verifications of chemical quality
- inspections of equipment or materials
- verifications or inspections of vendor product specifications

Our procedure for requisitioning supplies, instruments, equipment and other common use material is described in GL-RC-E-002 for Material Requisition. These requests typically include:

- The date and name of person(s) requesting materials
- Account, department, project number to which the material is to be billed
- Recommended supplier or vendor
- Additional information necessary to expedite the purchase request
- Specifications that could affect the quality of products and services
- Vendor's material part number
- Amount of material needed
- Description of material
- Cost per unit
- Person(s) authorizing the purchase
- Time frame in which the material is needed

The equipment, instruments, and reference materials we purchase are inspected upon receipt in

accordance with GL-RC-E-001 for the Receipt and Inspection of Material and Services. This inspection is to verify that procured items meet the acceptance criteria defined in the procurement documentation. Staff performing initial inspection routinely:

- Open and inspect all items for damage
- Compare the items with the issued purchase order or contract for catalog or part number, description or procurement specification, quality requirement, and acceptance criteria
- Label items with a limited shelf life with the date received
- Determine if the items conform to the specifications agreed to by the vendor.

The individual responsible for the technical acceptance of the item provides procurement and receiving staff with the proper acceptance documentation. Items found not to conform to quality standards are returned to the supplier, identified as nonconforming or disposed according to the established procedures in GL-QS-E-004 for LIMS Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items. These nonconforming items may also include those identified as suspect/counterfeit items as identified in DOE guide DOE G 414.-3 for use with DOE 414.1 D.

SECTION 6
HEALTH AND SAFETY**Section 6 – Health and Safety**

GEL maintains a safe work environment and promotes healthy work practices. Procedures outlined in the plan are consistent with Occupational Safety and Health Administration, CERCLA, the Environmental Protection Agency, and SCDES.

All employees are trained in the safety practices applicable to their job functions. This training is conducted in accordance with GL-HR-E-002 for Employee Training.

Discussed in the section are:

- Fire safety and safety equipment
- Safety equipment and procedures related to handling radioactive samples

6.1 Fire Safety

Our facility is equipped with a fire alarm system designed to detect smoke in all areas of the facility. Certain high-risk areas, such as, the cold and ambient storage areas, organic sample preparation lab, hazardous waste lab, and solvent storage are additionally equipped with automatic halon systems. Fire blankets and dry chemical extinguishers are located at strategic points throughout the lab. We routinely inspect these extinguishers in accordance with GL-FC-E-004. Lab personnel are trained in the proper use and selection of fire extinguishers.

In order to decrease the risk of fire, bulk solvents are stored in a halon-protected storage room.

6.2 Evacuation

In the unlikely event of a fire (or other emergency), we have defined evacuation routes depicted in Appendix H. This diagram is posted in pertinent areas of the facility and designated staff members to serve as evacuation guide for leaders and work groups.

6.3 Safety Equipment

Safety equipment, including safety glasses, lab coats, safety goggles, protective gloves, hard hats, and coveralls, is available to all employees as needed. We also provide respirators when needed for those who have completed training in the use of this specialized equipment.

Eyewashes and overhead showers are located throughout the laboratory. We routinely inspect these as directed in GL-FC-E-002 for Testing Emergency Eyewash and Shower Equipment.

6.4 Radiation Safety

Since GEL specializes in the handling of radioactive material, we have health physics procedures to ensure its safe handling. While lab personnel do not encounter significant levels of radiation requiring personal monitoring, a Dosimetry Program is in effect utilizing personal dosimeters for designated personnel. These dosimeters are exchanged quarterly, and records of exposure are maintained. Instructions for the proper use of dosimeters are addressed in GL-RAD-S-009 for Personnel Dosimetry.

We take special precautions to ensure that samples are safely processed. Upon receipt, trained personnel use a survey meter to screen all samples for the presence of radioactivity. Protocols for the receipt of radioactive samples and for surveying suspected or known radioactive samples are detailed in GL-RAD-S-007 for Receiving Radioactive Packages and GL-RAD-S-001 for Radiological Surveys. This process is described in Section 9.

Upon leaving a radiologically controlled area, personnel check their hands and feet for potential contamination. This is done utilizing detection instrumentation that employs Geiger-Mueller or scintillation technologies. In addition, stations with portable detection instruments are set up for personnel frisking and in-process contamination surveys.

Key areas throughout the facility are surveyed:

- Laboratory analytical areas (Monthly smears)
- Radioactive Sample Storage Areas (Monthly smears and exposure rate)
- Sample Receipt and Waste Handling Areas (Monthly smears and exposure rate)
- Unrestricted and Radioactive Material Prohibited Areas (Quarterly smears)

SECTION 7
MEASUREMENT, TRACEABILITY, AND CALIBRATION**Section 7 – Traceability and Calibration**

Traceability of measurements and the calibration of testing equipment are imperative to our ability to produce accurate and legally defensible data. As such, we have implemented procedures to ensure that equipment calibration and measurement verification are traceable to nationally recognized standards obtained from the National Institute of Standards and Technology (NIST) or accredited reference material producer (RMP) with traceability to NIST. Reference materials purchased outside the United States must be traceable back to each country's national standards laboratory or another national or international reference organization such as ILAC, APLAC and/or IAAC. The RMP may also have established acceptability by its approval as an ISO Guide 34 RMP. Commercial suppliers of radiochemistry reference standards/sources must conform to ANSI N42.22 and must be accompanied by a certificate of calibration consistent with ANSI N42.22-1995, section 8.

Where possible, calibration certificates provide traceability to national and/or international standards of measurement.

Calibration certificates provide measurement results and any associated uncertainty of measurement, and/or a statement of compliance with the identified specification. Calibration certifications are maintained as quality records.

When traceability to a national standard is not applicable, verification of measurement is achieved through inter-laboratory comparisons, proficiency tests, or independent analyses.

The following measurement and traceability practices are described in this section:

- Calibration criteria for support equipment
- General requirements
- Balances
- Temperature-sensitive devices and temperature monitoring
- Air displacement pipets
- Calibration criteria for instruments

- Calibration verification
- Initial calibration verification
- Continuing calibration verification

7.1 Calibration Criteria for Support Equipment

This section addresses calibration protocols for support equipment, including temperature –sensitive equipment, and air displacement pipets. The general criteria applicable to the calibration of support equipment are as follows:

- Equipment is maintained in proper working order. Records of all maintenance activities are recorded in the electronic maintenance logbooks. Service call records are maintained by the Facilities Group.
- Calibrations or re-verifications over the entire range of use, using NIST-traceable references when available, are conducted either quarterly, annually or biennially.
- The laboratory is allowed to re-verify some standards, sources and reagents to extend their expiration dates. However, these reverifications must meet method acceptance criteria for their specific method and intended use. This has been GEL's process for numerous years and the laboratory has established a track record for both the reference materials and the producers. The reference materials verified/re-verified by the process have been subjected to numerous interlaboratory comparisons and cross-checked by use of different methods over a period of many years.
- If results of calibration and verification are not within the specifications for the equipment's application, then:
 1. The equipment is removed or "tagged out" from service until repaired or replaced.
 2. Under certain conditions, a deviation curve may be prepared. All measurements are corrected for the deviation, recorded and maintained.

- Prior to use each day, balances, ovens, freezers, refrigerators, incubators, and water baths are checked with NIST-traceable references (where possible) in the expected range of use.
- If prescribed by the test method, additional monitoring is performed for a device used in a critical test (such as an incubator or water bath).
- Support equipment are used only if the reference standard specifications (provided by the supplier or described in the analytical method) are met.
- Reference standards of measurement such as Class 1 or equivalent weights or traceable thermometers may be used for calibration when demonstrated that their performance as reference standards will not be invalidated.
- Reference standards of measurement are calibrated by a service provider, where possible, traceability to a national standard.
- Reference standards and measuring and testing equipment are subject to in-service checks between calibrations and verifications, in accordance with ANSI/ISO/IEC 17025-2017.
- Reference materials, where possible, are traceable to national or international standards of measurement, or to national or international standard reference materials.
- Mechanical volumetric dispensing devices, used for critical measurements, except Class A glassware, are checked at least quarterly for accuracy.

7.1.1 Balances

Our balances are under a service contract for annual calibration, maintenance, and cleaning. Each balance is labeled with a serial number, service date, date of next service, and signature or initials of the service technician.

Balances are set up, calibrated, and operated in the range required by the analytical method in accordance with GL-LB-E-002 for Balances. Prior to using a balance, the analyst/technician is responsible for checking that the daily calibration was completed.

Calibration and calibration verification are performed using weights that are or have been calibrated using Class 1 weights. These weights are traceable to NIST and sent for calibration at least every 5 years by an approved calibration service provider that meets the requirements of the ANSI/ISO/IEC 17025-2017 standard. Please refer to GL-LB-E 002 Balances for GEL's protocol on annual reverification of in-house test masses.

Calibration and calibration verification are recorded in the electronic balance calibration logbook. If the calibration or calibration verification does not meet the specified acceptance criteria, the balance is recalibrated. If the calibration criteria are still not met, the balance is removed from service and tagged as such.

7.1.2 Refrigerators, Freezers, Incubators, Ovens, Water Baths, and Similar Devices

Careful control of temperature is often central to the production of acceptable data. Temperature excursions beyond the established limits may invalidate a procedure and the associated data. Constant monitoring in accordance with GL-LB-E-004 for Temperature Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens, Incubators, and Other Similar Devices assures us that regulatory and/or method temperature requirements are being met.

We measure temperatures with thermometers that are verified either semi-annually or annually against a NIST-traceable thermometer. The NIST traceable thermometers are independently verified at least annually by a verification service that meets the requirements of the ANSI/ISO/IEC 17025-2017 standard. The protocol for thermometer verification is described in GL-QS-E-007. We monitor the temperature of the following equipment according to GL-LB-E-004:

- Refrigerators and freezers used to store samples, standards, and other temperature-sensitive materials
- Incubators
- Ovens
- Water baths

We monitor the temperatures of refrigerators and freezers prior to use on each working day. The temperatures of ovens, water baths, and other devices used as part of an analytical process must be monitored prior to, during, and immediately after use. Incubators and other devices used for other specialized analytical methods may require more frequent monitoring as specified in the corresponding SOP.

Temperature measurements are documented on logs specific to each piece of equipment. These logs may be paper or recorded electronically in LIMS. The logs may be posted on or near each refrigerator, freezer, water bath, oven, or other temperature control device. Electronic monitoring logbooks for refrigerators, freezers, and coolers with temperature probes are found in LIMS. Each log includes the following information:

- Date and time of each measurement
- Acceptance limits for device being monitored
- Whether device conforms with specifications at time of measurement
- Name, location, and number of device being monitored
- Notation of any out-of-control condition
- Any corrective action

When the process to maintain and document temperatures within acceptance limits does not conform to specifications appropriate action is then taken to document the nonconformance. According to GL-QS-E-004 for LIMS Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items. Any corrective action taken to bring the equipment back into acceptable use is discussed.

Examples of nonconformances are:

- Failure to maintain process temperature within acceptance limits
- Failure of device to achieve calibration
- Total failure of temperature control device
- Failure to monitor the temperature as required

7.1.3 Air Displacement Pipets

We calibrate air displacement pipets in accordance with GL-LB-E-010 for Maintenance and Use of Air Displacement Pipets. As specified in the SOP, the

calibration of an air displacement pipet is verified daily prior to use, based on a single point measurement.

The acceptance criteria for each measurement are based on the standard deviation of the calibration measurements. Tolerance limits for commonly used verification volumes and accuracy and precision checks are included in the pipet calibration logbook. Calibrations and daily calibration verifications are traceable to each pipet using the unique identification found on its label.

If a pipet does not meet the calibration tolerance limits, it is removed from service until it again demonstrates compliance after being cleaned and/or repaired. Analysts whose jobs may require the use of air displacement pipets are trained in their proper use and calibration.

7.2 Instrument Calibrations

To ensure that the data generated by an instrument are accurate, we calibrate the instrument using standards containing known concentrations of target analytes. We verify the accuracy of calibration standards by analyzing an additional standard containing the target analytes. This initial calibration verification standard (ICV) originates from a second source. If a second source is not available from a second source manufacturer, it is acceptable to obtain a different lot from same manufacturer. If a second source is not available from the manufacturer, the source must be prepared by a different analyst at a different time independently. Verification that the instrument response is reliable and has not changed significantly from the current calibration curve is accomplished by the analysis of a continuing calibration verification (CCV) standard. Some analytical methods employ the use of CCVs at varying concentrations.

Traceability of calibration, calibration verification, and other quality control standards to the recognized standard is documented per GL-LB-E-007 for Laboratory Standards Documentation. Preparation and Verification of Radioactive Standards is described in GL-RAD-M-001. Individual identification numbers are assigned to each source standard and each subsequent intermediate and working standard prepared.

The identification number makes it possible to trace a standard to a parent standard and ultimately to the source standard. The date each standard is prepared, the protocol used in the preparation, the person preparing the standard, and the standard's expiration date are documented in the appropriate standards log, usually maintained in LIMS. The information is accessible via the standard ID number.

We record standard and reagent ID numbers on instrument run logs, analytical logbooks, sample preparation logs, and instrument raw data. Calibration standards that are used in the analysis of a particular sample or group of samples can be traced to NIST, US EPA, or other nationally recognized standards.

Calibration procedures for specific instruments, and the frequencies of performance for defined methods, are described in the applicable operating or analytical SOP. Calibration is discussed in general terms in GL-QS-E-014 and includes standard laboratory practices and formulas used for determinations made by these practices. General guidelines include:

- Verification of initial calibrations with a standard obtained from a second source (unless one is not available).
- Analysis of verification standards (ICV and CCV) with each initial calibration within 15% of the true value unless historical data have demonstrated that wider limits are applicable.
- Preparation of calibration curves as specified in the reference method.

If a test method does not specify the number of calibration standards, the minimum number is two, not including blanks, with one at the lowest quantitation limit. The reference SOP must establish the initial calibration requirements.

7.3 Calibration Verification

Unless otherwise specified by the method, regulatory program or demonstrated through historical data, the recovery of target analyte(s) in calibration verification standards shall be between 85 – 115%. We discuss additional requirements below.

7.3.1 Initial Calibration Verification (ICV)

- If an initial calibration curve is not established on the day of analysis, the integrity of the curve should be verified each day of use or every 24-hour period. Verification requires the initial analysis of a blank and standard from a second source. The standard concentration should be at the method-defined level. If not specified, a standard at a mid-level concentration may be used.
- If the initial calibration verification does not meet acceptance criteria, the analytical procedure is stopped and evaluated, and appropriate corrective measures are taken. Initial calibration verification must be acceptable before any samples are analyzed.

7.3.2 Continuing Calibration Verification (CCV)

Additional standards called CCVs are analyzed after the initial calibration curve or the integrity of the initial calibration curve is accepted. CCVs are analyzed at a frequency of 10% or every 12 hours, whichever is more frequent. If an instrument consistently drifts outside the acceptance criteria before the next calibration, the frequency is increased.

CCVs may be from the same source as the calibration standards or from a second source. The concentration is determined by the anticipated or known concentration of the samples and/or method-specified levels. At least one CCV shall be at a low-level concentration.

To the extent possible, we bracket the samples in each interval (every 10 samples or every 12 hours) with CCV concentrations closely representing the lower and middle range of reported sample concentrations. If this is not possible, the standard calibration checks should vary in concentration throughout the range of the data being acquired.

If the recovery of a CCV does not meet the acceptance criteria and routine corrective actions fail to produce a second consecutive check within acceptance criteria, a new initial calibration curve should be constructed. Analytes of interest found in corresponding environmental samples may be reported, however, only if all of these criteria are met:

1. CCV recovery for target analyte exceeds the acceptance criteria (biased high)

2. Target analyte in the environmental sample is not detected at a concentration exceeding the level required by client contract (i.e., MDL, PQL). Non-detects that meet these criteria are also referred to as “passable non-detects.”

If samples are found to contain target analytes that exceed the associated quantitation limits, and the CCV recovery does not meet the acceptance criteria, the affected samples are re-analyzed. This occurs only after a

new calibration curve has been established, evaluated, and accepted.

7.4 Radiobioassay Instrument Calibration and Frequency

Our Radiobioassay instruments are calibrated at the frequency of the instrument’s use, stability, and method requirements. The calibration procedure for each instrument is described in the corresponding analytical SOP and is performed by those individuals proficient in the analyses described in the SOP.

SECTION 8
ANALYTICAL METHODS AND STANDARD OPERATING PROCEDURES**Section 8 – Analytical Methods and Standard Operating Procedures (SOPs)**

We provide a wide array of parameters including volatile organics, extractable organics, metals, general inorganic/wet chemistry, radiochemistry, and radiobioassay. The procedures we use to determine these parameters are consistently executed due to our extensive system of SOPs and our training requirements for analytical staff.

A list of our SOPs and the analytical methods they represent (if applicable) is provided in Appendix I. Discussed here are:

- Selection of analytical methods
- Standard operating procedures
- Method validation and initial demonstration of capability
- Sample aliquots
- Data verifications
- Standard and reagent documentation and labeling (Refer to Section 10.1)
- Computers and data requirements

8.1 Selection of Analytical Method

Project Managers are ultimately responsible for selecting the test codes and methods assigned to a client based on client requirements and sample collection techniques. In selecting methods, our goal is to meet the specific needs and requirements of the client while providing data that are scientifically valid.

When the use of a specific test method is mandated, only that method is used. If the analysis cannot be performed by the client-requested method, we notify the client. We do not perform method substitutions without the client's consent. We recommend that clients who submit data to regulatory agencies also obtain the agency's approval of method modifications.

When clients have specific process or reporting deviations from GEL's standard practices, the laboratory may document the deviations in contracts, case narratives and/or with specific work instructions from the Project Management Team to the laboratory. Approval of the deviations is made after consideration of all safety

and quality concerns have been resolved by GEL's management.

A Project Management LIMS Manual (GL-CS-M-001) is available to assist PMs and PMAs in selecting test codes and methods and communicating the client's analytical and data reporting specifications.

8.2 Standard Operating Procedures (SOPs)

We determine each parameter by the protocol detailed in the corresponding SOP. The defined protocol originates from the analytical method or methods referenced in the SOP and may incorporate regulatory and client requirements. Descriptions of the methods we employ can be found in:

- EPA SW-846
- EPA/600/479/020
- Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC)
- American Society for Testing and Materials (ASTM)
- Standard Methods for the Examination of Water and Wastewater (SM)
- South Carolina Department of Health and Environmental Services (SCDES)
- Code of Federal Regulations (CFR) Titles 40 and 49
- Department of Energy Environmental Measurements Laboratory (EML)
- Los Alamos Health and Environmental Chemistry (LAHEC)
- DOE
- DoD
- HASL

In addition to these references, a number of our radiochemistry procedures were developed in conjunction with Florida State University (FSU) under the guidance of Dr. Bill Burnett.

Laboratory sections have access to GEL's SOPs to ensure that each operational system and analytical procedure is performed in a uniform manner. SOPs are controlled according to GL-DC-E-001 for Document Control and are posted on the Intranet by the Document Control Officer.

We write and issue SOPs in accordance with GL-ADM-E-001 for the Preparation, Authorization, Change,

Revision, and Release of Standard Operating Procedures. A technical and/or quality review is made of each new or revised analytical/technical SOPs prior to its implementation.

Technical reviews ensure that procedures are technically sound and method-compliant, and are conducted by a senior analyst, group leader, or data reviewer. The quality review is an independent review by a member of the Quality Systems Team and ensures that the quality requirements of the method, regulatory agencies, and GEL are adequately and accurately identified.

SOPs are modified when:

- Instruments or equipment change
- Applicable methods have been modified or updated
- An error is identified
- Improvements in technology and/or reagents need to be incorporated
- Reference methods are revised or discontinued
- Equations need to be defined

Proposed revisions are submitted for review on Documentation Initiation and Revision Request (DIRR) forms. Changes are not implemented without a technical and quality review.

We review our technical SOPs annually and revise them as necessary. Analytical SOPs either contain or reference other SOPs that contain:

- reference method
- applicable matrix or matrices
- method detection limit
- scope and application including parameters to be analyzed
- method summary
- definitions
- interferences and limitations
- specific safety requirements
- required equipment and supplies
- reagents and standards
- sample collection, preservation, shipment, and storage
- quality control
- calibration and standardization
- procedure

- calculations
- method performance
- pollution prevention
- data assessment and acceptance criteria for quality control measures
- corrective actions for out of control or unacceptable data
- waste management
- references
- tables, diagrams, flowcharts, validation data
- identification of any modifications we have made to the published procedure

8.3 Method Validation and Initial Demonstration of Capability

Method validation requirements for Radiochemistry are documented and maintained in accordance with GL-RAD-D-002, Analytical Methods Validation for Radiochemistry.

An initial demonstration of method performance is required before a new analytical method is implemented and any time that there is a significant change in instrumentation or methodology. Exempted from this requirement are any tests for which spiking solutions are not available. Analyses that are exempt include those for determining:

- total dissolved, total suspended, total volatile, and total solids
- pH
- color
- free liquids
- temperature
- dissolved oxygen
- turbidity

We conduct the initial demonstration as described in Section 8.3.1. Records of initial demonstration are maintained in accordance with GL-QS-E-008 for Quality Records Management and Disposition. These records are available upon request.

After we demonstrate our ability to perform a specific analysis, we continue to demonstrate method performance through the analysis of laboratory control samples and performance evaluation samples.

If spiking solutions or quality control samples are not available, an analyst is trained by a qualified trainer to

conduct the analysis. Analyst capability and proficiency is evaluated by the appropriate Group Leader before the analyst is qualified to perform the analysis on client samples. The evaluation is documented and maintained according to GL-QS-E-017 for Maintaining Technical Training Records.

Method Validation must also occur when substantive modifications are made to stoichiometry, technology, mass tuning acceptance criteria, quantitation ions, compressing digestion or extraction timeframes, reducing reagent or solvent volumes, changing solvents or compressing instruments.

8.3.1 Procedure for Initial and Continuing Demonstrations of Capability (IDOC and CDOC)

We conduct initial demonstrations of capability for mandated analytical or EPA reference test methods following the procedure outlined below. This procedure is adapted from the EPA test method published in 40 CFR part 136, Appendix A and the 2003 NELAC and 2016 TNI Standards and the QSM (Quality System Manual). IDOCs are completed whenever there is a change in instrument type, method or personnel. CDOCs are updated constantly in the laboratory LIMS.

Step 1: A quality control sample is obtained from an outside source (if possible). If one is not available, the sample may be prepared internally using stock standards that are prepared independently from those used in instrument calibration. The concentration is not known to the analyst.

Step 2: The QC sample is diluted in a volume of clean matrix. Sufficient volume of the diluted QC sample is prepared so that at least four aliquots of the required method are analyzed. Alternatively, four matrix spike samples may be evaluated for levels of precision and accuracy.

NOTE: For radiochemistry only, at least four blank samples are also prepared, analyzed and evaluated according to the method.

Step 3: Four aliquots of the diluted quality control sample are prepared and analyzed according to the analytical test method. This may occur concurrently or over a period of days.

Step 4: With the results obtained from the analysis of the diluted QC sample, the average recovery ($\bar{x}$) in the appropriate reporting units (such as $\mu\text{g/L}$) and the standard deviation of the population sample ($n-1$) (in the

same units) are calculated for each parameter of interest.

Step 5: For each parameter, the standard deviation (s) and the average recovery ($\bar{x}$) are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria. If " s " and " $\bar{x}$ " for all parameters meet the acceptance criteria, analysis of samples may begin. If any parameter exceeds the acceptance range, the performance is unacceptable for that parameter.

Step 6: When one or more tested parameters fail one or more of the acceptance criteria, we locate and correct the source of the problem and repeat the test for every parameter of interest.

Other options for successful IDOCs are the following:

- PT Study- successful analysis of a PT Sample. If 4 LCSs cannot be performed, successful analysis of a PT sample may be used to demonstrate capability to perform a test. The PT sample may be single-blind to the analyst or double blind to the laboratory.
- Supervised Analysis- where other options are not practical, supervised analysis of a procedure may be used to demonstrate capability.
- Analysis of authentic sample with results statistically matching those obtained by another trained analyst.
- Other – this option may be used for certain personnel having sufficient analytical skills to develop a new procedure, as deemed appropriate by the supervisor or Quality Assurance personnel.

8.4 Sample Aliquots

When obtaining aliquots from a sample, it is imperative that the subsamples be representative of the parent sample. This ensures that the results obtained from the analysis of the aliquots are representative of the entire parent sample, not just the subsample. We employ different techniques to obtain subsamples. GEL's SOP for subsampling is GL-LB-E-029.

We can obtain representative aliquots of soil samples for the determination of metals through quartering. This involves the repeated quartering of the sample until the resulting quarter is equivalent to the amount of sample needed for analysis. Quartering may not be appropriate for obtaining subsamples for volatiles

or other analyses where potential contamination or loss of target analytes is a concern.

Water samples are inverted several times prior to the collection of a subsample. This ensures a thorough mix and is absolutely required for the accurate determination of analytes like total and total suspended solids.

The appropriate techniques for obtaining sample aliquots for designated analyses are discussed in the applicable SOPs.

8.5 Data Verification

All of the data we include in final reports to our clients undergoes extensive data verification. At GEL, we have a multi-level review process that takes place in all areas of the laboratory beginning with sample login. This process and the responsibilities of each level of review are delineated in a number of procedures, including GL-GC-E-092 for General Chemistry Data Review and Packaging, GL-MA-E-017 for Metals Data Validation, GL-OA-E-044 for Organic Data Validation and GL-RAD-D-003 for Data Review, Validation, and Data Package Assembly.

8.5.1 Sample Login:

Samples are analyzed by the methods and for the target analytes identified when samples are logged into our database. If there is an error in this entry that is not promptly identified, the incorrect analytical method may be used, or certain analytes may not be determined.

To prevent this, the person who enters the information into the database is generally the client's assigned Project Manager or PM Assistant. This entered information is reviewed against the client confirmation letter and/or chain of custody. If errors are identified, they are immediately corrected.

8.5.2 Data Validation in the Laboratory

The multi-level review process in our laboratory includes an initial review by the analyst, a second review by a peer, and a final review by a group leader or data reviewer. As appropriate based on the complexity of the data report required (i.e. Level 1 or Level 2) for a project, the data review process can be consolidated into a two-level review that includes the analyst and the group leader or data reviewer.

Our analytical data reviews ensure that:

- The analytical procedures comply with current SOPs.
- Quality control samples are analyzed at the frequency specified in the SOP or client specifications.
- The acceptance criteria for quality control samples are met, including recoveries of matrix spikes and laboratory control samples, the relative percent difference for matrix duplicates, matrix spike duplicates, laboratory control sample duplicates, and concentrations of target analytes in the method blank.
- Instrument data, run logs, and logbooks are reviewed to ensure that all method quality control criteria were met (e.g., calibration, initial calibration verifications, and continuing calibration verifications).
- Documentation is sufficient to reconstruct the analytical procedure.
- Data are maintained according to GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices.
- Raw data are in agreement with the computer-generated batch sheets and data reports.
- The calculations, dilution factors, concentration reported, and nominal concentrations are verified.
- Comments, qualifiers, or nonconformances for noncompliant or questionable data are documented.
- Data generated when the analytical process appears to be out of statistical control are not reported.

8.5.3 Validation of Data Reports and Packages

Before we report data to the client, we review the requested data report for package accuracy, completeness, and client-specifications. Responsibilities for review are dependent upon the type of report or package being generated. (Refer to Section 11 for Laboratory Report Formats.)

When a client is receiving a certificate of analysis or certificate of analysis and Quality Control Summary Report, the Project Manager (PM) or Project Manager Assistant (PMA) reviews the information for accuracy, completeness and the addition of pertinent comments

made by the laboratory about the analysis or sample. The PM or PMA also reviews data for consistency as described in the Project Management LIMS Manual, GL-CS-M-001. For radiobioassay results, the package is then reviewed for completeness by validator, team or group leader as described in GL-RAD-B-026.

If a client requests a case narrative, our data validators review the analyst-prepared case narrative for accuracy and to assure its consistency with the information included on the certificate of analysis and Quality Control Summary Report. If a client requests a more detailed level of data package up to and including a CLP-like package, every laboratory fraction of data is reviewed by that fraction's data validator. The data are then compiled into a final data package. The Quality manager or designee will review a minimum of 10% of all data packages for technical completeness and accuracy on a quarterly basis and if data quality issues are discovered during the review, the client will be notified with fifteen (15) business days of the discovery of the issue.

8.6 Standard and Reagent Documentation and Labeling

The documentation and labeling of standards and reagents is addressed in GL-LB-E-007 and GL-RAD-M-

001 for Laboratory Standards Documentation, and in Section 10.1 of the QAP, Recordkeeping System and Design.

8.7 Computer and Electronic Data Related Requirements

Our Information Management System (IT) SOPs describe the way in which we manage our software programs and hardware systems. Control of software development and modification activities is described in GL-IT-E-003 for Requirements, Design, Operation, Validation, and Removal of Hardware and Software Systems Used by the GEL Group, Inc. All development and revision activities are validated, and revision activities are validated, verified, and controlled with revision software or other procedures prior to production use.

Analytical software that is purchased from a vendor is validated and verified in accordance with GL-IT-E-005 for Requirements, Design, Operation, Validation, and Removal of Applications Used by The GEL Group, Inc. Documentation requirements are also described in this SOP.

Electronic signature requirements for confidentiality of records are described in GL-IT-E-001 for Instrument Technology Program for Good Laboratory Practices.

SECTION 9**SAMPLE HANDLING, ACCEPTANCE, RECEIPT, AND INTERNAL CHAIN OF CUSTODY****Section 9 – Sample Handling, Acceptance, Receipt and Internal Chain of Custody**

The way we receive, and handle samples is critical to providing our clients with data that is of the highest quality and is legally defensible. We have strict policies that govern the acceptance and receipt of a sample, sample handling and integrity, maintenance of the internal chain of custody, and storage of the sample upon completion of the required analytical processes. This section describes the policies and practices that we employ, including the following:

- Agreements to perform analysis
- Proper labeling of submitted samples
- Chains of custody
- Sample receipt procedures
- Sample receipt procedures for radioactive samples
- Sample tracking
- Sample storage
- Sample disposal

9.1 Agreement to Perform Analysis

Before we accept samples, we should have an agreement with the client that specifies the analytical methods, the number of samples to be analyzed, the price for the analysis, the date by which the client must receive results, and the reporting format. Any special requirements the client may have, such as non-routine methods and reporting limits, should be part of that agreement.

An agreement to perform analysis should be in one of three forms, further detailed in our Analytical Services Reference Manual and the SOPs for Delegated Authority to Commit the Company and Request for Proposal (RFP) and Contract Review (GL-CO-E-002 and GL-CO-E-003):

- Client confirmation letter (CCL) between the client and project manager for a specific group of samples. This letter includes the cost, turn-around time, requested analysis, sample matrix, number of samples, and type of client report.
- Sample acceptance by the Project Manager from an established client based on previously agreed conditions and confirmed by the client's submission of the sample(s).
- Contractual agreement for analytical services over a designated time period or project that delineates the specifications agreed upon.
- When the laboratory agrees to perform analyses with exceptional departures from normal processes, these exceptions are clearly defined in the client-laboratory agreement.

9.2 Sample Labels and Chain of Custody Forms

Once an agreement is established, we assume joint responsibility with the client to ensure that the samples submitted are properly labeled and accompanied by full and complete documentation that includes chain of custody and, where possible, safety data sheets. Samples that are submitted without proper documentation may be refused.

Sample labels should include the:

- client's sample identification
- location, date, and time of collection
- collector's name
- chemical preservatives used
- constituents of interest (if space permits)

When requested, we ship labeled sample containers with appropriate preservatives and a chain of custody to the client for use during sample collection. There are several advantages to using these containers, including:

- Dedication of appropriate type sample container for the intended analyte or analytical method.
- Proper sample preservation for analytical test
- Traceability of bottle lot number to the manufacturer's certification that the containers are clean and show no signs of contamination.
- If a manufacturer cannot provide a certificate of cleanliness for radiochemistry parameters, a gross - beta screen can be performed on the Lot of containers being used. This is mandatory for containers used in support for SDWA programs.

Chain of custody forms include the following information and are initiated at the time of sample collection:

- client sample identification

- date and time of sample collection
- sample matrix
- description of sampling site location
- number of containers
- methods, chemical and physical constituents for which the analyses are to be conducted
- preservatives
- date and signature of person who collected the sample
- date of transfer and signature of person relinquishing sample to the laboratory.

When our Field Services personnel collect samples, our standard chain of custody form and certified containers are automatically used. Our standard chain of custody forms is also available to our clients and are included with each shipment of pre-labeled and preserved containers. GEL chain of custody forms should always be used unless otherwise agreed to by contract.

9.3 Sample Conditions

In addition to properly documenting sample container labels and the chain of custody form, we need to make sure that samples meet the established requirements for analytical testing. This is particularly critical for samples that are being analyzed to meet regulatory requirements.

Samples should be collected in the appropriate type of container, preserved as directed, and stored in the conditions specified in the analytical method or established regulatory guidelines. In addition, samples should be submitted with sufficient time to conduct the specified analysis within the regulatory or method holding time. Aliquots should be of sufficient volume to perform the requested analyses. A summary of these conditions and holding times for routine analyses can be found in Appendix J.

9.4 Sample Receipt

Samples submitted to us are received in a central sample receiving area by sample receiving technician. Every sample is subject to the protocols outlined in GL-SR-E-001 for Sample Receipt, Login and Storage.

Our sample receiving technician acknowledges receipt of a sample by signing the chain of custody and recording the date and time of custody was transferred from the client to the laboratory. The date, and person receiving the sample are also recorded on a standard or client-specific Sample Receipt Review (SRR) form.

The sample receiving technician is also responsible for noting the condition of a sample upon its arrival. This information may be recorded on both the sample chain of custody and the SRR form. As detailed in GL-SR-E-001, the sample receiving technician should:

- Inspect all sample containers for integrity.
- Document any unusual physical damage or signs of tampering with custody seals.
- Place any samples that appear to be leaking or have unusual odor under the fume hood while notifying the responsible project manager.
- Review the chain of custody submitted by the client for completeness.
- Compare descriptions and other information on the sample container labels to that listed on the chain of custody.
- Verify the sample is within the regulatory holding time for the analyses.
- Measure and record the temperature of sample aliquots that are to be used for analyses requiring thermal preservation.
- Measure and record the pH of all sample aliquots submitted for analyses that require chemical preservation to a specific pH.
- Verify that there are adequate sample aliquots for the requested analyses.
- Verify that appropriate sample containers were used for requested analyses.

If the sample receiving technician discovers any abnormalities or departures from standard conditions, the PM is informed immediately. The PM will then notify the client as quickly as possible so that a decision can be made to proceed with the analysis or submit another sample or additional sample aliquots.

Common abnormalities or departures from standard conditions include:

- Sample containers with signs of damage, leaking, or tampering.
- Incomplete/missing chain of custody.

NOTE: If a nonradioactive sample has no chain of custody, the sample should initiate one. "INITIATED ON RECEIPT" should be documented on the chain of custody.

- Discrepancies between the information on the chain of custody and the sample container labels.
- Method or regulatory holding time is exceeded.
- Sample is not preserved by the method or regulatory-required pH.
- The sample container does not meet method or regulatory criteria.
- The sample temperature exceeds or falls below the thermal preservation regulation or method requirement of $0^{\circ} \leq 6^{\circ} \text{ C}$.

NOTE: If a sample is hand delivered to the laboratory immediately after collection with evidence that the chilling process has begun (arrival on ice), the sample shall be deemed acceptable.

- Radioactivity that exceeds that allowed by our radioactive license. (The handling of radioactive samples is discussed in 9.5.)
Samples that are not appropriate for the requested analyses or have no full test specifications require:
- Retention of all correspondence and records of conversations concerning the final disposition of the sample.
- Full documentation on the chain of custody and SRR form of the nonconforming condition and a decision to proceed with analysis.
- Documentation that the analysis is qualified appropriately on the final report.

9.5 Receipt of Radioactive Samples

The radioactive samples we receive are subject to the same monitoring identified in 9.4 when radioactivity levels do not exceed the level permitted by our license. Special procedures governing the receipt of radioactive samples are described in the GL-RAD-S-007 for the Receiving Radioactive Packages. These procedures

prevent the inadvertent spread of radioactive contamination.

Because we cannot exceed the limits of our radioactive license, it is imperative that our clients notify us of impending shipments of radioactive samples. We reserve the right to refuse and return any radioactive sample where the radioactivity:

- Exceeds our permitted level by itself or in combination with other samples already on site; or
- Exceeds our administrative level of 25 mrem/hr.

The following special requirements for receiving radioactive samples are applicable:

- Only designated staff trained in the proper handling of radioactive materials handle radioactive samples.
- If a sample is labeled as radioactive, the sample receiving technician will immediately inform the Radiation Safety Officer (RSO) before opening the sample.
- The radioactivity of the sample will be measured by scanning the exterior surface of the cooler using a survey meter calibrated in Mr/hr. Refer to GL-RAD-S-001 for our Radiological Survey Procedures.
- If the radioactive level of the exterior of the cooler exceeds 0.5 Mr/hr, the RSO will be notified before the cooler is opened.
- If the radioactivity level of a sample or group of samples is found to exceed 25 mrem/hr, the RSO will be notified immediately. The client will be contacted, and arrangements will be made to return the sample(s) or reduce the per sample exposure.
- If a chain of custody is not submitted with a sample, it will be placed on hold until a chain of custody is submitted.
- The inside of the cooler will be surveyed to ensure that no leakage or contamination has occurred.
- Each sample container will be surveyed, and the highest reading will be documented on the Radioactive Shipment Inventory.

9.6 Sample Tracking

We track the samples we receive by a unique laboratory identification number that is automatically

assigned when information pertaining to the sample is first entered into our database. Pursuant to GL-SR-E-001, the following information is entered for each sample received:

- client and/or project code
- client sample ID
- sample matrix
- equivalent laboratory sample matrix
- type of report format specified by client
- date and time of collection
- date received
- initials of person making entries
- number of containers submitted for the sample
- requested analyses
- pertinent observations or comments affecting the sample analysis or rejection

As soon as this information is entered, LIMS automatically assigns a unique number to the sample and its containers. We use the number to track the location of a sample container and to link to any subsamples and subsequent digestates and extracts.

The unique laboratory identification number is printed on a durable barcode label that contains the client identification, sample date and time. Once labeled, the sample container's identification number is uploaded into the database by scanning the barcode. Information included in the database at the time of sample scanning is the container's storage location, bottle type and volume, physical characteristics of the bottle, preservative, and the initials of the person entering this information. Entering this information into the database is an important part of initiating our electronic internal chain of custody.

9.7 Internal Chain of Custody

The chain of custody procedures ensure traceability and sample integrity. Our legal and evidentiary chain of custody protocol establishes a continuous record of the physical possession, storage, and disposal of sample containers, collected samples and aliquots, and sample digestates or extracts.

The internal chain of custody starts with the scanning of a container's barcode label into an electronic database while identifying the location of the sample and

the person having custody or placing the sample in a secured storage area. If we supply the containers, the chain of custody may begin when the containers are provided to the client.

With regard to the internal chain of custody, a sample is defined as being in someone's custody if:

- It is in one's actual physical possession
- It is in one's view after being in one's physical possession
- It is in one's possession and then is locked up so that no tampering may occur
- It is kept in a secure area restricted to authorized personnel only

The protocol for ensuring sample integrity using the internal chain of custody is detailed in GL-LB-E-012 for Verifying the Maintenance of Sample Integrity. The electronic internal chain of custody works in conjunction with the chain of custody submitted by the client with a sample to:

- Account for all time associated with a sample, its subsamples, and extracts or digestates from the time the sample is received at GEL to its disposal
- Identify all individuals who physically handled the sample
- Provide evidence that the sample was stored in accordance with method and regulatory protocols

The electronic internal chain of custody is stored in LIMS so that information demonstrating the proper maintenance of custody can be provided to the client on the data reports or electronic data deliverables.

9.8 Sample Storage

To ensure the maintenance of sample integrity, all aliquots are stored in secured areas designated for sample storage. The storage location of each sample aliquot can be tracked using the internal chain of custody. Areas designated for sample storage include:

- Main cooler where most samples requiring maintenance at a temperature range of $0^{\circ} \leq 6^{\circ} \text{C}$ are stored.
- Volatile coolers for samples to be analyzed for volatile contaminants.

- Radioactive cooler for segregation of radioactive sample aliquots requiring refrigeration.
- Ambient storage for non-radioactive samples do not require refrigeration.
- Ambient storage for radioactive samples.

The temperature of each refrigerated storage unit is monitored daily and documented per GL-LB-E-004 for Temperature Monitoring and Documentation Requirements for Refrigerators Freezers, Ovens Incubators, and Other Similar Devices. In addition, the main and radioactive coolers are monitored twenty-four hours a day by temperature sensors that are connected to our main security system. If the temperatures exceed the required range, the security system notifies the facilities manager or his designee immediately. This allows corrective actions to be initiated promptly.

Prior to and immediately after analysis, samples and their digestates and extracts are stored in compliance with the requirements of the requested analytical methods and GL-SR-E-001 for Sample Receipt, Login, and Storage. If a single aliquot is supplied for analyses by several methods, the most stringent analytical storage requirements are applied to the sample.

If samples are to be analyzed for volatile organic compounds, they are stored in designated volatile coolers that are maintained at a temperature range of $0^{\circ} \leq 6^{\circ} \text{C}$. No sample aliquots are stored in these refrigerators unless they are to be analyzed for volatiles. These storage units are monitored on a weekly basis for contamination by the analysis of volatile cooler storage blanks.

At the beginning of each month, two 40 mL vials are filled with deionized water, which is used for volatile method blanks and placed in each monitored cooler. If the analysis reveals evidence of potential contamination, appropriate corrective actions are immediately implemented. SOP GL-OA-E-058 discusses the laboratory practices pertaining to monitoring and testing for VOA contamination.

Sample aliquots for non-volatile analysis, which also should be maintained at $0^{\circ} \leq 6^{\circ} \text{C}$, are stored in the main cooler unless they are radioactive. In order to

reduce the chance of contamination, radioactive samples are stored in a designated cooler.

Sample aliquots identified with short-holding times or requested quick turn-around times are segregated and placed in the Hold Cooler in the sample receiving area. This will allow quick access to analysts performing these tests. This cooler is also maintained at $0^{\circ} \leq 6^{\circ} \text{C}$. After initiation of these analyses, the remaining samples aliquots are returned to the appropriate storage location.

After all analyses are complete and results are submitted to the client, sample aliquots are transferred to the sample archive area. They are stored in this area until they are disposed.

Radioactive and non-radioactive samples remain segregated in the archive to reduce the risk of contamination.

9.9 Sample Disposal

Our policies concerning sample disposal are described in the Laboratory Waste Management Plan, GL-LB-G-001 and can be divided into two categories: those governing the disposal of sample laboratory waste, and those governing the disposal of residual client sample after the completion of all analyses.

9.9.1 Sample Laboratory Waste

Unless otherwise requested by contract, laboratory waste is collected in designated satellite containers found in sample collection and accumulation areas. These areas are monitored by both the waste department and analysts trained in waste collection. Wastes are segregated based on the type of hazard they present. I.e. radioactive, acid, base solvent, etc. when containers are full, the waste department is notified, and the containers are removed from the laboratory for disposal. Directions for disposal activities, such as packaging, shipping, and disposal site selection are provided in the Laboratory Waste Management Plan (GL-LB-G-001).

9.9.2 Residual Client Sample

Unused client sample material that is not consumed during the sample preparation or analytical procedures is either disposed of in accordance with the Laboratory Waste Management Plan, GL-LB-G-001 or at the client's

request, returned in accordance with GEL's SOP GL-SR-E-002 for Transportation and Shipping of Samples and Pre-preserved Sample Containers.

It is our policy to hold samples for a minimum of thirty days after invoicing and before disposal, unless otherwise specified by contract or if the sample is part of litigation. If the sample is part of litigation, disposal of the physical sample shall occur only with concurrence of the affected legal authority, sample data user, and/or client.

When sample analyses are complete and regulatory and/or contractual holding times have expired, samples

are moved from their storage locations to the radioactive or non-radioactive archives. Samples that are to be returned to the client or held for an extended time period are segregated from the other samples. Radioactive and non-radioactive samples remain segregated.

When internal or client-specified storage time expires, samples with like matrices are composited into appropriate containers. The composites are then subject to the same treatment and disposal protocol. Samples that are approved for disposal are scanned into our LIMS and assigned the status of "Disposed."

SECTION 10 RECORDS

Section 10 – Records

Our quality records provide the documentation we need to support analytical results and conclusions. Documented evidence that quality assurance and quality control requirements have been met is critical to providing data that fulfills the specifications of applicable procedures, programs, and contracts.

As described in Section 3 of this Quality Assurance Plan (QAP), quality records include but are not limited to:

- Observations
- Calculations
- Calibration data
- Certificates of analysis
- Certification records
- Chains of custody
- External, supplier, and internal audits
- Run logs
- Instrument data and analytical logbooks
- Instrument, equipment and building maintenance logs
- Material requisition forms
- Monitoring logs
- Nonconformance reports
- Corrective actions
- Method development and start-up procedures including MDL studies
- Training records
- Waste management records
- Standard logs
- Software validation
- Standard operating procedures (SOPs)
- Sample collection and field data

Our procedures provide a legal and evidentiary chain of custody and are described in Section 9 of this QAP. Described in this section are:

- Record keeping system and design
- Records management and storage
- Sample handling records
- Records of support activities
- Analytical records

- Administrative records

10.1 Recordkeeping System and Design

We manage, maintain and store our quality records according to GL-QS-E-008 for Quality Records Management and Disposition. The protocols established in this document work in conjunction with those for specific types of records addressed in other SOPs to govern our record keeping system. Our record keeping system allows the historical reconstruction of all laboratory activities that produced analytical data.

We facilitate historical reconstruction by maintaining the following records and information, from the time a sample is received until it is disposed.

- A master list of all employee signatures and initials is maintained in Human Resources. This allows the identification of any GEL personnel who accept, handle, analyze, prepare, review, store, or dispose of a sample, its subsamples, associated data and reports, and other related documentation.
- If we provide bottles and containers to a client or sampling personnel, these records are kept in accordance with GL-SR-E-002 Transportation and Shipping of Sample and Pre-preserved Sample Containers. These electronic and paper records include:
 - Supplier and the lot numbers of containers and/or bottles provided
 - Certifications that the containers are free of contaminants that may bias the analyses
 - Addition of preservatives and identity of person responsible for this preservation.
 - Barcode containers supplied to a particular client or for a specific field-sampling event.

The person or agency responsible for collecting a sample is documented on the chain of custody and entered into LIMS. Other records supporting the acceptance of a sample include:

- Date and time of sample receipt
- Person accepting sample
- Condition of sample upon receipt

- Client-confirmation letter and/or sample quote
- Client chain of custody
- Electronically generated sample ID numbers specific to each sample aliquot and linked to the client's sample description, sample collection and receipt information, and analyses to be performed.
- Identification of each person who has custody of a sample, its subsamples, extracts, or digestates. (This is provided through the internal chain of custody procedures described in Section 9.)

Documentation that materials purchased for use in the analysis or preparation of samples meet specifications is maintained in accordance with GL-RC-E-001 for Receipt and Inspection of Material and Services.

Records of equipment calibrations are maintained and traceable by date and ID number to a specific analysis. These records include certifications of calibration and service that have been initialed or signed.

Our thermometers are verified against a NIST traceable thermometer, and records of this verification are maintained as described in GL-QS-E-007 for Thermometer Verification. Records of the daily calibration verifications of our analytical balances are kept in accordance with GL-LB-E-002 for Balances. The calibration records for our air-displacement pipets are maintained in pipet calibration logs specific to each pipet according to GL-LB-E-010 for Maintenance and Use of Air Displacement Pipets.

When methods and/or regulations specify that samples, subsamples, extracts, and/or digestates be stored at designated temperatures, or when the method, itself, has temperature sensitive steps, we document those temperatures on monitoring logs at the frequency defined in the corresponding SOPs. We can trace the specific storage location of a sample through the internal chain of custody.

We require that the initials of all personnel responsible for monitoring temperatures be recorded in the temperature monitoring logs pursuant to GL-LB-E-004 for Temperature Monitoring and Documentation Requirements for Refrigerators, Freezers, Ovens,

Incubators and Other Similar Devices. The logs are reviewed for completeness in accordance with GL-QS-E-005 for Review of Monitoring Device Logs.

Documentation on the instruments and equipment used for the analysis of samples is recorded in run logs, laboratory logbooks, instrument data and/or sample preparation logs. Routine or corrective maintenance that is performed on equipment or instruments is recorded in the maintenance log specific to the instrument. We document these records in accordance with GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms and Other Recordkeeping Devices.

The standards containing known quantities of target analytes that we use in instrument calibration, calibration verification, and as quality control samples, such as matrix spikes and laboratory control samples, are documented according to GL-LB-E-007 and GL-RAD-M-001 for Laboratory Standards Documentation. These records contain the following information:

- Protocol by which each standard was prepared
- Traceability of each child standard to its parent
- Date each standard was prepared
- Initials of person preparing the standard
- Expiration dates
- Concentration of each standard

This information allows us to document that the standards used were prepared in accordance with the established protocol, produced using source standards that meet the method and regulatory criteria, and used prior to their expiration date.

If required, reagents used in the preparation, dilution, and analysis of samples are verified to be free of interferences or target analytes. We record these verifications in the Reference Material in LIMS in accordance with GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms and Other Recordkeeping Devices.

Analytical and sample preparation methods applied to each sample aliquot are documented via the internal chain of custody, method information, and information recorded in lab notebooks, sample preparation logs, run

logs, and instrument data. The laboratory protocol we employ during analysis is dictated by the SOP in effect at the time the sample was analyzed or prepared by a specific method.

Run logs, laboratory notebooks, instrument data and sample preparation logs are used to document the preparation and analysis of samples and the associated instrument calibrations. These logs and notebooks are governed by GL-LB-E-009 for Run Logs and GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices. As stated in these SOPs, sample preparation and analytical records that are not electronically generated should be:

- Legible
- Recorded in permanent ink
- Corrected using one line marked through the error, initialed and dated
- Initialed by the responsible party

We maintain electronic records for each analytical batch. These records include the ID numbers of each client and quality control sample prepared and/or analyzed together, the method of preparation and analysis, and the matrix of the samples included in the batch.

Through our electronic statistical process control system (SPC), the acceptance criteria applied for all quality control (QC) samples are stored and maintained. The acceptance limits for target analytes are method, matrix, and time-period specific, which allow us to regenerate the criteria applied to QC samples associated with identified client samples.

Our Quality Systems Team maintains the records of nonconformances, and corrective actions associated with specific samples, batches, and processes. We maintain these records according to GL-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items; and GL-QS-E-002- Conducting Corrective/Preventative Action and Identifying Opportunities for Improvement.

Electronic data records are maintained in a secured database designed to protect the integrity of the data.

Data that are uploaded directly from instruments and that are manually entered are backed up by a second system.

Permanent records of electronic data deliverables are maintained along with the corresponding sample preparation and analytical data review records. This documentation includes the initials of the reviewer and date of the review.

Records of the data we report to our clients are maintained in a manner that protects client confidentiality, as well as any potential national security concerns. These records include copies of certificates of analysis, quality control summary reports, case narratives, CLP forms, and other information we provided to the client. The copies may be paper or electronic. The majority of the data packages submitted to Federal clients are stored electronically prior to being submitted to the client.

Records of samples being disposed or returned to the client are documented in accordance with GL-SR-E-002 for Transportation and Shipping of Samples and Pre-Preserved Sample Containers. Such records include the date samples are returned or disposed of, the destination of the samples, and name of the person transferring the samples.

10.2 Record Storage

We store quality records in compliance with GL-QS-E-008 for Quality Records Management and Disposition. The records are:

- Stored in a secured area to maintain data integrity and protect client confidentiality, including any national security concerns.
- Kept in areas where they are protected from fire loss, environmental deterioration, and, in the case of electronic records, electronic or magnetic sources.
- Indexed and filed in a manner allowing for ready retrieval.
- Accessible to the client for whom the record was generated.
- Retained by the applicable law and client contract requirements, typically 10 years.

Electronic data records are stored on compact disks and kept at GEL's approved offsite storage provider.

All of the hardware and software we need to reconstruct data is maintained according to GL-IT-E-003 for Requirements, Design, Operation, Validation and Removal of Hardware and Software Systems Used by the GEL Group, Inc. Records that are stored or generated by network or personal computers have either hard copy or write-protected backup.

10.3 Sample Handling Policy

Records of all procedures applicable to samples are maintained in our possession. These records include documents that pertain to:

- Preservation, including sample container and holding time
- Sample identification, receipt, acceptance or rejection, and login
- Sample storage and tracking including shipping receipts, transmittal forms, routing and assignment records
- Sample preparation (ID codes, cleanup and separation protocols, volumes, weights, instrument printouts, meter readings, calculations, reagents)
- Sample analysis
- Standard and reagent origin, receipt, preparation, and use
- Equipment receipt, use, specification, operating conditions and preventative maintenance
- Instrument calibration frequency and acceptance criteria
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions
- Method performance criteria including expected quality control requirements
- Quality control protocols
- Electronic data security, software documentation and verification, software and hardware audits, backups and records of any changes to automated data entries

- Automated sample handling systems
- Disposal of hazardous samples

10.4 Records of Laboratory Support Activities

In addition to sample handling records, we maintain the following:

- Original raw data for calibrations, samples and quality control measures, including worksheets and data output records (chromatograms, strip charts, and other instrument readout records)
- A written description of or reference to the specific method used, including the computational steps used to translate parameter observations into a reportable analytical value
- Copies of final reports
- Archived standard operating procedures
- Correspondence relating to project-specific laboratory activities
- Corrective action reports, audits and audit responses
- Proficiency test results

10.5 Analytical Records

We document and maintain analytical records, accordance with GL-LB-E-008 for Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms, and Other Recordkeeping Devices, and GL-LB-E-009 for Run Logs.

The information that is documented in analytical records includes:

- Laboratory sample ID code
- Date and time of analysis
- Instrument ID and operating conditions/parameter (or reference to such data)
- Method of analysis
- All calculations
- Dilutions
- Initials of analyst or operator
- Units of measurement

Our policy is to produce and maintain analytical records that are:

- Accurate
- Reviewed and verified
- Legible and understandable
- Traceable and authentic to their source
- Grouped in a contemporary manner with data entered and information recorded as it is obtained

10.6 Administrative Records

A number of pertinent records are maintained by Human Resources or Quality Systems, including:

- Staff qualifications and experience.
- Training records, including initial demonstrations of proficiency. (Refer to procedure GL-HR-E-002 for Employee Training.)
- A log of names, initials and signatures for individuals having responsibility for initialing laboratory records.

We monitor continuing demonstrations of proficiency through LIMS per GL-HR-E-002 for Employee Training.

SECTION 11

LABORATORY REPORT FORMAT AND CONTENTS

Section 11 – Laboratory Report Format and Contents

Accurate data are of little benefit to a client unless they are reported in a format that is easy to interpret and provides all pertinent information relating to the analysis of a sample. At GEL, we have developed certificate of analysis report formats that meet the different needs of our clients yet provide all of the information necessary to satisfy regulatory requirements while allowing for the interpretation of the data. Each format provides accurate, clear, unambiguous and objective data.

In addition to a certificate of analysis, a client can request and receive an extended data package. This package may include any of the following: certificates of analysis; summaries of quality control; case narratives; instrument data; sample preparation data; measurement traceability and calibration information; and electronic data deliverables. If clients require the reporting of data following the established contract laboratory protocol (CLP), we can provide a CLP-like data package that will meet their needs.

It is important that the certificate of analysis format and data package requirements be discussed with the client prior to our acceptance of the samples. Project Managers and contract staff are responsible for establishing an agreement with the client concerning data reporting and the potential cost to the client for data packages and/or specialized reporting. Our analytical data are reported to three significant figures unless otherwise required by client contract.

Laboratory reports and data packages are stored and transmitted in a manner that protects client confidentiality and potential matters of national security. No reports or data packages are released to persons or organizations outside GEL without the expressed consent of the client. If directed by a regulatory agency or subpoenaed to submit documents to a court of law, we will notify the client of the demand and the records being released.

The following elements of report formats and data packages are described in this section:

- Certificates of Analysis (C of A)
- Quality control summary reports (QCSR)

- Analytical case narratives
- Electronic data deliverables (EDDs)
- Types of data packages and reporting formats
- Review of data packages and reports

11.1 Certificates of Analysis

We have two primary C of A report formats, Level 1 and Level 2. Both contain the following information when applicable:

- Title
- GEL address and phone number
- Name of PM or person serving as the primary client contact
- Number of pages and total number of pages
- Name and address of client, where appropriate
- Project name or code if applicable
- Client-provided sample description
- Unique laboratory ID number for the sample
- Sample matrix
- Characterization and condition of the sample where relevant
- Date of receipt of sample
- Date and time of sample collection, if provided
- Date and time of sample analysis, reanalysis, and/or sample preparation
- Initials of analyst and person responsible for sample prep
- Analytical batch number
- Sample analysis and preparation methods (or unambiguous description of any non-standard method used)
- Reference to sampling procedure
- Additions to or deviations or exclusions from the test method, and other information relevant to a specific test, such as environmental conditions and the use and meaning of data qualifiers
- Nonconformances that affect the data
- Whether data are calculated on a dry weight or wet weight basis
- Identification of the reporting units, such as µg/L or mg/kg

- Statement of the estimated uncertainty of the test result, if applicable
- Signature and title of the person(s) accepting responsibility for the content of the C of A
- Date C of A was issued
- Clear identification of data provided by outside sources, such as air temperature or ambient water temperature
- Identification of the reporting detection limit (RDL) or practical quantitation limit (PQL) for each analyte, if applicable.

If a portion of the sample analysis is subcontracted, the C of A will identify the subcontractor or applicable accreditation number, and the data that was determined by the subcontracting laboratory

Level 2 Certificates of analysis contain the following additional information:

- Dilution factors
- Method detection limits
- Surrogate recoveries and the acceptance criteria for all organic analyses
- Estimated concentrations determined for non-detects and appropriate “U” and “J” qualifiers for non-detects and concentrations that fall between the MDL and PQL respectively.

Once issued, a C of A is not altered unless a subsequent C of A is identified as a revised report.

11.2 Quality Control Summary Report (QCSR)

We prepare and analyze samples in groups of twenty or less. The quality control data that demonstrate the sample preparation and/or analytical efficiency of the batch are summarized on a QCSR. The data reported on the QCSR may be limited to a sample delivery group contained in the batch or may include all quality control for the batch. Information reported on QCSR includes:

- Quality control sample ID number
- Type of quality control sample
- Concentrations determined, where applicable, for method blanks, matrix spikes, matrix spike duplicates, matrix duplicates, laboratory control samples, serial dilutions, and laboratory control sample duplicates

- Acceptance criteria for matrix spikes, matrix spike duplicates, matrix duplicates, laboratory control samples, and laboratory control sample duplicates
- Nominal concentrations of matrix spikes, matrix spike duplicates, LCSs, and LCS duplicates
- Concentration of parent sample for the matrix spikes, matrix spike duplicates, or sample duplicates
- Percent recoveries for LCS and matrix spikes
- Relative percent differences for the matrix spike duplicates, matrix duplicates, and LCS duplicates
- Analytical batch number with which the quality control data is associated
- Parent sample numbers for matrix spikes, matrix duplicates, and matrix spike duplicates
- Sample or sample delivery group ID
- Project code
- Date issued, page numbers/total number of pages
- Identification of recoveries or relative percent differences that do not meet the acceptance criteria

11.3 Analytical Case Narratives

Analytical case narratives are written by an analyst or data validator to describe the overall conditions affecting the analysis of a batch or a specific sample in the batch. Case narratives usually include:

- Sample delivery group ID number
- Analytical batch number
- Methods of preparation and analysis
- Sample matrix
- Initial of person preparing and/or reviewing the narrative
- Specific sample ID numbers
- Identification and description of batch quality control samples including parent sample identification
- Affirmation that all sample preparation conditions specified by the method or regulatory agencies were met or identification of specific deviations
- Affirmation that all analysis criteria specified by the method or regulatory agencies were met or identification of specific deviations
- Instrumentation employed if applicable and verification of its calibration

- Summary of batch quality control as compared to acceptance criteria
- Identification of nonconformances
- Pertinent comments and observations of factors that affect sample data quality

11.4 Electronic Data Deliverables (EDDs)

Electronic data deliverables are generated according to client specifications. EDDs use programs supplied by the client or created internally by our EDD team. Internally generated EDDs are usually written in Perl and/or PL/SQL.

11.5 Types of Data Packages and Reports

We offer six levels of data reports and the ability to design packages to meet the needs of our clients. The levels of data reports are summarized in Table 1.

Table 1: Data Report Definitions

	General Chemistry	Metals	Organics	Radiochemistry
Level 1	COA	COA	COA	COA
Level 2	Level 1 + QC Summary EDD (Optional)	Level 1 + QC Summary EDD (Optional)	Level 1 + QC Summary EDD (Optional)	Level 1 + QC Summary EDD (Optional)
Level 3	Level 2 + EDD Case Narrative(s)	Level 2 + EDD Case Narrative(s)	Level 2 + EDD Case Narrative(s)	Level 2 + EDD Case Narrative(s)
Level 4	Same as Level 5	Level 3 + CLP Like forms (all)	Level 3 + CLP Like forms (all)	Level 3 + Raw data Run logs Continuing Calibrations
Level 5	Level 3** + Raw Data	Level 4 + Raw Data	Level 4 + Raw Data	Level 4 + Background & Efficiencies Standards
Level 6	Level 5 ** + Standards Traceability	Level 5 + Standards Traceability	Level 5 + Standards Traceability	Level 5 + Method Calibration QC SPC Charts

** ICV/CCV forms can be requested for these package levels

If a client requests, the above reports can be accompanied by EDDs, case narratives, copies of associated nonconformance reports, and other support documentation. The client's specific requirements are communicated to the laboratory and data reviewers through LIMS.

GEL's SOP GL-CS-E-002 for The Internal Review of Contractually Required Quality Criteria for Client Package Delivery defines preparation and review of the package.

If a client requests a CLP-like data package, and we agree to provide one, it is compiled in accordance with GL-LB-E-013 for CLP-Like/DOE Data Package Assembly and Revision. If a client does not request a full CLP-like data package but asks for data to be provided on CLP forms generated from software, we follow the applicable procedures in GL-LB-E-013.

11.6 Review of Data Reports, EDDs, and Data Packages

Level 1 and Level 2 data reports are reviewed for accuracy and completeness by the PM or PMA. Level 3-6 and CLP-like data packages are reviewed in the laboratory by a data reviewer, who is responsible for reviewing specific fractions of the data package for accuracy, consistency, and completeness in accordance with the SOP for that lab area.

No data package fraction is to be provided to the data packaging team without the approval of the appropriate data reviewer.

CLP-like data packages are reviewed in compliance with the basic protocol. Specific requirements are described in GL-LB-E-013 for the CLP-Like/DOE Data Package Assembly and Revision.

11.7 State Specific Reporting Criteria

Some state agencies require laboratories who perform drinking water analyses in support of Clean Water Act programs to communicate specific results to clients and/or agencies in some circumstances. If samples are found to contain concentrations of target analytes above those required by Federal or State regulations, the state must be informed. Please see SOP GL-CS-E-009 for state specific reporting criteria for drinking water programs.

SECTION 12
SUBCONTRACTING ANALYTICAL SAMPLES AND OUTSIDE SUPPORT SERVICES

Section 12 – Subcontracting Analytical Samples and Outside Support Services

We provide a full array of organic, inorganic, and radiochemical analyses. The subcontracting of samples to other facilities, while infrequent, may occur when:

- The client has requested analytical services for which we are not certified or do not offer as a routine product.
- The regulatory or method holding times and/or client due dates are in danger of not being met as the result of instrument malfunction or the unexpected influx of a large group of samples.

No samples are subcontracted without the client's consent. The laboratories selected to receive subcontracted samples are expected to meet the following criteria:

- Demonstrated technical capability to provide data that meets and conform to our quality standards.
- Established certification, if available, for the requested analyses.
- Successful proficiency evaluation results, if available.
- Commitment to meet time requirements for delivery of results to the client.
- Agreement to provide all documentation requested in conjunction with the analysis.

- NELAP, or ISO/IEC 17025 accreditation for the analysis if required by the client.

We audit potential subcontractors for technical and administrative compliance as directed in GL-QS-E-001 for Conduct of Quality Audits. An audit may be in the form of a book audit or an on-site review.

If there is evidence of a technical, administrative, or quality deterioration, the laboratory is removed from our list of approved subcontractor laboratories pending further evaluation, which may include an on-site audit. Once the laboratory again demonstrates compliance with GEL's standards, it can be reclassified as an approved subcontractor laboratory.

At GEL, we have a multi-faceted and trained staff. There are occasions, however, when it may be necessary to obtain the services of professionals outside of GEL. This may be due to such things as sample workload, introduction of a new instrument or method requiring special knowledge, or employee leaves of absence.

Any outside support services or service personnel are subject to the same scrutiny as a subcontract laboratory. If a service fails to meet our standards for excellence, the appropriate parties are promptly notified. If immediate corrections are not implemented and services are not of adequate quality to maintain confidence, the contract is canceled.

SECTION 13
CLIENT SATISFACTION

Section 13 – Client Satisfaction

Meeting the needs and expectations of our clients is essential to meeting our commitment to be the environmental laboratory of first choice. An important part of meeting this commitment involves receiving and resolving client concerns and complaints.

Client complaints that question the quality of laboratory data or data deliverables are directed to Quality Systems. These concerns are responded to with input from the laboratory, EDD team or data packaging group as may be needed.

The types of complaints, area(s) affected, and any impacts on quality are trended on a quarterly basis. This information is available to members of the Leadership Team and other managers and group leaders. Client feedback is solicited through ongoing relationships maintained by our Account Managers. Additionally, the Project Management team and members of the Quality Group stay in communication with clients through regularly scheduled meetings, client visits and open email correspondence.

We use LIMS to monitor client complaints, nonconformances and corrective actions. Every complaint is entered into the system upon receipt and assigned an internal and external due date. The external due date is often established by client contract. The internal due date allows time for the Quality Systems Team to review the response and transmit it to the client on or before the due date.

If we notice a trend that significantly affects the quality of our data, a corrective action is initiated following GL-QS-E-002-Conducting Corrective/Preventive Action and Identifying Opportunities for Improvement. The implementation and verification of the corrective action affirms an effective and permanent solution.

The Quality Systems Team promptly audits those areas of activity or responsibility for which a complaint or concern has been stated.

APPENDIX A: REFERENCES

- The NELAC Institute, TNI Standard, 2016.
- 40 CFR Part 136, August 19, 2014 Guidelines Establishing Test Procedures for the Analyses of Pollutants.
- 40 CFR Part 141- National Primary Drinking Water Regulations, July 1, 2009, Subpart C-Monitoring and Analytical Requirements
- DOE Orders 414.1B 414.1C, and 414.1D Quality Assurance, U.S. Department of Energy.
- EPA Requirements for Quality Assurance Project Plans (QAPPs), US EPA QA/R-5.
- EPA 815-R-05-004 EPA Manual for the Certification of Laboratories Analyzing Drinking Water.
- Model Statement of Work for Analytical Laboratories, Prepared for Department of Energy NNSA Service Center by Analytical Quality Associates, Rev 10, February 2020.
- Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs, American National Standard ANSI/ASQC E4-2004.
- Measurement Associated Instrument Quality Assurance for Radiobioassay Laboratories ANSI N42.23-1996.
- US Department of Defense (DoD) and Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories DoD/DOE QSM, Version 6.0, December 2023.
- MARLAP- Multi-Agency Radiological Laboratory Analytical Protocols
- 10 CFR Part 21- Reporting of Defects and Noncompliance
- 10 CFR Part 61- Licensing Requirements for Land Disposal and Radioactive Waste
- NRC REG Guide 4.15 and NRC REG Guide 4.8
- ISO/IEC 17025-2017
- DOE G 414/1-3, 11-3-04, Suspect/ Counterfeit Items Guide for use with 10 CFR 830 Subpart A. Quality Assurance Requirements, and DOE O 414.D, Quality Assurance.

APPENDIX B: DEFINITIONS

The following definitions are used throughout the text of our Quality Systems Plan. These definitions were reprinted from "Definitions for Quality Systems," NELAC, July 1, 1999. For most entries, the original source of each definition is provided.

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in the requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a program of study or an institution as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accreditation Body (AB): Entities recognized in accordance with the DoD ELAP and the DOECAP-AP that are required to operate in accordance with ISO/IEC 17011, *Conformity assessment: General requirements for accreditation bodies accrediting conformity assessment bodies*. The AB shall be a signatory, in good standing, to the International Laboratory Cooperation (ILAC) mutual recognition arrangement (MRA) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that its laboratories comply with ISO/IEC 17025.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (TNI Standard -2016)

Aliquot: A discrete, measured, representative portion of sample taken for analysis. (DoD, EPA QAD Glossary)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Analysis: A combination of sample preparation and instrument determination.

Analyte: The specific chemicals or components for which a sample is analyzed may be a group of chemicals that belong to the same chemical family and are analyzed together. (EPA Risk Assessment Guide for Superfund, OSHA Glossary)

Analytical Batch: Samples (e.g whole samples, extracts, digestates or concentrates) and quality control standards which are analyzed together as a group. An analytical batch/sequence can include prepared samples originating from various quality control matrices. An analytical batch/sequence shall use the same instrument calibration and shall be bracketed by calibration verifications within acceptance criteria. This is also called an Analytical Sequence. (DoD, EPA QAD Glossary)

Analytical Method: A formal process that identifies and may quantify the substance, organism, physical parameter, property, or chemical constituent of interest (target analytes) in a sample.

Analytical Detection Limit: The smallest amount of an analyte that can be distinguished in a sample by a given measurement procedure throughout a given confidence interval. (NELAC Quality Systems Committee)

Analytical Reagent (AR) Grade: Designation for the high purity of certain chemical reagents and solvents given by the American Chemical Society. (NELAC Quality Systems Committee)

Analytical Sample: Any solution of media introduced into an instrument on which an analysis is performed excluding instrument calibration, initial calibration verification (ICV), initial calibration blank (ICB), continuing calibration verification (CCV), and continuing calibration blank (CCB).

Annually: A period not to exceed 13 months.

ANSI: American National Standards Institute—this consensus standards body approves standards as a guide to aid the manufacturer, the consumer and the general public who may be concerned with its scope and provisions.

Assessment: Process undertaken by an accreditation body to assess the competence of a laboratory, based on particular standard(s) and/or other normative documents and for a defined scope of accreditation. (NELAC)

Audit: A systematic evaluation and independent examination of facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (DoD, EPA QAD Glossary)

Authoritative Source: An authoritative source for reference materials is an organization such as a manufacturer, government organization, or designated repository that can provide reference materials with known or appropriate identity and purity for laboratory use. (Glossary of Quality Assurance Terms, QAMS, 12/13/2023)

Batch: Environmental samples prepared and/or analyzed together with the same process and personnel using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) that are analyzed together as a group using the same calibration curve or factor. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Bias: The systematic or persistent distortion of a measurement process which causes errors in one direction; the difference between the mean value of the measurements and the true value of the measured. (Glossary of Quality Assurance Terms, QAMS, 12/13/2023)

Biennially: A period taking place every 2 years.

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subject to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. Blank samples are negative control samples, which typically include field blank samples (e.g. Trip Blank, Equipment (i.e. rinsate) Blank, and Temperature Blank) and the laboratory blank samples (e.g. Method Blank, Reagent Blank, Solvent Blank, Instrument Blank, Calibration Blank, and Storage Blank (ASQC))

Blind Sample: A subsample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibrate: To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration: The set of operations that establish, under specified conditions, the relationship between values indicated by a measuring device, or the correct value of measuring instrument, measuring system, or the values of represented by a material measure or reference material and the corresponding value of the standards. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response. (NELAC).

Calibration Range: The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check

standard and the high standard establish the linear calibration range, which lies within the linear dynamic range. (DoD QASM)

Calibration Standard: A substance or reference material used to calibrate an instrument or lab equipment. (QAMS)

Certified Reference Material (CRM): A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation that is issued by a certifying body. (ISO Guide 30 – 2.2)

Chain of Custody: A record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number of and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses. (NELAC Quality Systems Committee)

Commercial Grade Items: When applied to analytical services provided to nuclear power plants licensed pursuant to 10 CFR Part 50, commercial grade item means a structure, system, or component, or part thereof that affects its safety function, that was not designed and manufactured as a basic component. In the laboratory operations, commercial grade items may include calibration standards, quality control standards, reagents, instrument software conducting calculations, calibration services for support instrumentation, and other process controls, verifying their acceptability by inspections, tests, validation, or analyses by the purchaser or third-party dedicating entity (such as NIST, A2LA, NPL and TNI). This activity assures that a critical characteristic is acceptable. Commercial grade items do not include items where the design and manufacturing process require in-process inspections and verifications to ensure that defects or failures to comply are identified and corrected. These types of items are considered Consumables.

When applied to facilities and activities licensed pursuant to 10 CFR Parts 50, commercial grade item means an item that is:

- (245) Not subject to design or specification requirements that are unique to those facilities or activities;
- (ii) Used in applications other than those facilities or activities; and
- (iii) To be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacturer's published product description (for example, a catalog).

It is the responsibility of the purchaser to identify the vendor type, grade, and use of the purchased item

Confirmation: Verification of the presence of a component through the use of an analytical technique that differs from the original test method. These may include: (NELAC)

- Second column confirmation
- Alternate wavelength
- Derivatization
- Mass spectral interpretation
- Alternative detectors or
- Additional cleanup procedures

Continuing Calibration Blank (CCB): Aliquot of reagent water or other blank matrix that is analyzed after each CCV. The CCB is used to determine whether the analytical sequence is in control during sample analysis.

Continuing Calibration Verification Standard (CCV): An aliquot of reagent water or to the blank matrix to which known quantities of the method analytes are added in the laboratory. The CCV is analyzed exactly like a sample periodically throughout the sequence. Its purpose is to determine whether the analytical sequence is in control during

the sample analysis. It may be prepared from the same source as the calibration standards and is usually of varied concentrations.

Control Limits: A range within which specified measurement results must fall to be compliant.

Corrective Action: Action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Integrity: The condition that exists when a data are sound, correct and complete, and accurately reflect activities and requirements.

Data Reduction: The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form. (EPA-QAD).

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives. (e.g., for precision and bias). (NELAC)

Detection Limit: The lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated degree of confidence. Refer to Method Detection Limit. (NELAC).

Digestion: A process in which a sample is treated (usually in conjunction with heat and acid) to convert the target analytes in a sample to a more easily measured form.

Digital Signature: A digital signature is a specific type of electronic (e-signature) that relies on public-key cryptography to support identity authentication and provide data and transaction integrity. Digital signatures carry a user's information along with electronic signatures in the form of an electronic certificate. Electronic signatures do not contain authentication attached to them.

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Electronic Signature: The act of typing in your name, using an implement or tool to sign your name electronically to a .pdf or Word document. Electronic Signatures do not contain any authentication certificates attached to the like digital signatures.

Environmental Data:

Extracted Internal Standard:

Field of Accreditation:

Field Sample:

Holding Times (Maximum Allowable Holding Times): The maximum time(s) that samples may be held prior to analysis and still be considered valid. (40 CFR Part 136)

Incremental Sampling Methodology:

In- depth Data Monitoring:

Initial and Continuing Demonstrations of Capability: Procedures to establish the ability of the laboratory to generate acceptable accuracy and precision which is included in many of the EPA's analytical test methods. In general, the procedure includes the addition of a specified concentration of each analyte in each of four separate aliquots of laboratory pure water or authentic samples. These are carried out through the analytical procedure and the percentage recovery, and the standard deviation are compared to specified limits. (40 CFR Part 136, 2003 NELAC)

Internal Standard: A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Initial Calibration Blank (ICB): An aliquot of reagent water or another blank matrix that is analyzed after each ICV. The ICB is used to determine whether there is carryover contamination after injection of the mid-level ICV.

Initial Calibration Verification (ICV): A solution of method analytes of known concentrations that is used to fortify an aliquot of blank or sample matrix. The ICV is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check laboratory performance with externally prepared test materials.

Instrument Performance Check Solution (IPC): A solution of one or more method analytes, surrogates, internal standards, internal standards, or other test substances used to evaluate the performance of the instrument system with respect to a defined set of criteria.

Internal Standard (ISTD): A known amount of standard added to a portion of the sample extract as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Interferents: Substances that affect the analysis for the element of interest.

ISO/IEC 17025: The International Organization for Standardization and International

Electrotechnical Commission form this specialized system for worldwide standardization. Members of ISO or IEC participate in the development of International Standards through technical committees established by their organization to deal with particular fields of activity. Other international organizations, government and non-government, also take part in the development of these standards. The ANSI/ISO/IEC 17025-2017 is approved as an American National Standard and covers general requirements for the competence of testing and calibration laboratories.

Laboratory: A body that calibrates and/or tests.

1. In cases where a laboratory forms part of an organization that carries out other activities besides calibration and testing, the term "laboratory" refers only to those parts of that organization that are involved in the calibration and testing process.
2. As used herein, the term "laboratory" refers to a body that carries out calibration or testing at or from a permanent location, from a temporary facility, or a mobile facility. (ISO 25)

Laboratory Control Sample (LCS): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias to assess the performance of all or a portion of the measurement system. (NELAC)

Laboratory Duplicate: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC Quality Systems)

Limit of Detection (LOD): The lowest concentration level that can be determined by a single analysis and with a defined level of confidence to be statistically different from a blank. See also Method Detection Limit. (Analytical Chemistry, 55, p.2217, Dec. 1983, modified)

Limit of Quantitation (LOQ): The lowest concentration level of the initial calibration curve used to quantitate an analyte. (DoD clarification) The LOQ must be $\geq 3X$ the LOD, and is usually not more than 10X the LOD.

LIMS: GEL's Laboratory Information Management System. Also known as LIMS.

Linear Calibration Range: The concentration range over which the instrument response is linear. Also called Linear Dynamic Range.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch determination, the following matrix types shall be used:

- ◇ Aqueous: Any aqueous sample excluded from the definition of a drinking water matrix or saline/estuarine source. Includes surface water, groundwater, and effluents.
- ◇ Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.
- ◇ Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt-water source.
- ◇ Non-aqueous liquid: Any organic liquid with <15% settleable solids.
- ◇ Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- ◇ Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.
- ◇ Chemical Waste: A product or by-product of an industrial process.
- ◇ Air Samples: Media used to retain the analyte of interest from an air sample such as sorbent tubes or summa canisters. Each medium shall be considered as a distinct matrix. (Quality Systems)

Matrix Spike (MS): Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Matrix Spike Duplicate (spiked sample/fortified sample duplicate): A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

May: Denotes permitted action, but not required action. (NELAC)

Method Blank (MB): A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples containing an analyte of interest through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Method Detection Limit (MDL): The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B)

Mid-Range: The concentration equal to 50% of the highest calibration concentration.

Must: Denotes a requirement that is required to be met. (Random House College Dictionary)

National Institute of Standards and Technology (NIST): A federal agency of the US Department of Commerce's Technology Administration that is designated as the United States National Metrology Institute.

Negative Control: Measures taken to ensure that a test, its components, or the environment does not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC: National Environmental Laboratory Accreditation Conference. A voluntary organization of state and federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for

accrediting environmental laboratories. A subset of the National Environmental Laboratory Accreditation Program (NELAP).

Performance Audit: the routine comparison of independently obtained quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): A set of processes wherein the data quality needs, mandates, or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Practical Quantitation Limit (PQL): The lowest level in the calibration curve. With the prep factor applied, the PQL is referred to as the effective PQL.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. (NELAC)

Preservation: Refrigeration and/ or reagents added at the time of sample collection to maintain the chemical and or biological integrity of the sample. (NELAC)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC, Section 2.1)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results in comparison to peer laboratories and the collective demographics and results summary of all participating laboratories. (NELAC)

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed. (EPA-QAD)

Pure Reagent Water: Shall be water in which no target analytes or interferences are present at a concentration that would impact the results when using a particular analytical test method. (NELAC)

Quality Assurance: An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality within a stated level of confidence. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Quality Control: The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Quality Manual: A document stating the quality policy, quality system and quality practices of an organization. This may also be called a Quality Assurance Plan or a Quality Plan. **NOTE:** The quality manual may call up other documentation relating to the laboratory's quality arrangements. (Quality Systems Committee)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

Quantitation Limits: The value at which an instrument can accurately measure an analyte at a specific concentration that includes the maximum or minimum levels, concentrations, or quantities of a target that can be quantified with the accuracy required by the data user. These values establish the upper and lower limits of the calibration range. (NELAC with DoD clarification)

Range: The difference between the minimum and the maximum set of values. (EPA_QAD)

Raw Data: Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes that have been transcribed verbatim, dated and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

Reagent Blank (method reagent blank): A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Reference Material: A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30 -2.1)

Reference Standard: A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM – 6.08)

Relative Percent Difference (RPD): The difference between two duplicate samples, such as a MS/MSD/, LCS/LCSD, or sample/sample DUP. It is determined by taking the difference between the two results and dividing by the average.

Reporting Limit (RL): The level at which a target analyte would meet the data quality objectives of the laboratory and/or a project, which may include establishing compliance with a regulatory and/or action limit. The RL may be equal to the laboratory practical quantitation limit (PQL)

Requirement: Denotes mandatory specification; often designated by the term “shall.” (NELAC)

Sample: Portion of material collected for chemical analysis, identified by a single, unique term. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis. (DoD)

Safety Related Procured Items: As specified in 10 CFR Part 50 and other Nuclear Power related activities, a basic component includes safety-related analytical services that are associated with the component information in support of an early site permit application or other safety related services identified by the client, whether the services are performed by the laboratory or others. GEL has identified the primary safety related basic component item for these services as:

- ◇ Calibration Standards for Radiochemical Analyses used in the direct issuance of analytical data reported to a Nuclear Facility. These standards are the primary sources (critical characteristic) of calibration for instruments that will provide the analytical results to our clients. All Safety Related Procured Items are considered Type I procurement and must meet all specifications as identified in SOP GL-RC-E-002.

Standard Operating Procedure (SOP): A written document that details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and is accepted as the method for performing certain routine or repetitive tasks. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Standard Reference Material (SRM): A certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical test method. (NELAC)

Statistical Process Control (SPC): Statistically derived limits that establish acceptable ranges for recoveries of analytes of interest, including LCS, MS, MSD, PS, PSD and internal standards.

Stock Standard Solution: A concentrated solution containing one or more method analytes prepared in the laboratory using certified reference materials or purchased from a reputable commercial source.

Selectivity: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (NELAC Quality Systems)

Sensitivity: The capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC Quality Systems)

Serial Dilution: The dilution of a sample by a known factor. When corrected by the dilution factor, the diluted sample should agree with the original undiluted sample within the specified limits. Serial dilution may reflect the influence of interferences.

Shall: Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there will be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (ANSI)

Should: Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (ANSI)

Spike: A known mass of target analyte added to a blank sample or subsample; used to determine recovery efficiency or for other quality control purposes.

Subsample: A portion of the entire sample randomly collected and composited to create weight used for the solvent extraction process. The subsample should be representative of the entire sample.

Storage Blank: A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A Storage Blank is used to record contamination attributable to sample storage at the laboratory.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes. (Glossary of Quality Assurance Terms, QAMS, 8/31/92)

Test: A technical operation that consists of the determination of one or more characteristics or performance of a given product, material equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2 – 12.4)

Test Method: An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Tolerance Chart: A chart in which the plotted quality control data is assessed via a tolerance level (e.g. $\pm 10\%$ of a mean) based on the precision level judged acceptable to meet overall quality/data use requirements instead of a statistical acceptance criteria (e.g. ± 3 sigma). (ANSI N42.23-1995, Measurement and Associated Instrument Quality Assurance for Radiochemistry Laboratories)

Traceability: The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12) In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (DoD QSM)

Validation: The process of substantiating specified performance criteria.

Verification: confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: Verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation, or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustments, or to repair, or to downgrade, or to declare obsolete. In all cases it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

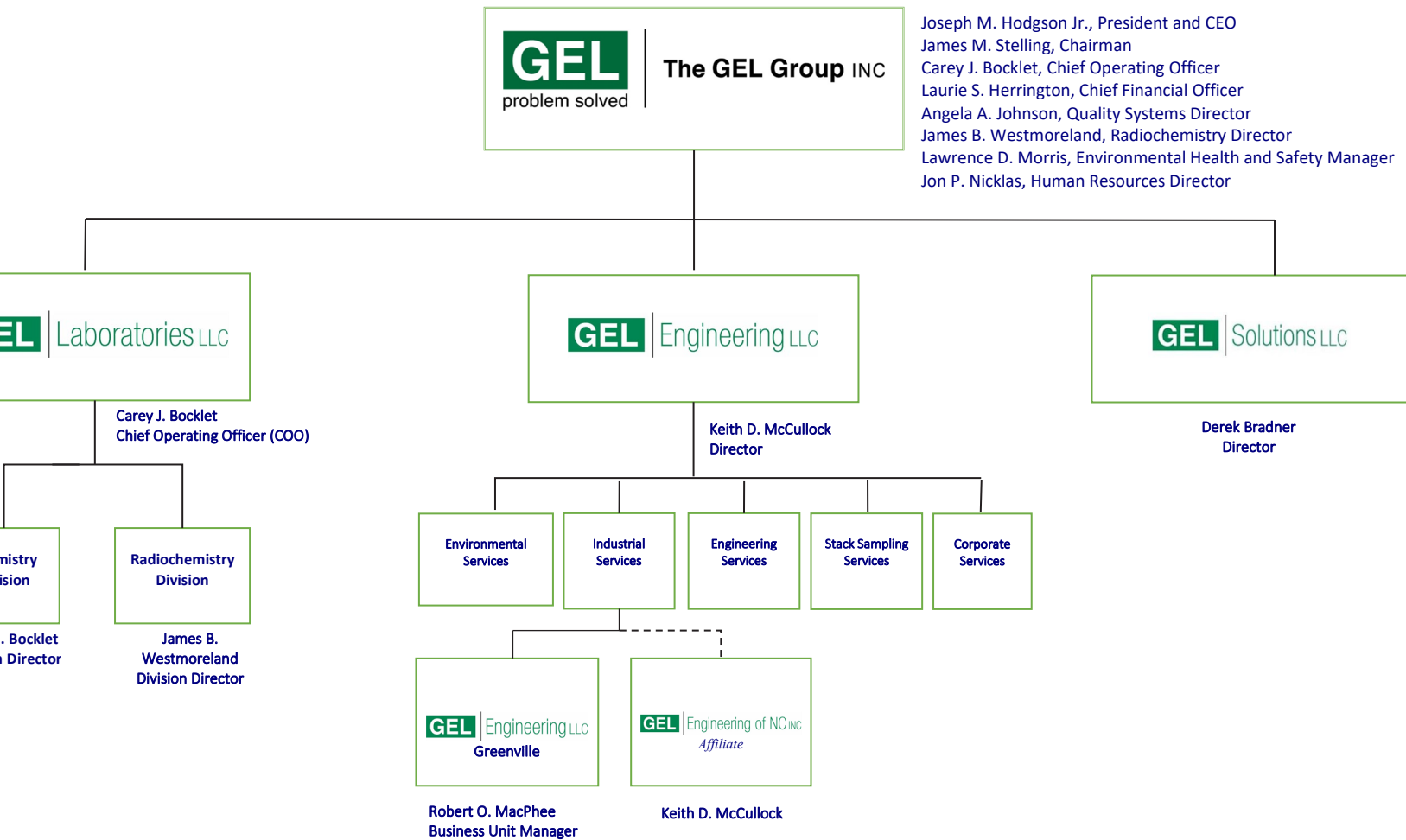
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APPENDIX C: CORPORATE ORGANIZATION CHART



GEL | Laboratories LLC
2040 Savage Road Charleston, SC 29407
Main: 843-556-8171
www.gel.com

APPENDIX D: CERTIFICATIONS

GEL Laboratories, LLC maintains environmental laboratory certification in many states, including primary NELAP in Utah and secondary in Florida, Illinois, Kansas, Louisiana, New Hampshire, New Jersey, New York, Pennsylvania, Texas and Virginia. We expand our list of certifications as needed.

Original Scope of Accreditation/Range of Activities are maintained in the Quality Assurance work area. Electronic copies are available in .pdf form on the GEL intranet. *Please call to confirm the status of any certification of interest.*

- **Department of Defense (DoD) Department of Energy (DOE)** Consolidated Quality Systems Manual Version 6.0, December 2023 through American Association for Environmental Laboratory Accreditation (A2LA) (A2LA 2567.01)
- **U.S. Department of Agriculture** – Foreign soil importation permit number # 525-24-281-19660
- **National Environmental Laboratory Accreditation Program (NELAP)** – Primary issued through the State of Utah, Department of Health; Secondary issued through the States of Florida, Illinois, Kansas, Louisiana, New Hampshire, New Jersey, New York, Pennsylvania, Texas and Virginia
- **Clinical Laboratory Improvement Amendments (CLIA)** – U.S. Department of Health and Human Services, Certificate of Compliance for Acceptance of Human Specimens (GEL ID: 42D0904046)
- **Alabama Department of Environmental Management**, Drinking Water (42200)
- **Alaska Department of Environmental Conservation Contaminated Sites** Laboratory Approval 17-018
- **Alaska Department of Environmental Conservation Laboratory Certification Program, Chemical Analysis in Drinking Water** SC00012
- **Arkansas** Department of Environmental Quality Laboratory Certification Program for Wastewater, Groundwater, Solid Waste Reciprocal Certification to SCDES (88-00651)
- **California** Environmental Laboratory Accreditation Program Certification, ELAP (GEL ID: 2940)
 - Sanitation Districts of Los Angeles County (GEL ID: 9255651)
- **Colorado** Department of Public Health and Environment, Reciprocal Certification to SCDES Environmental Laboratory Certification Program for Safe Drinking Water Chemistry and Radiochemistry (SC00012)
- **Connecticut** Department of Public Health – Potable Water, Wastewater and/or Trade Waste, Sewage and/or Effluent, Soil and Radiochemistry Reciprocal Certification (GEL ID: PH-0169)
- **Florida** Department of Health, Bureau of Laboratories, Secondary NELAP (GEL ID E87156)
- **Georgia** Department of Natural Resources, Reciprocal Certification to SCDES Environmental Laboratory Certification Program for Safe Drinking Water (GEL ID: 967)
- **Hawaii** Department of Health, Safe Drinking Water, reciprocal to Utah NELAP, (SC00012)

- **Idaho** Department of Health and Welfare, (SC00012)
- **Illinois** EPA Environmental Laboratory Accreditation for Drinking Water, Wastewater, and Hazardous and Solid Waste, Secondary NELAP (GEL ID: 200029)
- **Indiana** State Department of Health (C-SC-01)
- **Kansas** Department of Health and Environmental Laboratory, Non-potable Water and Solid and Hazardous Waste, Secondary NELAP (GEL ID: E-10332)
- **Kentucky** Department of Environmental Protection for Drinking Water and Wastewater (GEL ID: KY90129)
- State of **Louisiana** Department of Health and Hospitals (LA024), Safe Drinking Water, Secondary NELAP
- State of **Louisiana** Department of Environmental Quality, (03046, AI 33904), Non-drinking water, Secondary NELAP
- State of **Maine** Laboratory Accreditation Program (SC00012)
- **Maryland** Department of Health and Mental Hygiene, Laboratories Administration, Reciprocal Certification to SCDES Environmental Laboratory Certification Program for Safe Drinking Water –Radiochemistry (GEL ID: 270)
- **Massachusetts** Department of Environmental Protection, Division of Environmental Analysis – Potable Water, Radiochemistry (GEL ID: M-SC012), Per- and Polyfluoroalkyl Substances (PFAS)
- **Michigan** Department of Environmental Quality – Potable Water, Radiochemistry (GEL ID: 9976)
- **Mississippi** State Department of Health NELAP reciprocity SC00012
- **Nebraska**, Department of Health and Human Services (GEL ID: NE-OS-26-13)
- **Nevada** Department of Human Resources, Health Division, Bureau of Licensure and Certification, Radiological and Non-Radiological (GEL ID: SC00012), Nevada Mining
- State of **New Hampshire** Environmental Laboratory Accreditation Program, Drinking Water, Wastewater, and Hazardous and Solid Waste, Secondary NELAP (2054)
- **New Jersey** Department of Environmental Protection, Safe Drinking Water, Solid and Hazardous Waste, and Water Pollution Certification, Secondary NELAP (GEL ID: SC002)
- State of **New Mexico** Environment Department, Drinking Water Bureau, reciprocal to NELAP (SC00012)
- **New York** Department of Health, Environmental Laboratory Approval Program Certification, Potable Water, Non-potable Waters and Solids/Hazardous Wastes, Secondary NELAP (GEL ID: 11501)
- **North Carolina** Division of Water Quality Lab Certification Program, Waste Waters/Ground Waters. (GEL ID:233)

- **North Carolina** Department of Health and Human Services, North Carolina State Laboratory Public Health Environmental Sciences, Safe Drinking Water. (GEL ID: 45709)
- **Oklahoma** Department of Environmental Quality, General Water Quality/Sludge Testing Laboratory Dual Certification (GEL ID: 9904)
- **Pennsylvania** Department of Environmental Protection – Bureau of Laboratories, Secondary NELAP (GEL ID: 68-00485)
- **Puerto Rico** Department of Health Reciprocal certification to Manual for the Certification of Laboratories Analyzing Drinking Water. PRDOH (SC00012)
- **South Carolina** Department of Environmental Services – Environmental Laboratory Certification Program, Clean Water, Safe Drinking Water, Radiological, and Solid/Hazardous Wastes (GEL ID: 10120001/10120002)
- **South Carolina** Department of Environmental Services (SCDES) Radioactive Material License (License #362)
- **Tennessee** Department of Health – Division of Laboratory Services, Reciprocal Certification to SCDES Environmental Laboratory Certification Program, Safe Drinking Water-Radiochemistry and Non-radiochemistry (GEL ID: 02934)
- **Texas** Commission on Environmental Quality, Secondary NELAP (GEL ID: T104704235)
- **Utah** Department of Health, Division of Epidemiology and Laboratory Services, Safe Drinking Water, Clean Water and Resource and Conservation and Recovery Act Certifications Primary NELAP (EPA ID: SC00012 Certificate: SC000122026-50)
- **Vermont** Department of Environmental Conservation, Water Supply Division, Secondary NELAP (VT87156)
- Commonwealth of **Virginia** Department of General Services – Division of Consolidated Laboratory Services, Safe Drinking Water, Clean Water Act and Resource and Conservation Act Certifications, Secondary NELAP (GEL ID: 460202)
- **Washington** State Department of Ecology, Safe Drinking Water, Clean Water and Resource and Conservation and Recovery Act Certifications (GEL ID: C780)

APPENDIX E: ESSENTIAL QUALITY CONTROL REQUIREMENTS

At GEL, we enforce strict adherence to quality control measures. Quality control measures for each type of analysis are delineated in the associated standard operating procedure and include those specified in the identified analytical method. Client requests for additional quality control agreed to by us will be communicated to the laboratory by the Project Manager and performed accordingly.

All quality control measures are assessed and evaluated on an ongoing basis. We use these measures to establish statistically derived quality control acceptance criteria. The acceptance criteria are used to evaluate whether the analytical process is in control and to assist us in establishing the validity of the data. Our procedures for handling out-of-control situations are written in the analytical standard operating procedure.

Method-specific quality measures are described in the appropriate standard operating procedure. Essential but general quality control requirements are summarized in the sections below for chemical testing, including inorganic and organic analyses, and radiochemical testing.

E1 Chemical Testing

This section includes our quality control requirements for inorganic and organic analyses, and discusses:

- Negative controls
- Positive controls
- Analytical variability and reproducibility
- Method evaluation
- Method detection limits
- Data reduction
- Quality of standards and reagents
- Selectivity
- Constant and consistent test condition

E1.1 Negative controls

We implement a negative control at least once per analytical batch of samples having the same matrix, and where, if applicable, the same extraction or preparation method is employed. The negative control is a method blank that we use to determine the presence of contamination. If discovered, we must investigate the source of contamination and take measures to correct, minimize, or eliminate the source if:

1. The concentration of target analyte exceeds the established practical quantitation limit and exceeds a concentration greater than 1/10 of the measured concentration of any sample in the analytical batch;
2. The concentration of a target analyte in the method blank exceeds that present in the samples and is greater than 1/10 of the specified regulatory limit.

If a method blank is indicative of contamination, we must assess each sample in that batch against the above criteria to determine if the data are acceptable. Any sample associated with a contaminated method blank shall be reprocessed for analysis, as needed, or we will report the results with appropriate data qualifiers.

E1.2 Positive Control – Method Performance

E1.2.1 Laboratory Control Sample (LCS)

Purpose: The LCS is used to evaluate the performance of the total analytical system, including all preparation and analysis steps. Results of the LCS are compared to established criteria and, if found to be outside of these criteria, indicates that the analytical system is “out of control.” Any

affected samples associated with an out-of-control LCS shall be reprocessed for re-analysis or the results reported with appropriate data qualifying codes, as necessary.

Frequency: The LCS is analyzed at a minimum of 1 per preparation batch. Exceptions would be for those analytes for which no spiking solutions are available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, temperature, dissolved oxygen or turbidity. In those instances, for which no separate preparation method is used (example: volatiles in water) the batch shall be defined as environmental samples that are analyzed together with the same method and personnel, using the same lots of reagents, not to exceed the analysis of 20 environmental samples.

Composition: The LCS is a controlled matrix, known to be free of analytes of interest, spiked with known and verified concentrations of analytes. **NOTE:** The matrix spike may be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. Alternatively, the LCS may consist of a medium containing known and verified concentrations of analytes or as Certified Reference Material (CRM). All analyte concentrations shall be within the calibration range of the methods. The following shall be used in choosing components for the spike mixtures:

The components to be spiked shall be as specified by the mandated test method or other regulatory requirement or as requested by the client. In the absence of specified spiking components the laboratory shall spike per the following:

For those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene, and PCBs, the spike should be chosen that represents the chemistries and elution patterns of the components to be reported.

For those test methods that have extremely long lists of analytes, a representative number may be chosen. The analytes selected should be representative of all analytes reported. The following criteria shall be used for determining the minimum number of analytes to be spiked.

- a) For methods that include 1-10 targets, spike all components;
- b) For methods that include 11-20 targets, spike at least 10 or 80%, whichever is greater;
- c) For methods with more than 20 targets, spike at least 16 components.

NOTE: Unless otherwise noted in project quality assurance plans or if components interfere with an accurate assessment, all Department of Defense projects will have LCS, MS, and MSD that contain all target analytes.

Evaluation Criteria and Corrective Action: The results of the individual batch LCS are calculated in percent recovery. The laboratory shall document the calculation for percent recovery. The individual LCS is compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory determines internal criteria or utilizes client specified assessment criteria.

An LCS that is determined to be within the criteria effectively establishes that the analytical system is in control and validates system performance for the samples in the associated batch. Samples analyzed along with an LCS determined to be "out of control" should be considered suspect and the samples reprocessed and re-analyzed or the data reported with appropriate data qualifying codes as necessary.

E1.2.2 Sample Specific Controls

The laboratory must document procedures for determining the effect of the sample matrix on method performance. These procedures relate to the analyses of matrix specific Quality Control (QC) samples and are designed as data quality indicators for a specific sample using the designated test method. These controls alone are not used to judge

laboratory performance. Examples of matrix specific QC include: Matrix Spike (MS); Matrix Spike Duplicate (MSD); Post Spike (PS) and Post Spike Duplicate (PSD) sample duplicates; and surrogate spikes.

E1.2.3 Matrix Spike ; Matrix Spike Duplicates, Post Spike ; Post Spike Duplicates :

Purpose:	Matrix specific QC samples indicate the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. The information from these controls is sample/matrix specific and would not normally be used to determine the validity of the entire batch.
Frequency:	The frequency of the analysis of matrix specific samples shall be determined as part of a systematic planning process (e. g. Data Quality Objectives) or as specified by the required mandated test method.
Composition:	The components to be spiked shall be as specified by the mandated test method. Any permit specified analytes, as specified by regulation or client requested analytes shall also be included. If there are no specified components, the laboratory shall spike per the following: For those components that interfere with an accurate assessment such as spiking simultaneously with technical chlordane, toxaphene and PCBs, the spike should be chosen that represents the chemistries and elution patterns of the components to be reported. For those test methods that have extremely long lists of analytes, a representative number may be chosen using the following criteria for choosing the number of analytes to be spiked. However, the laboratory shall insure that all targeted components are included in the spike mixture over a 2-year period. a) For methods that include 1-10 targets, spike all components; b) For methods that include 11-20 targets, spike at least 10 or 80%, whichever is greater; c) For methods with more than 20 targets, spike at least 16 components.
Evaluation Criteria and Corrective Action:	The results from matrix spike/matrix spike duplicate and post spike/post spike duplicate are primarily designed to assess the precision and accuracy of analytical results in a given matrix and are expressed as percent recovery (%R) and relative percent difference (RPD). Results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory should determine internal criteria and document the method used to establish the limits. For matrix spike or post spike results outside established criteria, corrective action shall be documented or the data reported with appropriate data qualifying codes.

E1.2.4 Matrix Duplicates:

Purpose:	Matrix duplicates are defined as replicate aliquots of the same sample taken through the entire analytical procedure. The results from this analysis indicate the precision of the results for the specific sample using the selected method. The matrix duplicate provides a usable measure of precision only when target analytes are found in the sample chosen for duplication.
Frequency:	The frequency of the analysis of matrix duplicates may be determined as part of a systematic planning process (e. g. Data Quality Objectives) or as specified by the mandated test method.
Composition:	Matrix duplicates are performed on replicate aliquots of actual samples. The composition is usually not known.
Evaluation Criteria and	The results from matrix duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD) or another

Corrective Action statistical treatment (e. g., absolute differences). The laboratory shall document the calculation for relative percent difference or other statistical treatments.

Results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory shall determine internal criteria and document the method used to establish the limits. For matrix duplicates results outside established criteria corrective action shall be documented or the data reported with appropriate data qualifying codes.

E1.2.5 Surrogate Spikes:

Purpose Surrogates are used most often in organic chromatography test methods and are chosen to reflect the chemistries of the targeted components of the method. Added prior to sample preparation/extraction, they provide a measure of recovery for every sample matrix.

Frequency Except where the matrix precludes its use or when not available, or is not a method requirement, surrogate compounds are added to all samples, standards, and blanks for all appropriate test methods.

Composition: Surrogate compounds are chosen to represent the various chemistries of the target analytes in the method. They are often specified by the mandated method and are deliberately chosen for their being unlikely to occur as an environmental contaminant. Often this is accomplished by using deuterated analogs of select compounds.

Evaluation Criteria and Corrective Action: The results are compared to the acceptance criteria as published in the mandated test method or determined using statistical process controls (SPC). Where there are no established criteria, the laboratory determines internal criteria and documents the method used to establish the limits.

Surrogates outside the acceptance criteria must be evaluated for the effect indicated for the individual sample results. The appropriate corrective action may be guided by the data quality objectives or other site specific requirements. Results reported from analyses with surrogate recoveries outside the acceptance criteria include appropriate data qualifiers.

E1.3 Method Evaluation

The following procedures, as described in the other sections of the QAP, are in place in order to ensure the accuracy of the reported result:

- Procedure for initial demonstration of analytical capability performed initially (prior to the analysis of any samples) and if there is a significant change in instrument type, personnel, matrix or test method. Refer to Section 8.
- Procedures for initial and continuing calibration protocols as specified in Section 7.
- Procedures for utilizing proficiency test samples to evaluate the ability of a procedure and/or analyst laboratory to produce accurate data as specified in Section 3.

E1.4 Method Detection Limits

Method detection limits (MDLs) are determined as described in GL-LB-E-001 for The Determination of Method Detection Limits. This procedure is based on that established in 40 CFR Part 136, Appendix B Rev 2.

Where possible, MDL studies are conducted for both aqueous and solid matrices using a clean matrix appropriate to the test method (such as laboratory pure reagent water or Ottawa sand). MDL studies for the majority of routine parameters are conducted by ongoing data collection:

- analyzing a minimum of two MDL spiked samples (MDLs) each quarter in which samples are analyzed
- Annual recalculating of MDLs and MDLV as verification of current MDL as per GL-LB-E-001 for the Determination of Method Detection Limits and 40 CFR Part 136, Appendix B, Rev 2.

If the MDL study is being conducted for a new method or target analyte, the following steps are taken:

- the MDL is estimated based on information provided in the method or analytical experience.
- a standard with a concentration three to five times the estimated MDL is prepared and analyzed a minimum of seven times
- the MDL is calculated based on the standard deviation and degrees of freedom.
- the MDL is evaluated for reasonableness by verification through analysis of a prepared standard solution two to three times the calculated MDL.

MDL studies are not performed for any target analyte for which spiking solutions are not available such as total volatile solids, pH, color, temperature, dissolved oxygen, or turbidity.

Practical quantitation limits (PQLs) are determined by either multiplying the MDL by approximately 2 to 10 or are equal to that of the lowest calibration standard. Concentrations of a target analyte determined to be greater than its PQL are defined as quantitative results. All quantitative reported results are bracketed by calibration or calibration verification standards.

Upon acceptance of the MDL values, the MDLs reported to clients via our computer system are updated unless otherwise specified by contract. PQLs are also updated as directed by the new MDLs or changes to procedures.

All data pertaining to the study and the calculation of MDLs is stored on the LIMS system for data packages and then archived to DVD.

GEL uses an industry standard approach to establishing radiochemistry and radiobioassay MDA (minimum detectable activity). This approach is based on MARLAP guidance for posteriori determination of MDA. The approach incorporates real time events that affect the observed sensitivity for every measurement performed in the laboratory. GEL recognizes for EPA radiological drinking water samples, that an MDL study is required similar to chemical constituents tested for drinking water.

GEL will follow the source document EPA 815-B-17-003 EPA Procedure for Safe Drinking Water Act Program Detection Limits for Radionuclides.

The analyst should prepare and measure a sample set of at least four reagent blanks and four laboratory fortified blanks that have the radioanalyte of interest added to quantitation levels appropriate for drinking water samples, the activity level added to the laboratory fortified blanks should be between the radioanalyte's MCL and its required detection limit. To be deemed an acceptable demonstration of proficiency, the mean recoveries and the standard deviation of the recoveries of the replicate measurements should be consistent with the requirements for accuracy and precision described in Section 7.7, and reagent blank measurements must have a mean result below the detection limit for each analyte measured with the method.

E1.5 Data Reduction

The procedures for data reduction, such as use of linear regression, are documented in the individual analytical standard operating procedures. GEL's policy governing the manual integration of chromatographic data is detailed in GL-LB-E-017, Procedure and Policy for Manual Integration. Manual integrations of chromatographic peaks can only be performed in accordance with GL-LB-E-017. This ensures that the integrations are done in a consistent and technically justifiable manner while meeting the requirements set forth under the Good Automated Laboratory Practices.

SOP GL-QS-E-014, Quality Assurance Measurement Calculations and Processes, discusses the use of laboratory data in statistical determinations and includes discussion of Estimation of Total Analytical Uncertainty, Statistical Process Control (SPC) Limits, and Calibration of Instrumentation. Understanding of the procedures used for data generation and reduction is an important part of an analyst demonstrating proficiency in an analytical procedure. All analysts and technicians responsible for generating curves and using curve-generated data are trained to this SOP per GEL annual and interim training requirements.

E1.6 Quality of Standards and Reagents

The quality of standards used in instrument calibration or quality control samples and reagents used in sample preparation and/or analysis must meet the criteria described in Section 7. In methods where the purity is not specified, analytical grade reagents are used. Reagents of less purity than those specified by the test method are never used. Upon receipt and prior to use, the labels on the container are checked to verify that the purity of the reagents meets the documented requirements of the particular test method. Some chemicals or reagents may be re-verified when known to be in pristine condition and within the manufacturer's expiration date. Reagents, particularly solid, neat, or concentrated (NaOH pellets, NaCl, or concentrated acid) may be reverified for acceptability of intended use. Reverification and the new expiration date is documented in the laboratory LIMS. In no case shall standards, reagents, solvents or other analytical materials be used past their manufacturer's expiration date. Only Radiochemistry re-verifies standards for use past the manufacturer's expiration date.

The quality of water sources is monitored and documented as described in Section 4. The quality of water used in sample preparation or analysis meets the method-specified requirements. The type of water available in the laboratory is described in Section 4.

E1.7 Selectivity

Absolute and relative retention times aid in the identification of components in chromatographic analyses and in evaluation of the effectiveness of a column in separating constituents. The procedures governing retention time windows are documented in the applicable analytical SOP and meet all regulatory and method requirements.

In addition to retention time windows, the acceptance criterion for mass spectral training is also documented in the appropriate analytical SOP. In all cases, the acceptance criteria meet or exceed those specified in the analytical methods.

Unless stipulated in writing by the client, confirmations are performed to verify the compound identification of positive results detected on a sample from a location that has not been previously tested by our laboratory. Such confirmations are performed on a second column for organic tests such as pesticides, herbicides, or acid extractable or when recommended by the analytical test method except when the analysis involves the use of a mass spectrometer. All confirmation is documented.

E1.8 Constant and Consistent Test Conditions

GEL's implementation of standard operating procedures that specify quality criteria including initial and continuing calibrations assures that our test instruments consistently operate within the specifications required of the application for which the equipment is used.

In addition to the specifications applied to instrumentation, glassware used for sample preparation or analysis is cleaned in a manner that reduces the potential for positive or negative interferences. Glassware is prepared in accordance with GL-LB-E-003 for Glassware Preparation.

This SOP details the procedures used to clean the following groups of glassware:

- It is used for the determination of metals.
- Reusable bottles and plasticware
- Bottles used for the determination of biochemical oxygen demand (BOD)
- Glassware used in the determination of organic compounds
- That used for the determination of methylene blue active substances (MBAS)
- Glassware used in the determination of total organic halides (TOX)
- Glassware used in the analysis of samples for total Kjeldahl nitrogen (TKN) and total phosphorous
- Generic glassware used in all other analyses

If the method specifies that the glassware is stored in a particular manner, this requirement is documented in the appropriate analytical SOP.

E2 Radiochemical Analysis

This section describes the general quality control applied to radiochemical analysis. The specific quality control criteria applied to each analysis are delineated in the corresponding SOP. Detector Capabilities, Relative Bias, Relative Precision, and methods of calculating results for periodic Quality Control Determinations are discussed in the appropriate SOPs.

Discussed in this section are:

- Negative controls
- Positive controls
- Test variability/reproducibility
- Tracers and carriers
- Method evaluation
- Radiation measurement system calibration
- Data reduction
- Quality of standards and reagents
- Test conditions

E2.1 Negative Controls

Method blanks serve as the primary negative controls providing a means of assessing the existence and magnitude of contamination introduced via the analytical scheme. A method blank is analyzed at a frequency of one per preparation or analytical batch and is one of the quality control measures used to assess batch acceptance.

The activity level determined for each target in the method blank is assessed against the specific acceptance criteria specified in the applicable SOP. These criteria are based on a designated sample aliquot size and include appropriate calculations to compare the blank to activity levels determined for different sizes of sample aliquots.

The activity level of any target analyte in the method blank should be less than or equal to the contract required detection limit. The method blank may exceed this limit if the activity is less than 5% that of the lowest sample activity in the batch.

If the method blank acceptance criteria are not met, the specified corrective action and contingencies delineated in the SOPs are followed. Any failures of method blanks to meet the acceptance criteria are documented in the laboratory report and through GEL's nonconformance reporting system specified in GL-QS-E-004 for the Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items.

The activity levels determined for method blanks are not subtracted from those obtained for the samples in the associated preparation or analytical batch. Correction factors such as instrument background and analyte presence in the tracer may, however, be applied to all analyzed samples including both client samples and internal quality control samples.

E2.2 Positive Controls

Positive controls routinely employed in radiochemical analyses include both laboratory control samples (LCS) and matrix spikes (MS).

The laboratory standards used to prepare LCS and MS are from a different source than those used in instrument calibration, except when the calibration has been verified with a different source. This requirement may be superseded by client specific contract requirements. The activity levels of target analytes in the LCS and MS exceed ten times the prior detection limit and are less than one hundred times this detection limit. If a radiochemical method, however, has more than one reportable analyte isotope, the LCS need to only include one of the analyte isotopes.

Gamma spectroscopy is the exception to this guideline requiring the LCS and MS to contain isotopes representing the low, medium, and high-energy range of the analyzed gamma spectra.

E2.2.1 Laboratory Control Sample (LCS)

Laboratory control samples are analyzed at a minimum of once per preparation or analytical batch containing twenty or less samples.

The recovery of target analytes in the LCS is compared to the acceptance criteria specified in the applicable analytical SOP. If the recovery of the LCS does not fall within the acceptance range, the corrective actions and contingency steps specified in the SOP are implemented. These steps include noting the failure on the laboratory report.

E2.2.2 Matrix Spike (MS)

Matrix spikes are analyzed at a minimum of once per preparation or analytical batch containing twenty samples or less under the following conditions:

- The analytical method does not utilize an internal standard or carrier
- There is a physical or chemical separation process
- There is sufficient sample volume provided for the analysis.

The target analyte recoveries are one of the quality control measures used to assess batch acceptance. The recovery of target analytes in the MS is compared to the acceptance criteria specified in the applicable analytical SOP. If the recovery of the MS does not fall within the acceptance range, the data associated with that matrix spike are qualified accordingly.

E2.3 Test Variability/Reproducibility

The reproducibility of measurements can be evaluated by the use of matrix duplicates. Matrix duplicates are analyzed once per preparation or analytical batch of twenty samples for applicable tests. The relative percent difference (RPD) obtained between the activity levels obtained for the sample and its duplicate is evaluated against the range in the SOP. Matrix duplicates, matrix spikes and matrix spike duplicates are not performed for every analytical batch or for every twenty samples. They are performed per client request and if there is enough material/matrix to perform the test.

E2.4 Tracers and Carriers

Two additional quality control measures specific to radiochemical analysis are tracers and carriers. If the analytical method requires a tracer or carrier, each sample result will be associated with a tracer recovery that is calculated and reported. For radiochemistry procedures requiring gravimetric or radiometric recovery (tracer yields), the acceptable limits are 15% - 125%. These limits may vary for specific clients and/or projects. If the applicable limits are not met, the corrective actions delineated in the SOP are implemented.

E2.5 Method Evaluation

GEL evaluates the radiochemical preparation and analytical methods to ensure the accuracy of the reported result. This evaluation includes initial demonstrations of capability as described in Section 8 and the analysis of proficiency test samples as described in Section 3. The suppliers of proficiency test samples conform to the requirements of ANSI N42.22 and ISO/IEC 17025-2017.

E2.6 Radiation Measurement System Calibration

It is not generally necessary or practical to calibrate radiochemical instrumentation each day of use due to its stability and the time-consuming nature of some of the measurements. There are, therefore, significant differences in the calibration requirements for radiochemical instrumentation from those used for chemical analyses.

Calibration differences include but are not limited to the following:

- The requirement in Section 7 for the determination of the appropriate number of standards for initial calibration is not applicable to radiochemical methods. If the radiochemical method requires multiple standards for initial calibration, the number of standards is included in the applicable SOP.

- If linear regression or non-linear regression is used to fit standard response or calibration standard results to a calibration curve, the correlation coefficient is determined. This differs from Section 7.
- The requirement identified in Section 7 for the bracketing of quantitative results by calibration or calibration verification standards is not applicable to radiochemical analyses due to the non-correlated event nature of decay counting instrumentation.
- As indicated in Section 7, the LCS may fill the requirements for the performance of an initial calibration and continuing calibration verification standard. The calibration verification acceptance criteria are the same as specified for the LCS (75 -125%).
- Background calibration measurements are made on a regular basis and monitored using control charts. These values are subtracted from the total measured activity in the determination of the sample activity. The frequency of these measurements is indicated in the SOP GL-RAD-I-010.
- Instrument calibration shall be performed with reference standards as defined in Section E3.8.
- The frequency of calibration shall be addressed in the governing SOPs.

E2.7 Data Reduction

All sources of method uncertainties and their propagation must be traceable to reported results. This is performed under the guidance of the ISO "Guide to the Expression of Uncertainty in Measurement" and the NIST Technical Note 1297 on "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." Details of calculations and equations used in reporting Radiochemistry analytical results may be found in GL-RAD-D-003 for Data Review, Validation and Data Package Assembly.

E2.8 Quality of Standards and Reagents

The reference standards we use are obtained from the National Institute of Standards and Technology (NIST), EPA, or suppliers providing NIST standards. Reference standards should be accompanied by a certificate of calibration whose content is described in ANSI N42.22 – 1995, Section 8, Certificates. All reagents used shall be analytical reagent grade or better.

E2.9 Test Conditions

GEL adheres to written procedures that minimize the possibility of cross contamination between samples. This prevents incorrect analysis results from cross contamination. Procedures are in place, for example, to separate known radioactive and nonradioactive samples from the time of sample receipt to analysis and sample disposal.

Instrument performance checks are performed on a regular basis and monitored with control charts. This ensures that the instrument is operating properly, and that the calibration has not changed. The same check source used in the preparation of the control chart at the time of calibration is used in the performance checks of the instrument. The sources must provide adequate counting statistics for a relatively short count time and should be sealed or encapsulated to provide loss of activity and contamination of the instrument and laboratory personnel.

Instrument performance checks include checks on the counting efficiency and the relationship between channel number and alpha or gamma ray energy.

APPENDIX F: ETHICS AND DATA INTEGRITY AGREEMENT



ETHICS and DATA INTEGRITY AGREEMENT

- I. I, (Name), state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at The GEL Group, Inc.
- II. I agree that in the performance of my duties at The GEL Group, Inc.:
- A. I shall not intentionally report data values that are not the actual values obtained,
 - B. I shall not intentionally report data that does not meet method or procedural specifications unless that data is properly qualified through comments or other notations in the analytical report.
 - C. I shall not intentionally report dates and times of data analyses that are not the actual dates and time of data analyses; and
 - D. I shall not intentionally represent another individual's work as my own.
- III. I agree to inform a Group Leader, Manager, Director, or member of the Executive Committee of The GEL Group, Inc. of any accidental or intentional reporting of non-authentic data by myself or other employees in a timely manner.
- IV. I will knowingly not participate in any questionable activities or violations of the Procurement Integrity Act during purchasing or sales activities. I will report any questionable activities to a Group Leader, Manager, Director, or member of the Executive Committee of The GEL Group, Inc. This includes discussions on analytical, consulting, and geophysical services pricing and contracts, vendor pricing, or other essential business information to anyone outside of The GEL Group, Inc. family.

This Ethics and Data Integrity Agreement has been explained to me by the Director of Quality Systems, my Group Leader, or at a training session, at which time I have been provided the opportunity to ask questions on any part of this agreement that I did not understand. It has also been explained to me that any violation of this agreement conducted during work performed under a subcontract or direct contract with a government agency could subject me to potential prosecution.

I understand that violation of this policy subjects me to disciplinary action, up to and including termination of my employment with The GEL Group Inc.

Employee Signature: _____ Date: _____

Trainer Signature: _____ Date: _____



APPENDIX G: EQUIPMENT LIST

GENERAL CHEMISTRY ANALYSIS				
#	Equipment	Model #	Purchase Date	ID/Serial#
2	OI Analytical, TOC 1030S	OI1030S	Oct-2015 Mar-2022	A536733677 22B106532
3	Analytical, TOC 1030W	OI1030W	Apr-2015 Jan-2016 Mar-2022 Aug-2024	P505730368 P550730559P 21K103863 2IJ10449
2	ATOC (Software)	NA	Apr-15	NA
2	Horizon Speed Vap II	9000 9000	Oct-2001 Apr-2002	01-337 01-340
1	Lachat QuikChem 8500	8500 Series	Jan-2006	60900000344
3	Omnion (software)	3.0.218 3.0.218 3.0.219	Jul-2001 Jul-2002 Jan-2006	NA
2	ThermoSpectronic	20D+	Nov-2003 Aug-2006	3DUD255001 3DUJ199004
2	Mitsubishi Total Organic Halogen Analyzer	AOX-200 AOX-400 AOX-400	Jul-2010 Apr-2024 Jun-2025	E7B00117 12440453 12BB0224
1	Dionex Ion Chromatograph	ICS-5000	Jul-2010	10060501
5	Dionex Ion Chromatograph	Aquion	Jul-2016 Aug-2019 Mar-2020 Aug-2023 Aug-2023	160540166 190640129 200240003 230540034 230540037
1	Dionex Ion Chromatograph	ICS-1600	Jul-2014	14060002
7	Chromeleon (software)	7.2.1	Jul-2014	NA
1	Turbidmeter	430T	Nov-2019	19430781
1	TitriNoline Karl Fisher Moisture Analyzer	870KF	Mar-2020	1870001031535
2	TKN Block Digestor	TKN100	Jul-2016 May-2017	2016TKNBC115 2017TKNBC133
2	Fried Electronics Stirring Hotplates	MH1-3x2	Jul-2017	0568 0569
1	YSI Dissolved Oxygen Meter	5000	Apr-2015	15D100827

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GENERAL CHEMISTRY ANALYSIS

#	Equipment	Model #	Purchase Date	ID/Serial#
1	IEC Clinical Centrifuge	Clinical	Prior to 2008	42817189
1	VWR Oven	1370FM	Prior to 2008	101399
2	Yamato	DX602C	Mar-2020 Prior to 2008	J1812255 A7700008
1	Vulcan Muffle Furnace	3-550PD	Apr-2015	DKZ1316115V
2	HACH COC Reactor	95600-00	Jan-1994	911005731C 9807000017919
1	Orion Conductivity Meter	A212	Dec-2017	X37231
1	Parr 6200 Calorimeter	Parr 6200	Aug-2014	M40303
2	Sartorius Balance	LC 4800P ED200S	Prior to 2008	410010032 25150025
4	OHAUS Balance	AX124 PX224	Apr-2017 Mar-2021 Nov-2021 Jan-2023 Nov-2025	B649420569 C044392518 C324311837 C122868535 C228452818 C535186979
3	Thermo Scientific Centrifuge	CL2 CL30 CL31	Prior to 2008 Prior to 2008 Oct-2020	42617219 307070484 307040238
2	VWR Centrifuge	Clinical 200	Nov-2011 Aug-2012	68105001 68175150
5	Simple CN Hotblocks	SC6002	Apr-2009 Apr-2009 Jan-2009 Jan-2009 Dec-2018	5388DIS1012 5388DIS1016 5873DIS1030 5873DIS1036 2018DISW1225



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GENERAL CHEMISTRY ANALYSIS

#	Equipment	Model #	Purchase Date	ID/Serial#
2	BOD Incubator	2020 818	Jan-1999 Jan-2010	10059509 26AW-9
1	Thermo Orion Star A111	A111	Sep-2015	J10067
1	Thermo Orion Star A111	A111	Feb-2014	J06078
1	Electronic Digital Caliper	62379-531	Dec-2018	191986678
1	Setaflash Series 8 Active Cool	82100-2 U	Aug-2019 Jul-2025	1059732 1098133
2	MicroBlock R Distillation	EMD 1920-107	Nov-2017 Dec-2018	2262 2386
3	VIS Spectrometer	Spectronic 200E	Feb-2023	9A1B040105 9A1B034121
4	SEAL Autoanalyzer 500	AA500	Jul-2022 Jul-203 Oct-2023 Mar-2025	8048625 8048629 8056009 8062745
1	Brookfield Viscometer	DVPL	May-2023	86058070
1	ThermoFisher Scientific VIC Spectrometer	GENESYS 30	May-2023	9A1B040105

ORGANIC EXTRACTIONS

#	Equipment	Model #	Purchase Date	ID/Serial#
4	Tekmar Sonic Vibra Cell	VCX750		34186F 34187F
3	N-Evaps Organomation	11106	Oct-2018	N24-31316 N34035377
11	Soxtherms	SOX416/SE416	Jan-05 Nov-05 Nove-22	4041427 4040014 4040019 4040018 SX2033 SX2050 1/846516004 1/8465160005 1/8465160006 1/8465160007 1/8465170006

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ORGANIC EXTRACTIONS				
#	Equipment	Model #	Purchase Date	ID/Serial#
8	Turbovap II Biotage	Turbovap II	Apr-2020	200401550 194601422 200201529 200401549 200401553 194601427 200201526 200201523
6	Turbovap Biotage	Turbovap II	Mar-2018	180600350 180600353 180600348 180200293 174600239 180300303
2	Turbovap Biotage Automated Evaporation System	Turbovap II	NA	TV1346N20168 TV1246N17453
6	Special Mid Range 3D Shakers	099A9937700001	Nov-2020	12006122 12007064 12007066 12007063 12007067 12007065
1	2-OHAUS Adventurer Toploading Balance	AX2202	Jul-2019	B843654719
1	Ohaus Adventurer Toploading Balance	AX2202/E	May-2022	C206500109
1	Sartorius Toploading Balance	QUINTIX2102-1SNIA	Aug-2025	0044303167
4	ETHOS X Microwave Extraction System	ETHOS	Sep-2024 Jun-2025	24027898 25038639 25048684 25048685
13	UCT Hydraflow 4 Channel Universal Cartridge SPE	Hydraflow	Feb-2023	2111EX1173 2111EX1174 2111EX1175 2111EX1176 2111EX1178 2111EX1179 2111EX1182 2111EX1180 2111EX1181 2111EX1182 2204EX1212 2204EX1216 2204EX1213

1	GPC (Gel Permeation Chromatography)	PI2-A57-01	Jan-2023	2GI.0-2064
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LIQUID CHROMATOGRAPHY/HPLC				
#	Equipment	Model #	Purchase Date	ID/Serial#
10	LC-MS/MS	ABSciex 5500	Dec -2014	L20435252316(LC) L20435252317(LC) AU212181403 (MS)
		ABSciex 5500	Nov-2016	L20435252316(LC) L20435252317(LC) AU212181403 (MS)
		ABSciex 5500	Apr-2017	L20435453807(LC) L20435453808(LC) BB215361701 (MS)
		ABSciex 5500	Nov-2017	L20435553978(LC) L20435553979(LC) BB231241708 (MS)
		ABSciex 5500	Apr-2019	L20435654577(LC) L20435654578(LC) BB230071702 (MS)
		ABSciex 5500+	Mar-2019	L20435754975(LC) L20435754976(LC) EX221871911 (MS)
		ABSciex 5500+	Jan-2021	L20435855085(LC) L20435855086(LC) EX224592008 (MS)
		ABSciex 5500+	Oct-2022	L22136050484(LC) L22136050485(LC) EX234522206 (MS)
		ABSciex 6500+	Apr-2023	L22136050946(LC) L22136050947(LC) DZ247532302 (MS)
		ABSciex 6500+	Apr-2023	L22136050946(LC) L22136050947(LC) DZ247532302 (MS)
1	Shimadzu Column Heater	CTO-20AC	Dec-14	L20215251917
1	Shimadzu Degasser	DGU-20A	Dec-14	L20705263668
1	ABSciex PAL Autosampler	MXV013-02A	Dec-14	326966
1	Shimadzu Communications Module	CBM-20A	Dec-23	L20235255304
1	Shimadzu Column Heater	CTO-20AC	Nov-2016	L20305456379
1	Shimadzu Degasser	DGU-20A	Nov-2016	L20705366534
1	CTC Analytics PAL Autosampler	MXV13-02A	Nov-2016	380940
1	Shimadzu Communications Module	CBM-20A	Nov-2016	L20235356449

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LIQUID CHROMATOGRAPHY/HPLC				
#	Equipment	Model #	Purchase Date	ID/Serial#
1	Shimadzu Column Heater	CTO-20AC	Apr-2017	L20215452846
1	Shimadzu Degasser	DGU-20A	Apr-2017	L20705467839
1	ABSciex PAL Autosampler	MXY04-01A	Apr-2017	141417
1	Shimadzu Communications Module	CBM-20A	Apr-2017	L20235456857
1	Shimadzu Column Heater	CTO-20AC	Nov-2017	L20215553065
1	Shimadzu Degasser	CTO-20A	Nov-2017	L20705567380
1	ABSciex PAL Autosampler	MXY013-02A	Nov-2017	410574
1	Shimadzu Communications Module	CBM-20A	Nov-2017	L20235557182
1	Shimadzu Column Heater	CTO-20AC	Apr-2019	L20215653401
1	Shimadzu Degasser	DGU-20A	Apr-2019	L20705670383
1	ABSciex PAL Autosampler	PAL RSI 534	Apr-2019	423934
1	Shimadzu Communications Module	CBM-20A	Apr-2019	L20235657801
1	Shimadzu Column Heater	CTO-20A	Mar-2019	L20215653514
1	Shimadzu Degasser	DGU-20A	Mar-2019	L20205771309
1	CTC Analytics PAL Autosampler	PAL RSI 534	Mar-2019	423061
1	Shimadzu Communications Module	CBM-20A	Mar-2019	L20235758170
1	Shimadzu Column Heater	CTO- 20A	Jan-2021	L20215853676
1	Shimadzu Degasser	DGU-20A	Jan-2021	L20705872306
1	ABSciex PAL Autosampler	MXY013-02A	Jan-2021	529316
1	Shimadzu Communications Module	CBM-20A	Jan-2021	L20235858291
1	Shimadzu Column Heater	CTO-40C	Oct-2022	L22246051212
1	Shimadzu Degasser	DGU-405	Oct-2022	L22175905941
1	ABSciex PAL Autosampler	APL RST 534	Oct-2022	596579
1	Shimadzu Communications Module	CBM-40	Oct-2022	L22116050744
1	Shimadzu Column Heater	CTO-40C	Apr-2023	L22246051791
1	Shimadzu Degasser	DGU-405	Apr-2023	L22176050132
1	ABSciex PAL Autosampler	PAL RSI 850	Apr-2023	643843
1	Shimadzu Column Heater	CBM-40	Apr-2023	L22246051830
1	Shimadzu Degasser	DGU-405	Apr-2023	L22176050136
1	ABSciex PAL Autosampler	PAL RSI 850	Apr-2023	643845
1	Shimadzu Communications Module	CBM-40	Apr-2023	L22116050998
2	Agilent HPLC with DAD and FLD	1260 Quat Pump G7111B	Oct-2021	DEAET03464 DEAET03714

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LIQUID CHROMATOGRAPHY/HPLC				
#	Equipment	Model #	Purchase Date	ID/Serial#
2	Agilent HPLC with DAD and FLD	260 Vialsampler G7129A	Oct-2021	DEAET03464 DEAET03714
2	Agilent HPLC with DAD and FLD	1260 DAD HS G7117C	Oct-2021	DEAEK09261 DEAEK10351
2	Agilent HPLC with DAD and FLD	1260 FLD Spectra G7121B	Oct-2021	DEAEJ02452 DEAEJ02725
2	Biotage Turbovap	415000	NA	213102474 250905151
2	Fisherbrand Orbital Shaker	88861043	NA	K3CF61043184 K3CF61043177
1	Thermo Scientific	Sorvall ST1 Plus- MD	Jan-2023	43095747
1	Thermo Scientific	MEGAFORCE 40	Nov-2022	42423728
1	OHAUS Balance	PX224	Apr-2023	2141750593
1	Sartorius Balance	Entris 2202-1S	Jan-2017	347009649
1	OHAUS Analytical Balance	PX224	Apr-2023	C042289259
1	Organomation N-EVAP112	8125 9125	Nov-2016 Apr-2025	61476 5083
2	Branson Sonicator	M8800	NA	BGQ071972430B BGQ121859320B
1	Thermo Scientific Immersion Cooler	EK45	NA	0141574801151023
1	Thermo Scientific Immersion Cooler	EK20	NA	0127048601130501
1	CEM EDGE PFAs Extractor	Cem EDGE 60	Jul-2024	FC003210
1	Masterflex Syringe Pump	KD Legato 210	Jul-2024	1125629
4	Thermo Fisher Vortexer	M16715	NA	C1858130523539 C1858160811954 C1858140204035 1329030616492
1	Burrell Wrist-Action Shaker	Model 95	NA	183073119
1	Beckman Coulter Centrifuge	Avanti J-15	Jun-2023	JBY22E007
1	Vevor Grinder	PS-10A	Mar-2024	230818644010254
1	Cuisinart Mixer	CHB-60TG	Jan-2018	0824A
1	FOUR E's Scientific Vortex Mixer	MI0101002D	Dec-2025	DMQ121006

SEMI-VOLATILE ANALYSIS				
#	Equipment	Model #	Purchase Date	ID/Serial#
1	Agilent 6890N Gas Chromatograph/5973 Mass Spectrometer w/7683 Autosampler	5973	Sep-2005	CN10521005/US52440275 MSD1
1	Agilent 7890A Gas Chromatograph/5975C Inert Mass Spectrometer w/7683 Autosampler	5973	Apr-2009	CN10848121/US8313100 MSD2
1	Agilent 7890A Gas Chromatograph/5975C Inert Mass Spectrometer w/7683 Autosampler	5973	Apr-2009	CN10821032/US83131355 MSD3
1	Agilent 7890A Gas Chromatograph/5975C Inert Mass Spectrometer w/7683 Autosampler	5975	Nov-2007	CN10727001/US90704000 MSD4
1	Hewlett Packard 6890 Gas Chromatograph/5973 Mass Spectrometer w/ 7683 Autosampler Tower	5973	May-1997	US00023050/US82311233 MSD5
1	Hewlett Packard 6890 Gas Chromatograph/5973 Mass Spectrometer w/ 7683 Autosampler Tower	5973	May-1997	US00025502/US82311417 MSD6
1	Agilent 7890 Gas Chromatograph with MMI/5977A Mass Spectrometer w/ 7693 Autoinjector	5977	Jun-2015	CN15233175/US1523M414 MSDA
1	Hewlett Packard 6890 Gas Chromatograph/5973 Mass Spectrometer w/ 7683 Autosampler Tower	5973	May-1997	US00028102/US82311610 MSD8
1	Agilent 8890 Gas Chromatograph with 5977C Mass Spectrometer w/ 7693A Autoinjector	5977C	Jun-2023	US2448A025/US2447MA12 MSDB
1	Agilent 8890 Gas Chromatograph with 5977C Mass Spectrometer w/ 7693A Autoinjector	5977C	Jul-2025	US2501A036/US2449MA44 MSDC
1	Agilent 8890 Gas Chromatograph with MMI 5977B Mass Spectrometer w/ 7693A Autoinjector	5977B	Mar-2019	US1909M008

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#	Equipment	Model #	Purchase Date	ID/Serial#
1	Agilent 6890N Gas Chromatograph-FID w/ CTCH5500 Headspace Autosampler	6890	Jul-2008	CN10805007 FID8
1	Agilent 6890N Gas Chromatograph-FID w/ 7683B Autosampler	6890	Mar-2008	CN10805005 FID6
1	Agilent 6890N Gas Chromatograph-FID w/ 7683B Autosampler	6890	Jun-2008	CN10811015 FID7
1	Agilent 6890N Gas Chromatograph-FID w/ 7683B Autosampler	6890	Jul-2007	US10604037 FID5
1	Hewlett Packard 6890 Gas Chromatograph-Dual ECD w 8683 Autosampler	6890	Mar-1998	US00023402 ECD1
1	Hewlett Packard 6890 Gas Chromatograph-Dual ECD w/ LEAP PAL RSI Autosampler	6890	Mar-1998	US00028911 ECD2
1	Agilent 7890 Gass Chromatograph-Dual Micro ECD w/ 7693 Autosampler	7890	Mar-2010 (Purchased from CFA Dec-11)	CN10842125 ECD3
1	Hewlett Packard 6890 Gas Chromatograph-Dual ECD with 7683 Autosampler	6890	Nov-1997	US00023343 ECD6
1	Agilent 6890 Gas Chromatograph-Dual ECD w/7683 Autosampler	6890	Jul-1998	US10133016 ECD8
1	Agilent 7890A Gas Chromatograph-Dual Micro ECD w/ 7693 Autosampler	7890A	Jul-2010	CN10261088 ECD9
1	Agilent 8890 Gas Chromatograph-Dual Micro ECD w/ 7693A Autosampler	8890	Jun-2020	US2003A023 ECDA
1	Agilent 8890 Gas Chromatograph-Dual Micro ECD w/ 7693A Autosampler	8890	J ul-2020	US2003A023 ECDB

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#	Equipment	Model #	Purchase Date	ID/Serial#
1	Agilent 8890 Gas Chromatograph-Dual Micro ECD w/ 7693A Autosampler	7890A	Jul-2010	CN1251045 ECDC
1	Agilent 1260 Infinity II HPLC w/DAD	1260	Mar-2019	DEAK04846, DEAEQ24263
1	Agilent 1100 HPLC w/DAD	1100	2000	US80603453, DE91609651
1	Agilent Chem Station, Agilent Enviro Quant, Agilent Open Lab	NA	Various	NA
1	OHAUS Balance	AX220N/E	Jul-2019	B912414748
1	Ohaus Moisture Balance	MB23	Sep-2020	C015278098

VOLATILE ANALYSIS

#	Equipment	Model #	Purchase Date	ID/Serial#
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI Eclipse/Autosampler	6890/5973 4760/4100	Oct-99	VOA1 GC US00030386 MSD US91911845 4760 A917447740 4100 E921410286
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	8890/5977C 4760/4100	Jan-2026	VOAG GC US2547A974 MSD US2552MA04 4760 A910447548 4100 B521410351
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	7890A/5975 4760/4100	Aug-2006	VOA5 GC CN10848050 MSD US61332879 4760 23K104263 4100 23L106351
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	8890/5973 4760/4100	Jan-2026	VOAF GC US2547A973 MSD US2551MA29 4760 22G103659 4100 22L102650
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	6890N/5975C 4760/4100	Apr-2009	VOA2 GC CN10606080 MSD US83131318 4760 A050447679 4100 E046410998

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#	Equipment	Model #	Purchase Date	ID/Serial#
1	Hewlett Packard Gas Chromatograph/Mass Spectrometer Chemstation with OI Eclipse/Autosampler	6890/5973 4760/4100	Jul-2004	VOA3 GC US000282888 MSD US71191113 4760 A050447678 4100 E047410675
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	7890B/5977A 4760/4100	Jul-2004	VOAC GC CN15173066 MSD US51523M408 4760 PT21F103327 4100 21F103325
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	6890N/5975 4760/4100	Sep-2005	VOA6 GC CN10525054 MSD US52430466 4760 A920447563 4100 E919410645
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	7890A/5975C 4760/4100	Apr-2009	VOAA GC CN10848117 MSD US83131219 4760 22M101564 4100 22M102187
1	Agilent Flame Ionization Detector/ Chemstation with OI Eclipse/Autosampler	6890N 4760/4100	Aug-2008	VOC4A GC CN10813002 4760 24L120287 4100 24G100144
1	OHAUS Toploading Balance	AV812N	N/A	B323410747
1	Sartorius Toploading Balance	CP622	N/A	19452583
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	8890/5977C 4760/4100	Jan-2025	VOAD GC US2447A052 MSD US2418RA14 4760 A920447564 4100 E919410643

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#	Equipment	Model #	Purchase Date	ID/Serial#
1	Agilent Gas Chromatograph/Mass Specrometer Chemstation with OI Eclipse/Autosampler	8890/5977C 4760/4100	Jan-2025	VOAE GC US2447A047 MSD US2430RA18 4760 24L002311 4100 25A100100

METALS ANALYSIS/ TCLP INSTRUMENTATION

#	Equipment	Model #	Purchase Date	ID/Serial#
3	Perkin Elmer Mercury Analyzer	FIMS 100 FIMS 100 FIMS 100	Feb-2014 Nov-2019 Nov-2022	101S14020102 101S19081301 101S22100901
1	AA WINLAB (Software)	6.5.0.0266	Feb-2014	NA
2	Syngistix for AA (Software)	Ver 3.1	Oct-2018 Nov-2019	NA
2	PS Analytical Atomic Fluorescence Mercury Analyzer	10.035 20.410	Jul-2020 Apr-2025	631 6249A70849
2	Millennium (Software)	NA	Aug-2017 Jul-2020	NA
6	Perkin Elmer Inductively Coupled Plasma Mass Spectrometer	NexION 350X NexION 350X NexION 1000 NexION 350X NexION 1000 NexION 1000	Mar-2018 Mar-2022 Jul-2020 Jan-2023 Aug-2024 Jul-2025	85XN7111002 85XN7031001 815N0050901X 815N2082904X 815N3083002X 815N3111002X
4	Perkin Elmer ICPMS (Software)	2.4 SP3	May-2014 Aug-2014 Mar-2018 Jul-2020	NA
4	Perkin Inductively Coupled Plasma Spectrometer	AVIO500 AVIO500 AVIO500 AVIO550	Feb-2018 Jan-2020 Jun-2020 Feb-2026	081S1711281 081S1911213 081S2004051 M81S2509053
1	WINLAB 32 (Software)	Ver 3.1.0	Apr-19	NA
3	Syngistix (Software)	Ver. 3.0	Mar-2018 Jan-2020 Jun-2020	NA
1	Thermo Orion 3Star pH Meter	3Star	Dec-2017	9731
1	Thermo Orion pH meter	420	Prior to 2008	065576
1	OHAUS Balance	AV313	Jan-2014	B351136893



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METALS ANALYSIS/ TCLP INSTRUMENTATION				
#	Equipment	Model #	Purchase Date	ID/Serial#
1	Sartorius Balance	CP22025	Prior to 2008	14509268
8	OHAUS Adventurer Balance	AX423/E AX423/E AX2202 AX423/E AX2202/E AX2202/E AX423E AX423E	Jan-2019 Jan-2019 Oct-2019 Apr-2025 Jul-2024 Oct-2019 Jul-2025 Sep-2017	B848841591 B843640835 B925840821 C502392001 C410746413 B925840821 C514797897 B733534937
1	OHAUS Defender Balance	3000 Series		B136220863
4	TCLP Tumblers	NA	Prior to 2008	T 101 T 104 T 105 T 106
15	Environmental Express Hotblock	SC100	Prior to 2008	Various units
2	Torrey Pines Scientific Hotplate	HP51	Prior to 2008	08301024 08301025
1	U.S. Filter Modulab Water System	M00100	Prior to 2008	LW2264
1	Barnstead NANOPure Diamond	D11901	Aug-2002	1190030186870
1	Thermo Centrifuge	CL30	Apr-2008	307070484
3	HACH Turbidity Meter	HACH 2100 Q	Dec-2024	24070D000487 24100D000210 24070D000493

RADIOCHEMISTRY INSTRUMENTATION				
#	Equipment	Model #	Purchase Date	ID/Serial#
96	Canberra Alpha Spectrometers for Alpha Spectroscopy System (environmental)	7401	1992 to 1995	Various
156	Canberra Alpha Analyst Spectrometers with PIPS Detectors (environmental)	7200	1988 to 2009	Various
144	Canberra Alpha Analyst Spectrometer with PIPS Detectors (Radiobioassay)	7200	1988-2025	Various



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RADIOCHEMISTRY INSTRUMENTATION				
#	Equipment	Model #	Purchase Date	ID/Serial#
2	HIDEX AMG Automatic Gamma Counter	AMG	Mar-2025	2250382 2250383
1	Gamma Products G5400W Low background Alpha/Beta Counting Systems with 4 detectors	G54020-400T	Jan-2017	121603
5	Compaq/DEC Alpha Workstations for Alpha/Gamma Data Management System	500AU 500AU 500AU DS-10 AS-15	Nov-1998 Nov-1998 Jan-2004 Mar-2009 Dec-2019	N188806229 4006DP9Z1060 AY93206555 AY13206280 (spare) AY41803292 (spare)
2	Protean Automatic Proportional Counter (Radiobioassay)	WPC 9550	Jun-2023 Jul-2004	0329438 924233
11	Protean Multi-Detector (40) Proportional Counter	MDS-16	Apr-2002 Jul-2005 Oct-2005 Mar-2002	10751, 10752, 107754 0525767, 0525768 0531474, 0531474 311437, 311438, 0021910
4	Protean Multi-Detector (16) Proportional Counter	MDS-16	Feb-2009	9115168, 169, 170, 171
4	Beckman Liquid Scintillation Counters	LS6000 LS6500 LS6000 LS6500	Jun-2024 Jun-2024 Jan-2014 Jun-2024	7069634 7069633 7069693 7070265 (Radiobioassay)
5	Quantalus GCT	6220	Jan-2023 Jul-2024 Sep-2023 Aug-2022 Jul-2024	SGLO49170673 SGLO22242396 SGLO27232172 SGLO23221882 SGLO2124239
1	Revvity Tricarb TR	5110	Dec-2020	SGLO46201434
1	Perkin Elmer Inductively Coupled Plasma Mass Spectrometer	ELAN9000	Jun-2010	AJ13351006
2	Protean Automatic Proportional Counter	WPC 9550		2910 1111

RADIOCHEMISTRY INSTRUMENTATION				
#	Equipment	Model #	Purchase Date	ID/Serial#
2	Ortec- Alpha Spectrometers	Alpa ensemble-8	2010	10235232 10230971
8	Ortec- Alpha Spectrometers	Alpa ensemble-8	2020	10309516,11208349,111472200, 11159616,15260422,15260421, 15260419,15260420
1	Perkin Elmer ICPMS (Radiobioassay)	NexION 1000	Jan-2024	815N3101903X
1	Broad-Energy Germanium Detector (Carbon Comp. Window)	BE3825	2006	306173
1	High Purity Germanium Coaxial Detector	GEM90210-P	1990	30-TP30546-A
1	High Purity Germanium Coaxial Detector	GEM-35190	2004	CV-P122204CA
1	High Purity Germanium Coaxial Detector	GEM35	2007	CV-P042407CA
1	High Purity Germanium Well Detector	GCW3523	1994	3941466
1	High Purity Germanium Coaxial Detector	GEM-25185-P	1992	32-TP20757A
1	High Purity Germanium Coaxial Detector	GEM40P4-83	2011	51-TP12858A
1	High Purity Germanium Coaxial Detector	GEM40P4-83	2020	60-TUMC7443
1	High Purity Germanium Coaxial Detector	GEM-25185	1986	26-PJ96A
1	High Purity Germanium Coaxial Detector	GEM-100P4-95	2022	62-TP52125A
1	High Purity Germanium Coaxial Detector	GEM-25185-P	1992	32-TP20752B
1	High Purity Germanium Coaxial Detector	GEM-35190-P	1994	34-TP40551A
1	High Purity Germanium Coaxial Detector	GEM-100220-P	1992	32-TP40384A
1	High Purity Germanium Coaxial Detector	GEM-40P4-76	2011	51-TP32763A
1	High Purity Germanium Coaxial Detector	GEM-40190-P	1994	34-TP20875A
1	Low Energy Germanium Detector (Beryllium Window)	GL1010S	1990	10902649

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#	Equipment	Model #	Purchase Date	ID/Serial#
1	Low Energy Germanium Detector (Beryllium Window)	GL2820R	1995	1954119
1	Low Energy Germanium Detector (Beryllium Window)	GL2820R	1998	3984452
1	Low Energy Germanium Detector (Beryllium Window)	GL2020	2020	13425
1	Low Energy Detector (Carbon Comp. Window)	GL2020-S	1992	12922782
1	N-Type High Purity Germanium Coaxial Detector	GMX 45225-P-S	1990	37-TN11260A
1	N-Type High Purity Germanium Coaxial Detector	GMX30200-P	1990	30-TN10348
1	P-Type High Purity Germanium Coaxial Detector (Radiobioassay)	IGC3919	1993	2605
1	High Purity Germanium Coaxial Detector (Extended Range)	GMX-25P4-70	2022	62-TN24567A (Be)
1	High Purity Germanium Coaxial Detector (Extended Range)	GMX50-P4-83	2022	62-TN43647A (Be)
2	High Purity Germanium Coaxial Detector (Extended Range)	GMX-25190-P GMX-25190-P	1992 1992	32-TN10858B (Be) 32-TN10861B (Be)
1	Reverse-Electrode Coaxial Germanium Detector (Beryllium Window)	GR3019	1986	9861606
1	Reverse-Electrode Coaxial Germanium Detector (Carbon Comp. Window)	GR3520	1993	8932581
1	Reverse-Electrode Coaxial Germanium Detector	GR2020	1991	1912509
1	Reverse-Electrode Coaxial Germanium Detector (Beryllium Window)	GR3021	1992	3922553
1	Reverse Electrode Coaxial Germanium Detector (Beryllium Window)	GR4019	1996	1966073
2	Standard Electrode Coaxial Germanium Detector	GC3519	1991	9912854, 11912876
1	Standard Electrode Coaxial Germanium Detector	GC3520	2000	2007152

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#	Equipment	Model #	Purchase Date	ID/Serial#
4	Standard Electrode Coaxial Germanium Detector	GC2018	1992	9923035 9923043 10923049 10923050
1	Standard Electrode Coaxial Germanium Detector	GC3018	1993	5933088
2	Standard Electrode Coaxial Germanium Detector	GC3519	1992 2005	3922907 7059000
8	Standard Electrode Coaxial Germanium Detector	GC4019	1995 2001 2006 2007	6953489 6953483 6953542 10017452 10017444 9069163 9069175 10079344
3	Standard Electrode Coaxial Germanium Detector	GC4020	2005 2006	10059017 10059015 4069118
4	Standard Electrode Coaxial Germanium Detector	GC4520	2009	4099544 4099570 10099624 11099639
1	N-Type High Purity Germanium Coaxial Detector	GMX35195-P-S	1991	34-TN-20891A
3	Extended Range Germanium Detector (Carbon Comp. Window) Manufactured by Canberra - 2020	GX4018	2020	5538 5540 5543
8	Ludlum Alpha Scintillation Detector	Ludlum 2200		328187 328191 328180 339912 338979 339888 267904 267631
1	Open VMS Alpha VMS (Alpha Spec) Software	Version 7.1.1H2	1999	NA
2	Alpha AMS	Canberra	1999 2001	NA
1	Open VMS Alpha VMS (Radiobioassay)	Version 7.3-2	1999	NA

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RADIOCHEMISTRY INSTRUMENTATION				
#	Equipment	Model #	Purchase Date	ID/Serial#
1	Open VMS (Gamma)	Version 7.3-2	1999	NA
1	Procount- ESP	Version 3.5 Canberra Consolidated Distribution Version 5.4	2002	NA
1	Apex-Gamma	Version 1.5.1	2024	NA
1	Genie 200 Software Suite	Version 4.0.0	2024	NA
1	Sartorius Balance	CP 2202S	May-2007	17955156
1	Sartorius Balance Toploader	I 2000D	Jun-1999	39039003
1	Sartorius Balance	ENTRIS 5201	Jul-2016	34104035
1	Sartorius Entris Balance	ENTRIS5201-1s	Feb-2023	33005595
6	Yamato Drying Oven	DX402/DX600/DX602	Various years	Various SN
1	OHAUS Analytical Balance	AX2202	Jul-2020	B949708441
1	OHAUS Analytical Balance	AX423/E	Feb-2025	C442912708
1	OHAUS Analytical Balance	EX12001	Aug-2020	C018367602
1	OHAUS Analytical Balance	AX244	Feb-2018	B733529066
1	OHAUS Analytical Balance	PR2202N/E	Jul-2022	C142774667
2	OHAUS Analytical Balance	AX2202/E	Jul-2022 Nov 2022	C133357449 C234673837 C238839655
1	OHAUS Analytical Balance	2200	Nov-2022	C236761727
1	OHAUS Analytical Balance	AX5202	Dec-2024	C421142292
1	OHAUS Analytical Toploader	EX 12001	Apr-2022	C207548631
2	OHAUS Analytical Balance	OHAUS	May-2021 Nov-2023	C046519545 C327443638 C202389980
1	Sartorius CP 2202S Toploader	CP 323S	Dec-2012	15750050
1	Sartorius CP 2202S Toploader	CP 2202S	May-2007	17955156
1	Sartorius Toploader	BCE52011-1S	May-2021	39003021

SAFETY ALIQUOT LAB				
#	Equipment	Model #	Purchase Date	ID/Serial#
2	OHAUS Adventurer	AX2202/E	Mar-2025	C436716039 C436716041
1	OHAUS CD-11 Indicator	CD-11		0011926-6EK
1	OHAUS Champ Sq.	CQ10R		0630957-6EK
1	OHAUS Adventurer Pro	AV2102	Oct-2014	B440101411

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LABORATORY INFORMATION MANAGEMENT SYSTEMS

#	Equipment	Model #	Purchase Date	ID/Serial#
1	HPE Nimble Storage Expansion Shelf	ES3-H42T	2022	AF-215614
1	HPE StoreOnce	3660	2022	2M224504X5
1	HP-Proliant DL380 Gen9 (GELESX01) 2-10QuadCoreX2.40Ghz 352GB	DL380	2019	MXQ6290GNC
1	HP-Proliant DL380 Gen9 (GELESX02) 2-10QuadCoreX2.40Ghz 352GB	DL380	2019	MXQ6290GNH
1	HP-Proliant DL380 Gen9 (GELESX03) 2-QuadCoreX2.40Ghz 352GB	DL380	2019	MXQ6290GP5
1	HP-Proliant DL380 Gen9 (GELESX04) 2-QuadCoreX2.40Ghz 352GB	DL380	2019	MXQ6290GNQ
1	HPE Nimble Hybrid Storage Array	HF40	2019	AF-213390
1	50kW Caterpillar Backup Generator	DG50	2020	LSB03776
1	Liebert Vertiv (UPS)	47SA040EAC	2020	M20CZB0016

UNIVERSAL POWER SUPPLY/BACK UP GENERATOR

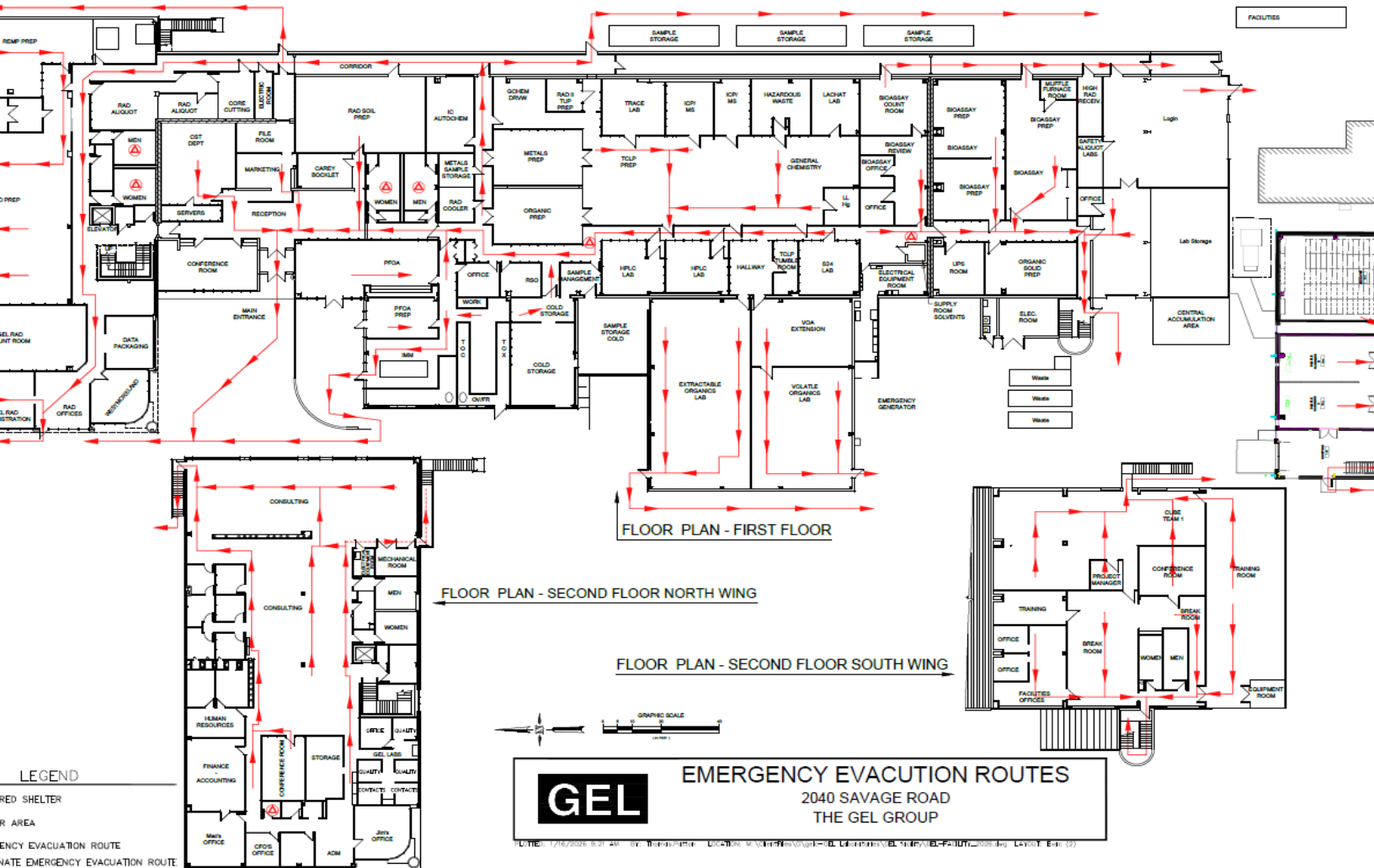
#	Equipment	Model #	Purchase Date	ID/Serial#
1	Kohler Generator (Walk in coolers)	60 RCLB	Sep-2022	34DDGMKK0132
1	Mitsubishi (Instrumentation lab computers)	9933B	Oct-2017	19-7M85443-01

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APPENDIX H: FACILITIES WITH EVACUATION ROUTES



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APPENDIX I: STANDARD OPERATING PROCEDURES AND ANALYTICAL METHODS

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-ADM-E-001	Preparation, Authorization, Advance Change, Revision, Release, and Retirement of Standard Operating Procedures	N/A
GL-AP-E-001	Invoicing Analytical Lab Numbers	N/A
GL-CO-E-001	Revising GEL Laboratories Catalog of Analytical Services	N/A
GL-CO-E-002	Delegated Authority to Commit the Company	N/A
GL-CO-E-003	Request for Proposal (RFP) and Contract Review	N/A
GL-CS-E-002	Internal Review of Contractually Required Quality Criteria for Client Package Delivery	N/A
GL-CS-E-005	Electronic Data Deliverables	N/A
GL-CS-E-006	Subcontracting Analytical Services	N/A
GL-CS-E-008	Prelogin, Login, and Login Review	N/A
GL-CS-E-009	State Specific Drinking Water Reporting Criteria	N/A
GL-CS-M-001	Project Management LIMS Manual	N/A
GL-DC-E-001	Document Control	N/A
GL-FC-E-001	Facility Security	N/A
GL-FC-E-002	Testing Emergency Eyewash and Shower Equipment	N/A
GL-FC-E-003	Local Exhaust Ventilation Systems	N/A
GL-FC-E-004	Inspection of Fire Extinguishers	N/A
GL-GC-E-001	Total Dissolved Solids	EPA 160.1 SM 2540C
GL-GC-E-004	General Chemistry Standards, Definitions, and Preparation	N/A
GL-GC-E-007	Total Organic Halogen (TOX) and Adsorbable Organic Halides on Liquid Samples Using the Mitsubishi AOX-200 Analyzer	EPA 1650C SW-846 9020B
GL-GC-E-008	pH	EPA 150.1 SW-846 9040B SW-846 9040C SW-846 9041A SW-846 9045C SW-846 9045D SM 4500-H ⁺
GL-GC-E-009	Conductivity and Salinity	EPA 120.1 SW-846 9050A SM 2510B SM 2520B
GL-GC-E-010	Paint Filter Test	SW-846 9095A SW-846 9095B
GL-GC-E-011	Total Solids	SM 2540B

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
		SM 2540G
GL-GC-E-012	Total Suspended Solids	SM 2540D
GL-GC-E-028	Carbonaceous Biochemical Oxygen Demand (CBOD)	EPA 405.1 SM 5210B
GL-GC-E-029	Corrosivity Toward Steel	SW-846 1110(M) SW-846 1110A(M)
GL-GC-E-032	Carbon Dioxide (Total and Free) by Calculation	SM 4500-CO ₂ D
GL-GC-E-033	Alkalinity: Total, Bicarbonate, Carbonate, Hydroxide, and Phenolphthalein	EPA 310.1(M) SM 2320B
GL-GC-E-035	Volatile Suspended Solids	EPA 160.4 SM 2540E
GL-GC-E-036	Color by Visual Comparison	SM 2120B
GL-GC-E-037	Turbidity	EPA 180.1 SM 2130B
GL-GC-E-040	Pretreatment of Cyanide Amenable to Chlorination	EPA 335.1 SW-846 9010B SW-846 9010C SW-846 9012A SW-846 9012B SM 4500-CN- G
GL-GC-E-044	Colorimetric Determination of Hexavalent Chromium	SW-846 3060A SW-846 7196A SM 3500-Cr B
GL-GC-E-045	Biochemical Oxygen Demand (BOD)	EPA 405.1 SM 5210B
GL-GC-E-047	Methylene Blue Active Substance	EPA 425.1 SM 5540C
GL-GC-E-048	Heating Value Determination by Bomb Calorimeter	ASTM D 240-14 ASTM 4809-13 ASTM E711-87(M)
GL-GC-E-052	Sulfide (Methylene Blue Method)	EPA 376.2(M) HACH 8131 SM 4500 S ²⁻ D
GL-GC-E-056	Sulfite	EPA 377.1 SM 4500-SO ₃ ²⁻ B
GL-GC-E-057	Volatile Solids and % Ash Procedure for Water Samples	EPA 160.4 SM 2540E
GL-GC-E-058	Volatile Solids and % Ash Procedure for Solid and Semisolid Samples	SM 2540G
GL-GC-E-059	Dissolved Oxygen Analysis by Membrane Electrode Method	EPA 360.1 SM 4500-O- G

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-GC-E-061	Chemical Oxygen Demand (COD) Digestion Reactor Method	EPA 410.4 HACH 8000
GL-GC-E-062	Total Carbon and Total Organic Carbon Analysis Using the OI Analytical 1030S TOC Solids Module	SM 5310B SW-846 9060 (M) SW-846 9060A (M)
GL-GC-E-062A	Total Carbon and Total Organic Carbon Analysis Using the OI Analytical 1030S TOC Solids Module	SM 5310C
GL-GC-E-064	Density	ASTM D5057
GL-GC-E-065	Specific Gravity	ASTM D5057
GL-GC-E-066	Flashpoint by Setaflash	ASTM D3278-78 ASTM D3278-96 SW-846 1020A SW-846 1020B SW-846 1020C
GL-GC-E-067	Cyanide Sample Distillation	ASTM 4500-CN- C EPA 335.4 SW-846 9010B SW-846 9010C SW-846 9012A SW-846 9012B
GL-GC-E-068	Viscosity	ASTM D2161 (Mod) ASTM D2983 (Mod) Brookfield Viscometer
GL-GC-E-069	Reactive Cyanide and Sulfide	SW-846 Chap 7.3.3 SW-846 Chap 7.3.4
GL-GC-E-071	Total Phosphorous and Total Kjeldahl Nitrogen Sample Preparation	EPA 365.4 EPA 351.2 SM 4500N _{org} -D
GL-GC-E-072	Ammonia-Nitrogen Sample Preparation	EPA 350.1 SM 4500-NH ₃ - B
GL-GC-E-073	Free Cyanide Analysis by Microdiffusion	ASTM D4282
GL-GC-E-074	Extractable Organic Halides (EOX)	SW-846 9023
GL-GC-E-076	Total Residue Chlorine	SM 4500-Cl G
GL-GC-E-077	Cyanide Weak Acid Dissociable Sample Preparation and Analysis	EPA 335.4 SM 4500-CN-I
GL-GC-E-079	Bomb Preparation Method for Solid Waste	SW-846 5050
GL-GC-E-082	Acid-Soluble Sulfides	SW-846 9030B SW-846 9034
GL-GC-E-086	Ion Chromatography (IC)	EPA 300.0 SW-846 9056A
GL-GC-E-087	Percent Water by Karl Fischer Titration	ASTM E203-08

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-GC-E-090	Acidity	SM 2310B
GL-GC-E-091	Wavelength Calibration Verification of Thermospectronic Spectrophotometers	N/A
GL-GC-E-092	General Chemistry Data Review and Packaging	N/A
GL-GC-E-093	Total, Total Inorganic and Total Organic Carbon (TOC) using the OI Analytical Model 1010 TOC Analyzer	EPA 415.1 SW-846 9060 SW-846 9060A SM 5310B
GL-GC-E-093A	Total, Total Inorganic and Total Organic Carbon (TOC) using the OI Analytical Model 1010 TOC Analyzer	SM 5310C
GL-GC-E-094	N-Hexane Extractable Material (HEM; Oil and Grease) and Silica GEL Treated N-Hexane Extractable Material (SGT-HEM Non-Polar Material) in Aqueous Matrices	EPA 1664 EPA 1664B
GL-GC-E-100	Total Hardness by Titration	SM 2340C
GL-GC-E-107	Inorganic Calculations	N/A
GL-GC-E-109	Total Kjeldahl Nitrogen (TKN) Using the SEAL Autoanalyzer 500	SM 4500 N _{org} D EPA 351.2
GL-GC-E-110	Ammonia Determination by Using SEAL Auto Analyzer 500	4500 Norg D EPA 351.2
GL-GC-E-111	Total Recoverable Phenol	EPA 420.4 SW-846 9066
GL-GC-E-112	Cyanide Determination by SEAL Autoanalyzer 500 Instrument	EPA 335.4 SM 4500CN-C SM 4500CN-E SW-846 9010B SW-846 9010C SW-846 901012A SW-846 9012B
GL-GC-E-113	Total Phosphorus by SEAL Auto Analyzer 500 Instrument	EPA 365.4 SM 4500P-H
GL-GC-E-123	Column Settling	EM 1110-02-5027
GL-GC-E-127	Modified Elutriate Test	N/A
GL-GC-E-128	Nitrate/Nitrite (NO ₃ +NO ₂) Analysis Using the Lachat QuickChem FIA + 8000 Series Instrument	EPA 353.2 SM 4500-NO ₃ -F
GL-GC-E-130	Percent Ash Determined at 775 C Procedure for Solid and Semisolid Samples	ASTM D 482-03 (M)
GL-GC-E-132	Hexavalent Chromium Analysis Using the Lachat QuikChem FIA +8000 Series Instrument	SM 3500-Cr B SW-846 7196A
GL-HR-E-002	Employee Training	N/A
GL-IT-E-002	Computer Systems Team Roles and Responsibilities	N/A

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-IT-E-003	Requirements, Design, Operation, Validation and Removal of Hardware and Software Systems Used by the GEL Group, Inc.	N/A
GL-IT-E-004	Change Control Requirements for Hardware and Software	N/A
GL-IT-E-005	Requirements, Design, Operation, Validation and Removal of Applications Used by The GEL Group, Inc.	N/A
GL-IT-E-006	Change Control Requirements for Applications	N/A
GL-IT-E-007	User Roles and Responsibilities for Personnel Using Computer Services	N/A
GL-IT-E-009	Archive and Retrieval of Systems Information	N/A
GL-IT-E-010	Backup of Computer Controlled Instrumentation	N/A
GL-IT-E-011	System Security and Virus Protection	N/A
GL-IT-E-012	Application Tools used by Computer Services Personnel	N/A
GL-IT-E-013	GEL Electronic Processes and LIMS Audit System	N/A
GL-IT-E-014	Disaster Recovery	N/A
GL-IT-E-015	Operation of LIMS Database Primary and Failover Servers	N/A
GL-IT-E-017	AI Usage and Data Security Policy	N/A
GL-LB-E-001	The Determination of Method Detection Limits and Method Quantitation Limits	N/A
GL-LB-E-002	Balances	N/A
GL-LB-E-003	Glassware Preparation	N/A
GL-LB-E-004	Temperature Monitoring and Documentation Requirements for Refrigerators, Ovens, Incubators, and Other Similar Devices	N/A
GL-LB-E-005	Data Review and Validation	N/A
GL-LB-E-006	Toxicity Characteristic Leaching Procedure Preparation	SW-846 1311
GL-LB-E-007	Laboratory Standards Documentation	N/A
GL-LB-E-008	Basic Requirements for the Use and Maintenance of Laboratory Notebooks, Logbooks, Forms and Other Recordkeeping Devices	N/A
GL-LB-E-009	Run Logs	N/A
GL-LB-E-010	Maintenance and Use of Air Displacement Pipets	N/A
GL-LB-E-012	Verifying the Maintenance of Sample Integrity	N/A
GL-LB-E-013	CLP-Like/DOE Data Package Assembly and Revision	N/A
GL-LB-E-016	The Collection and Monitoring of the DI Water Systems	N/A
GL-LB-E-017	Procedure and Policy for Manual Integration	N/A
GL-LB-E-018	Instrument Clock Verification	N/A
GL-LB-E-023	Waste Extraction Test (WET)	N/A
GL-LB-E-024	Synthetic Precipitation Leaching Preparation	SW-846 1312
GL-LB-E-026	Container Suitability Testing	N/A
GL-LB-E-027	Bioassay Kit Delivery and Retrieval	N/A
GL-LB-E-029	Laboratory Sub-Sampling	N/A

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-LB-E-030	Silica Gel and Air Filter Removal and Replacement	N/A
GL-LB-E-031	Sample Compositing	N/A
GL-LB-E-032	The Distribution of High Risk and Limited Volume Samples	N/A
GL-LB-E-033	Proper Peak Identification for Organics	N/A
GL-LB-E-034	Laboratory Filtration Samples	N/A
GL-LB-G-001	Laboratory Waste Management Plan	N/A
GL-LB-N-001	Safety, Health and Chemical Hygiene Plan	N/A
GL-LB-S-001	Disaster Preparedness and Recovery Plan	N/A
GL-LB-X-001	Facility Closure Plan	N/A
GL-MA-E-006	Acid Digestion of Total Recoverable or Dissolved Metals in Surface and Groundwater Samples for Analysis by ICP or ICP-MS	SW-846 3005A
GL-MA-E-008	Acid Digestion of Total Metals in Aqueous Samples and Extracts for Analysis by ICP and ICP-MS	SW-846 3010A
GL-MA-E-009	Acid Digestion of Sediments, Sludges, and Soils	SW-846 3050B SW-846 6010 SW-846 6020
GL-MA-E-010	Mercury Analysis Using the Perkin Elmer Automated Mercury Analyzer	EPA 245.1 EPA 245.2 SW-846 7470A SW-846 7471A SW-846 7471B
GL-MA-E-013	Determination of Metals by ICP	EPA 200.7 SW-846 6010B SW-846 6010C SW-846 6010D
GL-MA-E-014	Determination of Metals by ICP-MS	EPA 200.8 SW-846 6020 SW-846 6020A SW-846 6020B
GL-MA-E-016	Sample Preparation for Total Recoverable Elements by EPA Method 200.2	EPA 200.2
GL-MA-E-017	Metals Data Validation	N/A
GL-MA-E-018	Mercury Analysis using the PS Analytical Millennium Automated Mercury Analyzer	EPA 1631 Rev E
GL-OA-E-001	Establishing Retention Time Windows for GC and HPLC Analysis	SW-846 8000
GL-OA-E-003	Non-Volatile Total Petroleum Hydrocarbons by Flame Ionization Detector	SW-846 8000D SW-846 8015C SW-846 8015D

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
		WDOE NWTPH-DX
GL-OA-E-004	Volatile Total Petroleum Hydrocarbons by Flame Ionization Detector	SW-846 5030A SW-846 5030B SW-846 5030C SW-846 5035 SW-846 5035A SW-846 8000C SW-846 8000D SW-846 8015A SW-846 8015B SW-846 8015C SW-846 8015D WDOE NWTPH-Gx
GL-OA-E-009	Analysis of Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry	EPA 625.1 SW-846 8270D SW-846 8270E
GL-OA-E-010	Extraction of Semivolatile and Nonvolatile Organic Compounds from Soil, Sludge, and Other Miscellaneous Solid Samples	SW-846 3550C <i>Applicable Analytical: WA EPH</i>
GL-OA-E-011	Analysis of Chlorophenoxy Acid Herbicides by ECD	SW-846 8000 SW-846 8151A
GL-OA-E-013	Extraction of Semivolatile and Nonvolatile Organic Compounds from Groundwater, Wastewater, and Other Aqueous Samples	SW-846 3510 <i>Applicable Analytical Methods: 8270D, 8270E 625.1</i>
GL-OA-E-015	The Extraction of Herbicides from Groundwater, Wastewater, and Other Aqueous Samples	SW-846 8151A
GL-OA-E-020	Percent Moisture	ASTM D2216-05
GL-OA-E-026	Volatile Organic Compounds (VOC) by Gas Chromatograph/Mass Spectrometer	EPA 624.1
GL-OA-E-027	The Extraction of Herbicides from Soil and Sludge Samples	SW-846 8151A
GL-OA-E-036	Florisil Cleanup of Organochlorine Pesticide Solvent Extracts	SW-846 3620C <i>Prep Methods: 3510C</i> <i>Applicable Analytical Methods: 608.3, 8081A, 8081B</i>
GL-OA-E-037	Sulfuric Acid/Permanganate Cleanup of PCB Solvent Extract	SW-846 3665A <i>Prep Methods: 3510C</i>

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
		<i>Applicable Analytical Method: 8082A, 608.3</i>
GL-OA-E-038	Volatile Organic Compounds (VOC) by Gas Chromatograph/Mass Spectrometer	SM 6200 SW-846 3585 SW-846 5030A SW-846 5030B SW-846 5035 SW-846 5035A SW-846 8000D SW-846 8260C SW-846 8260D
GL-OA-E-039	Closed-System Purge-and-Trap Collection and Extraction Volatile Organics in Soil and Waste Samples	EPA 3585 SW-846 5035 SW-846 5035A
GL-OA-E-040	The Analysis of Polychlorinated Biphenyls	EPA 608.3 SW-846 8000D SW-846 8082A
GL-OA-E-041	Organochlorine Pesticides and Chlorinated Hydrocarbons	EPA 608.3 SW-846 8000D SW-846 8081B
GL-OA-E-044	Organics Validation	N/A
GL-OA-E-045	Sulfur Clean-up	SW-846 3660B <i>Applicable Analytical Methods: 8081A, 8082A, 608.3</i>
GL-OA-E-046	Common Industrial Solvents, Glycols, and Various Organic Compounds by Flame Ionization Detector	SW-846 8000D SW-846 8015C SW-846 8015D
GL-OA-E-047	Gel Permeation Cleanup of Solvent Extracts	SW-846 3640A <i>Prep Methods: 3541, 3580, 3535A</i> SW-846 8082
GL-OA-E-050	The Extraction of Semi-Volatile and Nonvolatile Organic Compounds from Oil	SW-846 3580 <i>Applicable Analytical Methods: 8270D, 8270E, 8081A, 8081B, 8015C, 8015D, 8082, 8082A</i>
GL-OA-E-054	The Determination of Gasoline Range Organics Using Flame Ionization Detection Per Alaska Method AK101	AK101
GL-OA-E-055	The Determination of Diesel Range and Residual Range Organics	AK102 AK 103

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
		<i>Prep Methods:</i> SW-846 3535C SW-846 3541B
GL-OA-E-056	Definitive Low-Level Analysis of Nitroaromatic Explosives Utilizing Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC-MS/MS) by SW-846 Method 8330	SW-846 8000D SW-846 8330B
GL-OA-E-058	Volatile Storage Blanks	N/A
GL-OA-E-059	Analysis of 1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-Chloropropane (DBCP) in Water by GC/ECD Using Methods 504.1 or 8011	EPA 504.1 SW-846 8000 SW-846 8011
GL-OA-E-063	Massachusetts Method for the Determination of Extractable Petroleum Hydrocarbons	Massachusetts EPH
GL-OA-E-064	Dissolved Gases in Water by Flame Ionization Detector (FID)	RSK-175
GL-OA-E-065	Reagent/Solvent/Standards Screening for Organic Prep	N/A
GL-OA-E-066	Automated Soxhlet Extraction	SW-846 3541 SW-846 3600 <i>Applicable Analytical Methods: 8270D, 8270E, 8015, 8081, 8082A DRO, DRO/MO soils</i>
GL-OA-E-067	Definitive Low-Level Perchlorate Analysis Utilizing Liquid Chromatography/Mass Spectrometry/Mass Spectrometry (LC-MS/MS) by EPA Method 6850 Modified (6850M)	SW-846 6850(M) SW-846 8000D
GL-OA-E-068	The Processing, Extraction, and Analysis of Nitroaromatics, Nitroimines, and Nitrate Esters by SW-846 8330B	SW-846 8330B SW-846 3535A
GL-OA-E-070	Solid-Phase Extraction	SW-846 3535 SW-846 3535A <i>Applicable Analytical Methods: 8081A, 8081B, 8082A, 8015C, 8015D and 608.3</i>
GL-OA-E-071	The Pre-Extraction Processing of Soil Samples Collected Using Multi-Incremental Sampling (MIS) Techniques	SW-846 8330B
GL-OA-E-073	The Extraction and Analysis of 1,4-Dioxane by Gas Chromatography/Mass Spectrometry SIM	EPA 522 SW-846 8270E SIM
GL-OA-E-075	Washington Method for the Determination of Extractable Hydrocarbons	WA EPH
GL-OA-E-076	The Extraction and Analysis of Per and Polyfluoroalkyl Substances Using LC-MS/MS by 537.1 Modified	ASTM D79698-17A EPA 537.1 (Mod)

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-OA-E-076A	The Extraction and Analysis of Per and Polyfluoroalkyl Substances Using LC-MS/MS	EPA 533
GL-OA-E-076B	Extraction and Analysis of Per-and Polyfluoroalkyl (PFAS) Substances in Drinking Water	EPA 537.1 Drinking water method
GL-OA-E-076D	Extraction and Analysis of Per- and Polyfluoroalkyl (PFAS) Substances using LC-MS/MS by Method 1633/1633A	EPA 1633/1633A
GL-OA-E-078	The Extraction and Analysis of Cannabinoids High Performance Liquid Chromatography	GEL Developed Method
GL-OA-E-079	The Extraction of Herbicides Using Solid Phase Extraction	SW-846 3535A <i>Applicable Analytical Methods: 8151A</i>
GL-OA-E-080	The Analysis of Naphthalene Sulfonate Using High Performance Liquid Chromatography	SW-846 8330B
GL-OA-E-085	Extraction of Semi-Volatiles, Pesticides, PCBs and DRO in Soil Matrices Using Microwave Assisted Extraction	SW-846 3546
GL-OA-E-086	Standard Test Method for Determination of Per-and Polyfluoroalkyl Substances (PFAS) in Aqueous Matrices by Co-solvation followed by LC-MS/MS	ASTM 8421
GL-QS-B-001	Quality Assurance Plan	N/A
GL-QS-E-001	Conduct of Quality Audits	N/A
GL-QS-E-002	Conducting Corrective/Preventive Action and Identifying Opportunities for Improvement	N/A
GL-QS-E-003	Training and Qualifying Quality Assurance Audit Personnel	N/A
GL-QS-E-004	LIMS Documentation of Nonconformance Reporting and Dispositioning and Control of Nonconforming Items	N/A
GL-QS-E-005	Review of Monitoring Device Logs	N/A
GL-QS-E-007	Thermometer Verification	N/A
GL-QS-E-008	Quality Records Management and Disposition	N/A
GL-QS-E-011	Method Validation and Initial and Continuing Demonstrations of Capability	N/A
GL-QS-E-012	Client NCR Database Operation	N/A
GL-QS-E-013	Handling of Proficiency Evaluation Samples	N/A
GL-QS-E-014	Quality Assurance Measurement Calculations and Processes	N/A
GL-QS-E-015	Use of Logos and Describing Accredited Status	N/A
GL-QS-E-016	Identification and Implementation of New and Revised Methods	N/A
GL-QS-E-017	Maintaining Technical Training Records	N/A
GL-QS-E-018	Communication of Substantial Nonconforming Safety Related Services	N/A
GL-QS-E-019	Trending of Performance Evaluation Data	N/A

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-RAD-A-001	The Determination of Gross Alpha and Gross Non-Volatile Beta in Water	EPA 900.0 SW-846 9310
GL-RAD-A-001B	The Determination of Gross Alpha and Gross Non-Volatile Beta in Soil, Filters, Solid Matrices and Direct Count Air Filters	EPA 900.0(M) SW-846 9310
GL-RAD-A-001C	The Determination of Gross Alpha in Water by Co-precipitation	EPA 520/5-84-006 Method 00-02
GL-RAD-A-001D	The Determination of Gross Alpha Gross Non-Volatile Beta in Drinking Water	EPA 600/4-80-032 Method 900.0
GL-RAD-A-002	The Determination of Tritium	EPA 600/4-80-032, 906.0(M)
GL-RAD-A-003	The Determination of Carbon-14 in Water, Soil, Vegetation and Other Solid Matrices	N/A
GL-RAD-A-004	The Determination of Strontium 89/90 in Water, Soil, Milk, Filters, Vegetation and Tissues	EPA 905.0(M) DOE RP501 Rev1(M) HASL 300(M)
GL-RAD-A-005	The Determination of Technitium-99 Using ICP-MS	HASL 300(M) TC-02-RC DOE RP550(M) ASTM C 1387-03(M) ASTM 1476-00(M)
GL-RAD-A-006	The Determination of Radiometric Iodine	EPA 901.1(M) HASL 300(M) I-01
GL-RAD-A-007	The Determination of Radon-222 in Water	SM 7500 Rn-B
GL-RAD-A-008	The Determination of Radium-226	EPA 903.1(M) HASL 300(M) Ra-04-RC
GL-RAD-A-010	Total Alpha Radium Isotopes in Soil and Water	EPA 900.1(M)
GL-RAD-A-011	The Isotopic Determination of Americium, Curium, Plutonium, and Uranium	DOE RP800 1997(M) HASL-300 U-02-RC(M) HASL-300 Am-05-RC(M) HASL-300 Pu-11-RC(M)
GL-RAD-A-013	The Determination of Gamma Isotopes	901.1 (M) HASL-300 (M) Sec. 4.5.2.3 HASL-300 Ga-01-R
GL-RAD-A-015	Digestion for Soil	N/A
GL-RAD-A-016	The Determination of Radiometric Polonium	EPA 600/4-80-032
GL-RAD-A-017	The Determination of Iodine-131 in Drinking Water	902.0, 7500 I- B
GL-RAD-A-018	The Determination of Lead-210 in Liquid and Solid Matrices	DOE RP280(Mod)
GL-RAD-A-019	Determination of Phosphorus-32 in Soil and Water	EML HASL -300
GL-RAD-A-020	The Determination of Promethium-147 in Soil and Water	EML HASL -300
GL-RAD-A-021	Soil Sample Preparation for the Determination of Radionuclides	N/A
GL-RAD-A-021B	Soil Sample Ashing for the Determination of Radionuclides	EML HASL-300 EPA 520/5-84-006

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-RAD-A-022	The Determination of Ni-59 and Ni-63	N/A
GL-RAD-A-026	The Preparation of Special Matrices for the Determination of Radionuclides	N/A
GL-RAD-A-028	Radium-226 in Drinking Water by EPA Method 903.1	EPA 903.1
GL-RAD-A-029	The Determination of Strontium-89/90 in Drinking Water by EPA Method 905.0	EPA 905.0
GL-RAD-A-030	Determination of Radium-228 in Drinking Water	EPA 904.0 SW846 9320
GL-RAD-A-031	The Determination of Selenium	N/A
GL-RAD-A-032	The Isotopic Determination of Neptunium/Thorium	N/A
GL-RAD-A-033	Determination of Chlorine-36 in Solid and Liquid Samples	N/A
GL-RAD-A-035	The Isotopic Determination of Plutonium-241	HASL-300 Pu-11-RC(M)
GL-RAD-A-036	The Isotopic Determination of Americium, Curium, and Plutonium in Large Soil Samples	DOE RP800(M) HASL-300 Am-05-RC(M) HASL-300 Pu-11-RC(M) HASL-300 Pu-12-RC(M)
GL-RAD-A-038	The Isotopic Determination of Thorium	DOE RP800(M) HASL-300(M) Pu-02-RC Pu-03-RC
GL-RAD-A-041	The Determination of Total Activity in Solids and Liquids	N/A
GL-RAD-A-044	Total Alpha Radium Isotopes in Drinking Water	EPA 903.0 SW-846 9315 HASL 300(M)
GL-RAD-A-046	The Determination of Radium-224 and Radium-226 by Alpha Spectroscopy	N/A
GL-RAD-A-047	48 Hour Rapid Gross Alpha Test	ECLS-R-G-A EPA 600/4-80-032 EPA 900.0(M)
GL-RAD-A-048	The Determination of Calcium-45 in Soils and Waters	N/A
GL-RAD-A-049	The Determination of Sulfur-35	NAS-NS-3054
GL-RAD-A-050	The Determination of Tritium in Drinking Water Samples	600/4-80-032 EPA 906.0
GL-RAD-A-051	The Rapid Determination of Strontium 89/90 by Cerenkov Counting	N/A
GL-RAD-A-052	The Determination of Organically Bound Tritium	EPA 600/4-80-032 EPA 906.0
GL-RAD-A-053	Isotopic Determination of Plutonium in Large Water Resin Samples	HASL 300 Pu-11-RC
GL-RAD-A-056	The Determination of Gross Alpha and Beta by Liquid Scintillation Counter	EPA/600/4/80/032 Method 900.0(Mod) SW-846 9310

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-RAD-A-058	The Rapid Determination of Strontium 89/90 by Gas Flow Proportional Counting	DOE RP501 R1(Mod) EML HASL-300(Mod) EPA/600/4/80/032 Method 905.0(Mod)
GL-RAD-A-059	The Determination of Technetium-99 Using Analytical Grade 1X8 Resin	ASTM C 1387-03(Mod) ASTM C 1476-00(Mod) DOE RP550 1997(Mod) EML HASL-300 Method Tc-02-RC 1999(Mod)
GL-RAD-A-063	The Determination of Radium-228	EPA/600/4/80/032 Method 904.0(Mod)
GL-RAD-A-064	The Determination of Fe-55 in Liquid and Solid Matrices Using DGA Resin	N/A
GL-RAD-A-065	The Determination of Carbon-14 in Atmospheric Screening Cartridges	N/A
GL-RAD-A-066	The Determination of Radiometric Polonium Using DGA Cartridges	N/A
GL-RAD-A-067	The Determination of Radiometric of Tritium and Carbon 14 in Combustible Materials Using Pyrolysis	N/A
GL-RAD-A-068	The Determination of Americium, Curium, Plutonium, Uranium, and Thorium in Liquid and Solid Matrices Using Eichrom Resin	N/A
GL-RAD-A-069	Determination of Neptunium Using AG Anion Resin	N/A
GL-RAD-A-070	The Preparation of Environmental Samples for Isotopic Uranium Using DGA Resin Via ICP-MS	N/A
GL-RAD-A-071	The Determination of Strontium-90 via Yttrium-90 in Samples Using DGA Resin	N/A
GL-RAD-A-073	The Determination of Actinium-225	N/A
GL-RAD-A-074	Distribution Coefficients of Inorganic Species by Batch Method	D1293 D1733
GL-RAD-A-075	Radionuclide Solubility Determination in Simulated Lung Fluid	N/A
GL-RAD-B-001	The Sequential Determination of Isotopic Americium, Curium, Californium, Plutonium, Strontium and Uranium in Urine	N/A
GL-RAD-B-002	The Determination of Polonium-210 or Radium-226 in Bioassay Samples	N/A
GL-RAD-B-005	Management of Blank Populations	N/A
GL-RAD-B-008	The Determination of Gross Alpha Activity in Nasal Swipes	N/A
GL-RAD-B-009	Bioassay Countroom Alpha Spectroscopy Instrument Standardization and Performance	N/A
GL-RAD-B-010	The Determination of Thorium in Fecal Samples	N/A
GL-RAD-B-011	The Determination of Tritium in Urine	EPA 906

Standard Operating Procedures and Analytical Methods		
SOP #	SOP Title	Methods
GL-RAD-B-012	The Ashing of Fecal, Bone, and Tissue Samples	N/A
GL-RAD-B-013	Sequential Determination of Americium, Plutonium, Strontium, Plutonium-241, and Uranium in Fecal, Bone, and Tissue Samples	N/A
GL-RAD-B-014	The Preparation of Synthetic Urine and Fecal Material	N/A
GL-RAD-B-016	The Determination of Technetium-99 in Urine	N/A
GL-RAD-B-020	The Determination of Ni-59 and Ni-63 in Urine	N/A
GL-RAD-B-022	The Determination of Gross Alpha and Gross Non-volatile Beta in Urine	EPA 900.0 SW-846 9310 EERF 00-01 USGS R-1120-76
GL-RAD-B-023	The Determination of Carbon-14 in Urine	EERF C-01(M)
GL-RAD-B-024	Managing Statistical Data in the Bioassay Laboratory	N/A
GL-RAD-B-025	The Combination and Preservation of Urine Samples	N/A
GL-RAD-B-026	Bioassay Data Review, Validation and Data Package Assembly	N/A
GL-RAD-B-027	Specific Gravity in Urine	ASTM D5057
GL-RAD-B-029	The Determination of Radiometric Iodine in Urine	N/A
GL-RAD-B-030	The Preparation and Determination of Gamma Isotopes in Urine and Fecal Samples	EPA 600/4-80-032
GL-RAD-B-031	Bioassay Quality Control Package Assembly	N/A
GL-RAD-B-033	Bioassay Count Room Alpha Spectrometry Instrument Calibration	N/A
GL-RAD-B-034	The Determination of Metals by ICP-MS	N/A
GL-RAD-B-035	The Preparation of Urine Samples for Total Uranium Analysis by ICP-MS	N/A
GL-RAD-B-036	Initial Installation and Returning to Service of Repaired Instrumentation	N/A
GL-RAD-B-038	The Determination of Neptunium in Fecal Samples	N/A
GL-RAD-B-039	The Determination of Iron-55 in Urine	N/A
GL-RAD-B-040	The Determination of Radium-224 and Radium-226 by Alpha Spectroscopy in Bioassay Sample	N/A
GL-RAD-B-041	The Sequential Determination of Isotopic Thorium and Neptunium in Urine	N/A
GL-RAD-D-002	Analytical Methods Validation for Radiochemistry	N/A
GL-RAD-D-003	Data Review, Validation, and Data Package Assembly	N/A
GL-RAD-D-005	REMP Quality Control Package Assembly	N/A
GL-RAD-D-006	Equations Used in Data Reduction for Environmental Radiochemistry	N/A
GL-RAD-I-001	Gamma Spectroscopy System Operation	N/A

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SOP #	SOP Title	Methods
GL-RAD-I-004	Beckman LS-6000/6500	N/A
GL-RAD-I-007	Ludlum Lucas Cell Counter	N/A
GL-RAD-I-008	VAX/VMS Quality Control Software Program	N/A
GL-RAD-I-009	Alpha Spectroscopy System	N/A
GL-RAD-I-010	Counting Room Instrumentation Maintenance	N/A
GL-RAD-I-012	Managing Statistical Data in the Radiochemistry Laboratory	N/A
GL-RAD-I-013	Column Preparation	N/A
GL-RAD-I-015	WPC 9550 Gross Alpha/Beta Counter: Operating Instructions	N/A
GL-RAD-I-016	Multi-Detector Counter: Operating Instructions	N/A
GL-RAD-I-021	G5400W Series Alpha/Beta Counting System Operating Instructions	N/A
GL-RAD-I-022	The Operation of the Tri-Carb 5110TR Liquid Scintillation Detector	N/A
GL-RAD-I-024	The Operation of the HIDEK AMG Gamma Counter	N/A
GL-RAD-M-001	Preparation and Verification of Radioactive Standards	N/A
GL-RAD-S-000	Radiation Safety Plan for GEL Laboratories, LLC	N/A
GL-RAD-S-001	Radiological Surveys	N/A
GL-RAD-S-002	Radiation Related Emergencies	N/A
GL-RAD-S-003	Administration of the Radioactive Material License Inventory	N/A
GL-RAD-S-004	Radioactive Material Handling	N/A
GL-RAD-S-006	Radiation Worker Training	N/A
GL-RAD-S-007	Receiving Radioactive Packages	N/A
GL-RAD-S-009	Personnel Dosimetry	N/A
GL-RAD-S-010	The Handling of Biological Materials	N/A
GL-RAD-S-013	Air Sampling for Radioactivity	Guide 825
GL-RAD-S-014	Release of Laboratory Coats	N/A
GL-RAD-S-015	The Acceptance and Classification of Radioactive Material	N/A
GL-RAD-S-016	Radiation Work Permits	N/A
GL-RAD-S-018	Laboratory Analysis of High Activity (RAD 3) Samples	N/A
GL-RC-E-001	Receipt and Inspection of Material and Services	N/A
GL-RC-E-002	Material Requisition	N/A
GL-SR-E-001	Sample Receipt, Login, and Storage	N/A
GL-SR-E-002	Transportation and Shipping of Samples and Pre-Preserved Sample Containers	N/A
GL-SR-E-003	The Inspection, Cleaning and Screening of Sample Coolers	N/A
GL-SR-E-004	Control of Foreign Soils	N/A
GL-SR-E-005	Wipe Test	N/A
GL-SVR-D-001	Design Specifications for the Network Infrastructure	N/A

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SOP #	SOP Title	Methods
GL-SVR-D-002	Design Specifications for the Mail Server	N/A

APPENDIX J: SAMPLE STORAGE AND PRESERVATION REQUIREMENTS

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
INORGANICS							
Acidity	SM 2310B	Liquid	P,G	0 ≤ 6° C	14 days	25 mL	NA
Adsorbable Organic Halides (AOX)	EPA 1650C	Liquid	G, amber	0 ≤ 6° C, HNO ₃ to pH < 2, zero headspace	>3days and <6 months from collection	50 mL	NA
Alkalinity	EPA 310.1 (Modified) SM2320B	Liquid	P,G	0 ≤ 6° C	14 days	100 mL	NA
Biochemical Oxygen Demand (BOD) and Carbonaceous Oxygen Demand (CBOD)	EPA 405.1 SM 5210B	Liquid	P,G	0 ≤ 6° C	48 hours	500 mL	NA
Bromide	EPA 300.0	Liquid Solid	P,G	None	28 days	10 mL	4 g
Bromide	SW-846 9056A	Liquid Solid	P,G	0 ≤ 6° C	28 days	10 mL	4 g
Bromine by Bomb Calorimeter	SW-846 5050/9056A	Oil	P, G	0 ≤ 6° C	None	NA	0.5 g
Carbon Dioxide	EPA 310.1 SM 4500-CO ₂ D	Liquid	P,G	0 ≤ 6° C	14 days	100 mL	NA
Chemical Oxygen Demand (COD)	EPA 410.4 HACH 8000	Liquid	P,G	0 ≤ 6° C, H ₂ SO ₄ to pH < 2	28 days	2 mL	NA
Chlorine by Bomb Calorimeter	SW-846 5050/9056A	Oil	P,G	0 ≤ 6° C	None	NA	0.5 g
Chloride	EPA 300.0	Liquid Solid	P,G	None	28 days	10 mL	4 g
Chloride	SW-846 9056A	Liquid Solid	P,G	0 ≤ 6° C	28 days	10 mL	4 g
Color	EPA 110.2 SM 2120B	Liquid	P,G	0 ≤ 6° C	48 hours	50 mL	NA
Conductivity	EPA 120.1 SM 2510B	Liquid	P,G	0 ≤ 6° C	28 days	15 mL	NA
Corrosivity by pH	EPA 150.1 SW-846 9040B or C SM 4500-H+ - 2011	Liquid	P,G	None	Immediate	10 mL	NA
Corrosivity by pH	EPA 150.1 SW-846 9045C or D SM 4500-H+ - 2011	Solid	P,G	None	Immediate	NA	5 g
Corrosivity by pH	SW-846 9041A	Oil	P,G	None	Immediate	NA	5 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Corrosivity to Steel	SW-846 1110 (Mod)	Liquid	P,G	None	None	290 mL	NA
Cyanide, amenable to chlorination	EPA 335.1/335.4 SM 9010B or C/9012A or B SM 4500 CN-G	Liquid	P,G	0 ≤ 6° C, NaOH to pH > 12, 0.6 g ascorbic acid ³	14 days ⁴	25 mL	NA
Cyanide, Reactive Releasable	SW-846 Chap 7.3.3	Liquid	G, amber	Zero headspace	7 days liquids,	10 mL	10 g
		Solid			28 days solids		
Cyanide, total, available, or free	EPA 335.4 SM 4500-CN-C-2016 SW-846 9010B or C/SW-846 9012A or B	Liquid Solid	P,G	0 ≤ 6° C, NaOH to pH > 12, 0.6 g ascorbic acid ³	14 days ⁴	25 mL	1 g
Cyanide, Weak Acid Dissociable	EPA 335.4 SM 4500-CN-I-2011	Liquid	P,G	0 ≤ 6° C, NaOH to pH > 12	14 days ⁴	25 mL	NA
		Solid	P,G	0 ≤ 6° C	7 days	NA	1 g
Dissolved Oxygen	SM 4500 O-G	Liquid	G (BOD)	10 - 20° C, Zero headspace	Immediate	300 mL	NA
Extractable Organic Halides (EOX)	SW-846 9023	Solid or Oil	G, amber	Zero headspace, 0 ≤ 6° C	28 days	NA	1 g
Flashpoint	SW-846 1020A	Oil Misc Solid	P,G	None	None	2 mL	2 g
Fluoride	EPA 300.0	Liquid	P,G	None	28 days	10 mL	NA
Fluoride	SW-846 9056A	Liquid Solid	P,G	0 ≤ 6° C	28 days	10 mL	4 g
Fluorine by Bomb	SW-846 5050/9056A	Oil	P,G	0 ≤ 6° C	None	NA	0.5 g
Hardness (EDTA titration)	EPA 130.2	Liquid	P,G	0 ≤ 6° C, HNO ₃ to pH < 2	6 months	25 mL	NA
Hardness (calculation)	SM 2340B	Liquid	P,G	HNO ₃ to pH < 2	6 months	25 mL	NA
Hardness (EDTA titration)	SM 2340C	Liquid	P,G	HNO ₃ to pH < 2	6 months	25 mL	NA
Heating Value	ASTM 4809-13 ASTM D 240-14 ASTM E711-87(Mod)	Misc Liquid Oil	P,G	0 ≤ 6° C	None	1 mL	0.5 g
Iodide	EPA 300.0 SW-846 9056A	Liquid Solid	P,G	0 ≤ 6° C	None	10 mL	4 g
Nitrogen-Ammonia	EPA 350.1 SM 4500 NH3-B SM 4500 NH3-B (Mod)	Liquid	P,G	0 ≤ 6° C, H ₂ SO ₄ to pH < 2	28 days	5 mL	NA
Nitrogen-Ammonia	EPA 350.1	Solid	P,G	0 ≤ 6° C	28 days	NA	1 g
Nitrate – Liquids	EPA 300.0 SW-846 9056A	Liquid	P,G	0 ≤ 6° C	48 hours	10 mL	NA

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Nitrate – Solids	SW-846 9056A	Solid	P,G	0 ≤ 6° C	28 days for extraction, 48 hrs from extraction to analysis	NA	4 g
Nitrite - Liquids	EPA 300.0 SW-846 9056A	Liquid	P,G	0 ≤ 6° C	48 hours	10 mL	NA
Nitrite - Solids	SW-846 9056A	Solid	P,G	0 ≤ 6° C	28 days for extraction, 48 hrs from extraction to analysis	NA	4 g
Nitrate/Nitrite	EPA 353.2 SM 4500 NO ₃ F	Liquid	P,G	0 ≤ 6° C, H ₂ SO ₄ to pH < 2	28 days	4 mL	NA
Nitrate/Nitrite	EPA 353.2	Solid	P,G	0 ≤ 6° C	28 days	NA	4 g
Nitrogen - Total Kjeldahl and Organic	EPA 351.2 SM 4500 Norg	Liquid	P,G	0 ≤ 6° C, H ₂ SO ₄ to pH < 2	28 days	20 mL	NA
Nitrogen - Total Kjeldahl and Organic	EPA 351.2 SM 4500 Norg	Solid	P,G	0 ≤ 6° C	28 days	NA	1 g
Oil and Grease (Hexane Extractable Material or HEM)	EPA 1664A, B	Liquid	G	0 ≤ 6° C, HCl or H ₂ SO ₄ to pH < 2	28 days	1000 mL	NA
Orthophosphate - Liquids	EPA 300.0 SW-846 9056A	Liquid	P,G	Field filter immediately, 0 ≤ 6° C	48 hours	10 mL	NA
Orthophosphate – Solids	EPA 300.0 SW-846 9056A	Solid	P,G	0 ≤ 6° C	28 days for extraction, 48 hrs from extraction to analysis	NA	4 g
Paint Filter Liquids Test	SW-846 9095B	Solid	Any	None	None	NA	100 g
Percent (%) Moisture Karl Fischer	ASTM E203	Liquid Solid	P,G	0 ≤ 6° C	None	1 mL	1 g
Total Phenols	EPA 420.4 SW-846 9066	Liquid	G, amber	0 ≤ 6° C, H ₂ SO ₄ to pH < 2	28 days	50 mL	NA
Total Phenols	SW-846 9066	Solid	G, amber	0 ≤ 6° C	28 days	NA	1 g
pH	EPA 150.1 SW-846 9040B, 9040C SM 4500-H	Liquid	P,G	None if within 15 mins of collection, 0 ≤ 6° C when shipped to lab	Immediate	10 mL	NA
pH	EPA 150.1 SW-846 9045C, 9045D	Solid	P,G	None if within 15 mins of collection, 0 ≤ 6° C when shipped to lab	Immediate	NA	5 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
pH	SW-846 9041A	Oil	P,G	None if within 15 mins of collection, 0 ≤ 6° C when shipped to lab	Immediate	NA	5 g
Total Phosphorus	EPA 365.4 SM 4500 P H	Liquid	P,G	0 ≤ 6° C, H ₂ SO ₄ to pH < 2	28 days	20 mL	NA
Total Phosphorus	EPA 365.4 Mod	Solid	P,G	0 ≤ 6° C	28 days	NA	1 g
Residual Chlorine	SM 4500-Cl G	Liquid	P,G	0 ≤ 6° C	Immediate	25 mL	NA
Residue, Total (Total Solids)	SM 2540 B	Liquid	P,G	0 ≤ 6° C	7 days	100 mL	NA
Residue, Filterable (TDS)	EPA 160.1 SM 2540 C	Liquid	P,G	0 ≤ 6° C	7 days	100 mL	NA
Residue, NonFilterable (TSS)	EPA 160.2 SM 2540 D	Liquid	P,G	0 ≤ 6° C	7 days	1000 mL	NA
Residue, Volatile and Fixed (% Ash)	EPA 160.4/SM 2540E, G	Liquid Solid	P,G	0 ≤ 6° C	7 days	100 mL	1 g
% Ash	ASTM D482	Oil	P, G	None	7 days	NA	5 g
Salinity	SM 2520B	Liquid	P,G	0 ≤ 6° C	28 days	25 mL	NA
Specific Gravity	ASTM D5057	Liquid	P,G	0 ≤ 6° C	None	5 mL	NA
Sulfate	EPA 300.0 SW-846 9056A	Liquid Solid	P,G	0 ≤ 6° C	28 days	10 mL	4 g
Sulfide	EPA 376.2 SM 4500 S2D	Liquid	P,G	0 ≤ 6° C, add ZnAc and NaOH to pH > 9	7 days	25 mL	NA
Sulfide, Acid Soluble	SW-846 9030B/9034	Liquid	P,G	0 ≤ 6° C, Zero Headspace, add ZnAc and NaOH to pH > 9 (Liquid) Fill surface with 2 N ZnAc (solids)	7 days liquids,	200 mL	20 g
		Solid			365 days solids		
Sulfide, Reactive Releasable	SW-846 7.3.4	Liquid Solid	G, amber	Zero headspace, 0 ≤ 6° C	7 days liquids,	10 mL	10 g
					28 days solids		
Sulfite	SM 4500	Liquid	P,G	EDTA ⁹	Immediate	50 mL	NA
Sulfur by Bomb	SW-846- 5050/9056A	Oil	P,G	0 ≤ 6° C	None	NA	0.5 g
Surfactants	EPA 425.1 SM 5540C	Liquid	P,G	0 ≤ 6° C	48 hours	100 mL	NA
Total Organic Carbon (also DOC, TC, TIC)	EPA 415.1 SM 5310B SW-846-9060A	Liquid	G, amber	0 ≤ 6° C, HCl or H ₂ SO ₄ to pH < 2	28 days	25 mL	NA

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Total Organic Carbon (also DOC, TC, TIC)	SW-846-9060A	Solid	G, amber	0 ≤ 6° C	28 days	NA	1 g
Total Organic Halides (TOX)	SW-846-9020B	Liquid	G	0 ≤ 6° C, H ₂ SO ₄ to pH < 2, Zero headspace	28 days	50 mL	NA
Total Petroleum Hydrocarbons (SGT-HEM)	SW-846-1664A/B	Liquid	G	0 ≤ 6° C, HCl or H ₂ SO ₄ to pH < 2	28 days	1000 mL	NA
Toxicity Characteristic leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP)	SW-846-1311 (TCLP) SW-846-1312 (SPLP)	Liquid	P,G depending on test	0 ≤6° C, depends on test	14 days VOA,	2 L for full	105 g or 130 g for full TCLP list
					14 days SVOA,	TCLP list	
		Solids			28 days Mercury,	or	
					180 days non-Hg metals	250 mL Metals only	
Turbidity	EPA 180.1 SM 2130B	Liquid	P,G	0 ≤ 6° C	48 hours	50 mL	NA
Viscosity	ASTM 2983 ASTM 2161	Liquid Oil	P,G	0 ≤ 6° C	None	7 mL	NA
Metals – Liquids (except chromium VI, boron, silica and mercury)	EPA 200.7 EPA 200.8 SW-846-6010D SW-846-6020B	Liquid	P, (G as long as no B or Si is required)	HNO ₃ to pH < 2	6 months	50 mL	NA
Metals – Solids ⁸ (except chromium VI and mercury)	SW-846-6010D SW-846-6020B	Solid	P, (G as long as no B or Si is required)	None	6 months	NA	0.5g
Chromium VI – Liquids	SM 3500 Cr D SW-846-7196A	Liquid	P,G	0 ≤ 6° C	24 hours	25 mL	NA
Chromium VI - Liquids	SM 3500 Cr D SW-846-7196A	Liquid	P,G	0 ≤ 6° C, (NH ₄) ₂ SO ₄ , pH = 9.3 to 9.7	28 days when field filtered prior to preservative additions	25 mL	NA
Chromium VI - Solids ⁸	SW-846-7196A	Solid	P,G	0 ≤ 6° C	30 days to digestion, 7 days from digestion to analysis	NA	1 g
Mercury - Liquids	EPA 245.1/245.2 SW-846-7470A	Liquid	P,G	HNO ₃ to pH < 2	28 days	20 mL	NA
Mercury - Solids ⁸	SW-846-7471B	Solid	P,G	0 ≤ 6° C	28 days	NA	.25 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Mercury – Low Level Liquids	EPA 1631E	Liquid	P,G	HCl or BrCl	90 days when preserved w/in 48 hrs or oxidized w/in 28 days	50 mL	NA
ORGANICS							
Method AK101-Solids ⁷	AK101	Solid	Amber G	4 ± 2 °C, zero headspace, methanol	14 days	NA	4 oz ⁷
Method AK101-Liquids	AK101	Liquid	Amber G	4 ± 2 °C, HCl < 2	14 days	40 mL	NA
Method AK102-Liquids	AK102	Liquid	Amber G	4 ± 2 °C, HCl or H ₂ SO ₄ to pH < 2	14 days	1000 mL	NA
Method AK102/103-Solids	AK102/AK103	Solid	Amber G	4 ± 2 °C	14 days for extraction 40 days after extraction for analysis	NA	30 g
MADEP EPH - Liquids	Massachusetts EPH	Liquid	Amber G	4 ± 2 °C, HCl < 2	14 days	1000 mL	NA
MADEP EPH – Solids	Massachusetts EPH	Solid	Amber G	4 ± 2 °C	14 days	NA	30 g
BTEX – Liquids	EPA 624.1 SW-846-8260D	Liquid	G, teflon-lined septum	0 ≤ 6° C, zero headspace, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₃	14 days ⁶	40 mL	NA
BTEX - Solids⁸	SW-846-8260D	Solid	G, teflon-lined septum	0 ≤ 6° C	48 hours for preservation and 14 days for analysis	NA	5035 Kit
Volatiles - Drinking Water, Wastewater/groundwater (except 2-CLEVE, acrolein, acrylonitrile)	SM 6200B SW-846-8260D EPA 624.1	Liquid	G, teflon-lined cap	0 ≤ 6° C, zero headspace, HCl to pH < 2	14 days	40 mL	NA
Volatiles (including 2 CLEVE) - Wastewater	SM 6200B SW-846-8260D EPA 624.1	Liquid	G, teflon-lined cap	0 ≤ 6° C, zero headspace, unpreserved	7 days ⁶	40 mL	NA
Volatiles (acrolein, acrylonitrile)	SM 6200B SW-846-8260D	Liquid	G, teflon-lined cap	0 ≤ 6° C, zero headspace, HCl to pH 4-5	7 days ⁶	40 mL	NA
Volatiles (acrolein)	EPA 624.1	Liquid	G, teflon-lined cap	0 ≤ 6° C, zero headspace, unpreserved	3 days	40 mL	NA

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Volatiles - Solids⁸	SW-846-5035A/8260D	Solid	5035 kit (2 water, 1 MeOH vial, 1 Moisture) or 3 EnCore Sampler	0 ≤ 6° C	48 hours for preservation n 14 days for analysis	NA	5035 Kit
Volatiles - Concentrated Waste	SW-846-5035A/8260D	Solid Oil	G, teflon-lined septum	None	14 days	40 mL	40 mL
Base/Neutral and Acid Extractables and 1,4-Dioxane – Liquids	SW-846-8270E	Liquid	Amber G, teflon-lined cap	0 ≤ 6° C, 0.008% Na ₂ S ₂ O ₃ ³	7 days for extraction, 40 days after extraction for analysis	1000 mL	NA
Base/Neutral and Acid Extractables and 1,4-Dioxane- Solids ⁸	SW-846-8270E	Solid	G, teflon-lined cap	0 ≤ 6° C	14 days for extraction, 40 days after extraction for analysis	NA	30 g
Base/Neutral and Acid Extractables - Concentrated Waste	SW-846-8270E	Oil	G, teflon-lined cap	None	7 days for extraction, 40 days after extraction for analysis	1 mL	1 g
Dissolved Gases	RSK-175	Liquid	G, teflon-lined septum	0 ≤ 6° C, HCl to pH < 2, zero headspace	14 days	40 mL	NA
TPH-GRO	SW-846-8015C/D NWTPH-Gx	Liquid	G, teflon-lined cap	0 ≤ 6° C, HCl to pH < 2, zero headspace	14 days	40 mL	NA
TPH-GRO	SW-846-8015C/D NWTPH-Gx	Solid	40ml vial with MeOH	0 ≤ 6° C	14 days	NA	5g
TPH-DRO - Liquids	SW-846-8015C/D NWTPH-Dx	Liquid	G, teflon-lined cap	0 ≤ 6° C, HCl to pH < 2	7 days for extraction, 40 days after extraction for analysis	1000 mL	NA
TPH-DRO - Solids	SW-846-8015D NWTPH-Dx	Solid	G, teflon-lined cap	0 ≤ 6° C	14 days for extraction, 40 days after extraction for analysis	NA	30 g
Chlorinated Herbicides - Liquids	SW-846-8151A	Liquid	Amber G, teflon-lined cap	0 ≤ 6° C, 0.008% Na ₂ S ₂ O ₃ ³	7 days for extraction 40 days after extraction for analysis	1000 mL	NA
Chlorinated Herbicides - Solids ⁸	SW-846-8151A	Solid	G, teflon-lined cap	0 ≤ 6° C	14 days for extraction 40 days after extraction	NA	50 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Organochlorine Pesticides by SW-846 EPA 8081 Liquids	SW-846-8081B	Liquid	Amber G, teflon-lined cap	0 ≤ 6° C 0.008% Na ₂ S ₂ O ₃ ³	7 days for extraction 40 days after extraction for analysis	1000 mL	NA
Organochlorine Pesticides by SW-846 EPA 8081 Solids	SW-846-8081B	Solid	Amber G, teflon-lined cap	0 ≤ 6° C	14 days for extraction 40 days after extraction	NA	30 g
Organochlorine Pesticides by EPA 608 only	EPA 608.3	Liquid	Amber G, teflon-lined cap	0 ≤ 6° C,	Unpreserved Prep within 72 hrs	1000 mL	NA
				0.008% , Na ₂ S ₂ O ₃ ³ , NaOH and H ₂ SO ₄ preserve to pH 5.0 to 9.0 (for prep >72 hrs and <7days)	Preserved prep within 7 days, 40 days after extraction for analysis		
PCBs by EPA 608 only	EPA 608.3	Liquid	Amber G, teflon-lined cap	0 ≤ 6° C, 0.008% Na ₂ S ₂ O ₃ ³	7 days for extraction 40 days after extraction for analysis	1000 mL	NA
PCBs - Liquids	SW-846-8082A	Liquid	Amber G, teflon-lined cap	0 ≤ 6° C, 0.008% Na ₂ S ₂ O ₃ ³	365 days for extraction 40 days after extraction for analysis	1000 mL	NA
PCBs - Solids	SW-846-8082A	Solid	Amber G, teflon-lined cap	0 ≤ 6° C	365 days for extraction 40 days after extraction for analysis	NA	30 g
PCBs in Oil	SW-846-3580A/8082A	Oil	G, teflon-lined cap	None	365 days	1 mL	1 g
Solvents, Glycols, Alcohols, Acetates - Liquids	SW-846-8015D	Liquid	G, teflon-lined septum	0 ≤ 6° C, zero headspace or 0 ≤ 6° C, zero headspace, HCL to pH < 2	7 days unpreserved, 14 days preserved	1 mL	NA
Solvents, Glycols, Alcohols, Acetates - Solids	SW-846-8015D	Solid	G, teflon-lined septum	0 ≤ 6° C	14 days	NA	10 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
1,4-Dioxane in Drinking Water by EPA 522	EPA 522	Liquid	G, teflon-lined septum	<10°C during transport, Sodium sulfite (50mg/L), sodium bisulfate (1g/L)	28 days for extraction at 0 ≤ 6° C (not frozen) and 28 days after extraction for analysis at - 5° C, protected from light	100 mL	NA
1,4-Dioxane in Drinking Water by EPA 625.1 SIM or 8270E SIM	EPA 625.1 SIM SW-846 8270E SIM	Liquid	G, teflon-lined septum	0 ≤ 6° C	28 days for extraction at 0 ≤ 6° C (not frozen)	100 mL	NA
1,4-Dioxane by EPA 8270E SIM	SW-846-8270E SIM	Solids	G, teflon-lined septum	0 ≤ 6° C	14 days to extraction (Solids) 40 days to analysis after extraction	NA	30 g
Dioxin Screen	EPA 625.1 SW-846-8270E	Liquid	G, teflon-lined cap	0 ≤ 6° C	7 days for extraction, 40 days after extraction for analysis	1000 mL	NA
Dioxin Screen	SW-846-8270E	Solid	G, teflon-lined cap	0 ≤ 6° C	7 days for extraction, 40 days after extraction for analysis	NA	30 g
EDB and DBCP	EPA 504.1 SW-846-8011	Liquid	G, teflon-lined septum	0 ≤ 6° C, 0.4% Na ₂ S ₂ O ₃	14 days	40 mL	NA
Polynuclear Aromatic Hydrocarbons	EPA 625.1 SIM SW-846-8270E SIM	Liquid	Amber G, teflon-lined septum (Liquids), Teflon-lined cap (Solids)	0 ≤ 6° C	7 days for extraction (Liquids)	1000 mL	30 g
	SW-846-8270E SIM	Solid			14 days to extraction (Solids)		
					40 days to analysis after extraction		
Nitroaromatics and Nitroamines	SW-846-8330B	Liquid	Amber G, teflon-lined septum	0 ≤ 6° C	7 days for extraction (Liquids)	1000 mL	2 g
	SW-846-8330B	Solid			14 days to extraction (Solids)		
					40 days to analysis after extraction		

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Nitroaromatics and Nitroamines by MIS Prep	SW-846 8330B	Solid	Protect from light	0 ≤ 6° C until air drying	14 days for extraction,	NA	Entire Sample
				22 ± 4° C (or cooler) after drying	40 days after extraction for analysis		
RDX Breakdown	SW-846-8330B	Liquid	Amber G, teflon-lined septum for liquids and teflon-lined cap for solids	0 ≤ 6° C	7 days for extraction (Liquids)	1000 mL	2 g
	SW-846-8330B	Solid			14 days to extraction (Solids)		
					40 days to analysis after extraction		
Low Level Perchlorate	SW-846-6850	Liquid	P	0 ≤ 6° C	28 days	10 mL	
		Solid	Amber G	0 ≤ 6° C	28 days for extraction 28 days after extraction for analysis		2 g
Perfluorinated Alkyl Acids - Drinking Water by EPA 537.1	EPA 537.1 Ver 2	Drinking Water	PFAS-Free HDPE - unlined polyethylene screw cap	≤ 10° C within 48 Hours of collection, add 5 g/L Trizma®	14 days for extraction	250 mL	NA
					28 days after extraction for analysis		NA
Perfluorinated Alkyl Acids - Drinking Water by EPA 533	EPA 533	Drinking Water	PFAS-free HDPE - unlined polyethylene screw cap	< 10° C within 48 Hours of collection, ammonium acetate @ 1g/L	28 days from collection to extract	250 mL	NA
					28 days from extraction to analyze		NA
Perfluorinated Alkyl Acids - Liquids by DoD Compliant Table B-15	GEL 537 Modified	Liquid	PFAS-free HDPE - unlined polyethylene screw cap	≤ 10° C within 48 Hours of collection, may add 5 g/L Trizma®	14 days to extraction	250 mL	NA
					28 days after extraction for analysis		NA
Perfluorinated Alkyl Acids - Solids by DoD Compliant Table B-15	GEL 537 Modified	Solid	PFAS-free HDPE - unlined polyethylene screw cap	0 ≤ 6° C	28 days from collection to extract and analyze	NA	10 g
		Tissue	PFAS-free HDPE - unlined polyethylene screw cap	Received frozen, stored at ≤ -10° C		NA	

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Perfluorinated Alkyl Acids - Water by EPA 1633A	EPA 1633A	Liquid	PFAS-free HDPE - unlined polyethylene screw cap	0 ≤ 6°C from collection until lab receipt, protect from light	28 days to extraction, except NEtFOSE, NEtFOSAA, NMeFOSE, NMeFOSAA, which must be extracted within 7 days of collection., 90 days after extraction for analysis, except for 11-Cl- PF3OUdS and 9-Cl- PF3ONS, which must be analyzed within 28 days after extraction.	500 mL	NA
Perfluorinated Alkyl Acids - Leachate by EPA 1633A	EPA 1633A	Leachate	PFAS-free HDPE - unlined polyethylene screw cap	0 ≤ 6°C from collection until lab receipt, protect from light	28 days to extraction, except NEtFOSE, NEtFOSAA, NMeFOSE, NMeFOSAA, which must be extracted within 7 days of collection., 90 days after extraction for analysis, except for 11-Cl- PF3OUdS and 9-Cl- PF3ONS, which must be analyzed within 28 days after extraction	100 mL	NA
Perfluorinated Alkyl Acids - Solids by EPA 1633A	EPA 1633A	Solid	PFAS-free HDPE - unlined polyethylene screw cap	0 ≤ 6°C from collection until lab receipt, protect from light	90 days to extraction, except NFHDA, which must be extracted within 3 days of collection, 90 days after extraction for	NA	50 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
					analysis, except for 11-Cl-PF3OUdS and 9-Cl-PF3ONS, which must be analyzed within 28 days after extraction		
Perfluorinated Alkyl Acids - Tissue by EPA 1633A	EPA 1633A	Tissue	PFAS-free HDPE - unlined polyethylene screw cap	0 ≤ 6°C from collection until lab receipt, but no more than 24 hours, ≤ -20° C upon lab receipt	90 days to extraction when stored at </- -20°C, 90 days after extraction for analysis, except for 11-Cl-PF3OUdS and 9-Cl-PF3ONS, which must be analyzed within 28 days after extraction.	NA	Whole fish, cleaned, filleted or other tissue - 20 g

RADIOCHEMISTRY

Americium – Liquids	DOE EML HASL-300, Am-05-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Americium – Solids ⁸	DOE EML HASL-300, Am-05-RC Modified	Solid	P,G	None	6 months	NA	0.1 g
Calcium-45 – Liquids	GL-RAD-A-048	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	50 mL	NA
Calcium-45 - Solids ⁸	GL-RAD-A-048	Solid	P,G	None	6 months	NA	0.1 g
Carbon-14 Liquids & Solids ⁸	EPA EERF C-01 Modified	Liquid Solid	P,G	None	6 months	100 mL	1.5 g
Chlorine-36 Liquids & Solids ⁸	GL-RAD-A-033	Liquid Solid	P,G	None	6 months	30 mL	0.5 g
Curium - Liquids	DOE EML HASL-300, Am-05-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Curium - Solids ⁸	DOE EML HASL-300, Am-05-RC Modified	Solid	P,G	None	6 months	NA	0.1 g
Gamma Isotopes - Liquids	EPA 901.1	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	2000 mL	NA
Gamma Isotopes - Solids ⁸	DOE HASL 300, 4.5.2.3/Ga-01-R	Solid	P,G	None	6 months	NA	200 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Gross Alpha & Beta – Liquids	EPA 900.0/SW-846 9310	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	150 mL	NA
Gross Alpha & Beta - Drinking Water ¹⁰	EPA 900.0	Drinking Water	P,G	HNO ₃ or HCl to pH < 3	6 months	150 mL	NA
Gross Alpha & Beta - Solids ⁸	EPA 900.0/SW-846 9310/SM 7110B Modified	Solid	P,G	None	6 months	NA	0.1 g
Iodine-129 - Liquids & Solids ⁸	DOE EML HASL-300, I-01 Modified	Liquid Solid	P,G	None	6 months	1000 mL	0.1 g
Iodine -131 - Liquids	EPA 902.0/SM 7500-I B	Liquid	P,G	None	8 days	1000 mL	NA
Iodine-131 Drinking Water¹⁰	EPA 902.0 SM 7500-IB	Drinking Water	P,G	None	8 days	1000 mL	NA
Iron 55 -Liquids	DOE RESL Fe-1, Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	50 mL	NA
Iron 55 - Solids ⁸	DOE RESL Fe-1, Modified	Solid	P,G	None	6 months	NA	0.5 g
Lead-210 – Liquids	DOE RP280 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	400 mL	NA
Lead-210 - Solids ⁸	DOE RP280 Modified	Solid	P,G	None	6 months	NA	0.5 g
Neptunium - Liquids	ASTM C 1476-00 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Neptunium - Solids ⁸	ASTM C 1476-00 Modified	Solid	P,G	None	6 months	NA	0.1 g
Nickel-59 – Liquids	DOE RESL Ni-1	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	500 mL	NA
Nickel-59 – Solids ⁸	DOE RESL Ni-1	Solid	P,G	None	6 months	NA	0.5 g
Nickel-63 - Liquids	DOE RESL Ni-1, Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	150 mL	NA
Nickel-63 - Solids ⁸	DOE RESL Ni-1, Modified	Solid	P,G	None	6 months	NA	1.5 g
Phosphorus-32 –Liquids	GL-RAD-A-019	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	250 mL	NA
Phosphorus-32 - Solids ⁸	GL-RAD-A-019	Solid	P,G	None	6 months	NA	0.25 g
Plutonium – Liquids	DOE EML HASL-300, Pu-11-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Plutonium - Solids ⁸	DOE EML HASL-300, Pu-11-RC Modified	Solid	P,G	None	6 months	NA	0.1 g
Plutonium-241 – Liquids	DOE EML HASL-300, Pu-11-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	400 mL	NA
Plutonium-241 - Solids ⁸	DOE EML HASL-300, Pu-11-RC Modified	Solid	P,G	None	6 months	NA	0.4 g
Polonium - Liquids	DOE EML HASL-300, Po-01 RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Polonium - Solids ⁸	DOE EML HASL-300, Po-01 RC Modified	Solid	P,G	None	6 months	NA	0.1 g
Promethium-147/Samarium-151 – Liquids	EPA EERF PM-01-1 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	250 mL	NA
Promethium-147/Samarium-151 - Solids ⁸	EPA EERF PM-01-1 Modified	Solid	P,G	None	6 months	NA	0.5 g
Radium-226 – Drinking Water ¹⁰	EPA 903.1	Drinking Water	P,G	HNO ₃ or HCl to pH < 2	6 months	1000 mL	NA
Radium-226 – Liquids	EPA 903.1 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	500 mL	NA
Radium-226 (Radon emanation) - Solids ⁸	EPA 903.1 Modified	Solid	P,G	None	6 months	NA	0.5 g
Radium-228 – Liquids	EPA 904.0/EPA 9320 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	300 mL	NA
Ra-228 Drinking Water ¹⁰	EPA 904.0/EPA 9320	Drinking Water	P,G	HNO ₃ or HCl to pH < 3	6 months	1000 mL	NA
Radium-228 - Solids ⁸	EPA 904.0/EPA 9320 Modified	Solid	P,G	None	6 months	NA	0.1 g
Radon-222 – Liquids	SM 7500 Rn B	Liquid	G	None, Zero headspace	4 days	40 mL	NA
Selenium-79 – Liquids	NERC ORD	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Selenium-79 - Solids ⁸	NERC ORD	Solid	P,G	None	6 months	NA	0.5 g
Strontium-89/90 – Liquids	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	300 mL	NA
Strontium-89/90 - Drinking Water ¹⁰	EPA 905.0	Drinking Water	P,G	HNO ₃ or HCl to pH < 3	6 months	300 mL	NA
Strontium-89/90 - Solids ⁸	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	Solid	P,G	None	6 months	NA	0.3g
Sulfur-35 - Liquids	NAS-NS-3054	Liquid	P,G	None	6 months	50 mL	NA
Sulfur-35 - Solids ⁸	NAS-NS-3054	Solid	P,G	None	6 months	NA	0.1 g
Technetium-99 – Liquids	DOE EML HASL-300, Tc-02-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	300 mL	NA
Technetium-99 – Solids ⁸	DOE EML HASL-300, Tc-02-RC Modified	Solid	P,G	None	6 months	NA	1.2 g
Thorium – Liquids	DOE EML HASL-300, Th-01-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Thorium - Solids ⁸	DOE EML HASL-300, Th-01-RC Modified	Solid	P,G	None	6 months	NA	0.1 g

Parameter	Method	Matrix	Container ¹	Preservation	Holding Time ²	Water Min. Volume ⁵	Solid Min. Mass ⁵
Total Activity Liquids	GL-RAD-A-041	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	300 mL	NA
Total Activity - Solids ⁸	GL-RAD-A-041	Solid	P,G	None	6 months	NA	0.5 g
Total Alpha Radium – Liquids	EPA 900.1 Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	300 mL	NA
Total Alpha Radium - Drinking Water ¹⁰	EPA 903.0/SW-846 9315	Drinking Water	P,G	HNO ₃ or HCl to pH < 2	6 months	300 mL	NA
Total Alpha Radium - Solids ⁸	EPA 900.1 Modified	Solid	P,G	None	6 months	NA	0.5 g
Tritium – Drinking Water ¹⁰	EPA 906.0	Drinking Water	G	None	6 months	50 mL	NA
Tritium – Liquids & Solids ⁸	EPA 906.0 Modified	Liquid Solid	P,G	None	6 months	50 mL	3 g
Uranium – Liquids	DOE EML HASL-300, U-02-RC Modified	Liquid	P,G	HNO ₃ or HCl to pH < 2	6 months	100 mL	NA
Uranium - Solids ⁸	DOE EML HASL-300, U-02-RC Modified	Solid	P,G	None	6 months	NA	0.1 g

¹ P = Polyethylene; G = Glass

² Samples should be analyzed as soon as possible after collection. The holding times listed are maximum times that samples may be held before analysis and be considered valid.

³ Used only in the presence of residual chlorine.

⁴ Maximum holding time is 24 hours when sulfide is present. All samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If present, remove by adding cadmium nitrate powder until a negative spot test is obtained. Filter sample and add NaOH to pH 12.

⁵ Minimum amounts of sample needed to prepare and analyze for the parameter. Some parameters may be combined into one analysis, others may need additional amount if quality control is being requested for site-specific samples. Please check with GELs Project Manager for proper sample amounts based on project specific requirements.

⁶ Volatiles Groundwater/Wastewater: If samples are to be analyzed for vinyl chloride, styrene, or 2-chloroethylvinyl ether (2-CLEVE) for soil or water, separate samples must be collected without acid preservation and analyzed within 7 days. For aqueous samples to be analyzed for acrolein and acrylonitrile, by EPA Method 624.1, the samples are not to be acidified and must be analyzed within 3 days of collection.

⁷ Solids Method AK101 2-4 oz amber wide-mouth jars tared and labeled, 1-4 oz amber wide-mouth jar labeled (evaporative loss), 2-25 mL 2.5 ppm surrogated P/T methanol tubes.

⁸ Solids matrix typically applies to soils, sludges and sediments. Some tests have been developed for filters, miscellaneous solid waste, plant and animal tissue, also referred to as solids. Contact GEL to verify a particular matrix for the test of interest.

⁹ 1 mL of 2.5% EDTA solution per 100mL sample

¹⁰ Samples preserved with reagents that are not provided by the laboratory must be accompanied by a radioactive free field blank sample that is preserved in the same manner as the submitted sample(s).

APPENDIX B:

Eberline Analytical QA Manual

Eberline Analytical Oak Ridge Laboratory Quality Assurance Program Manual

AUTHORIZATION AND APPROVAL STATEMENT

This **Eberline Analytical** - Oak Ridge Laboratory,
"Quality Assurance Program Manual"
is authorized and approved in its entirety by:



Saba Arnold Seaver
Quality Assurance Manager

Date: August 8, 2016



Michael R. McDougall
Laboratory Manager

Date: August 8, 2016

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MISSION STATEMENT

Our mission is to ensure that all of The Eberline Services, Oak Ridge Laboratory's systems, services, processes, and deliverables are of a quality that meets or exceeds client requirements; and to foster a Laboratory culture in which there is a commitment to a rising standard of quality. This culture demands that the quality of those systems, services, processes, and deliverables and the methods used to achieve that quality be continuously improved.

Quality Assurance is a spirit that pervades all aspects of an organization. It is the quality attitude developed by a quality culture in an organization. It is the spirit in which any organization, procedure or activity is documented, implemented and performed. This spirit produces empowerment and motivation in all employees to achieve the highest level of quality. The result of this attitude is **"Quality Assurance."**

The policy guidelines are presented in this Eberline Analytical Laboratory Quality Assurance Program Manual, and are based on the philosophy and premises that:

- People are our greatest asset and are ultimately responsible for the quality of the items and services we provide. Therefore, each person is treated with the greatest possible respect and consideration.
- Employees are inherently proud and want to produce top quality and on time services and deliverables. In order to do this they must be made aware of the quality requirements that are expected and must be provided appropriate facilities, equipment, and proper training.
- A culture of quality embodied within the entire Eberline Analytical Laboratory organization is the most effective way to provide support for the employee's commitment to quality.
- Management support is paramount, and organizational responsibilities must ensure integration of quality requirements in the day-to-day operations.
- All systems, services, processes, and deliverables can be planned, performed, assessed, and improved.
- Improvements allow operations to become more efficient and result in contractual requirements performed "on time" and done "right the first time."
- Quality improvements lead to reduced costs and allow the ultimate objective of providing the highest quality items and services to be a viable goal.

Quality is our client's perception of us. Our actions must assure our clients that the Oak Ridge Laboratory organization provides for quality systems, services, processes, and deliverables that will meet or exceed their requirements. To this end, each employee must understand and exercise the highest standards of ethics in the performance of their duties and ensure the integrity of the data they report.



STATEMENT OF COMPLIANCE AND MATRIX COMPARISON

This Quality Assurance Program Manual addresses the basic requirements outlined in several regulatory manuals, standards, regulations, and national laboratory programs. Matrix comparison to some of these documents is included in the following pages. Additional regulatory requirements are listed in Section 1.0.

NQA-Quality Assurance Requirements for Nuclear Facility Application
National Environmental Laboratory Accreditation Conference (NELAC), USEPA; 2003, the NELAC Institute (TNI), 2009
USEPA Requirements for the Certification of Laboratories Analyzing Drinking Water; 2005
ISO/IEC 17025: 2005 for the General Requirements for the Competence of Calibration and Testing
DOE Quality Systems for Analytical Services (QSAS) Document
DoD Quality Systems Manual for Environmental Laboratories (DoD QSM)
PJLA Accreditation Compliance Requirements

This manual is organized as follows:

Name, Title, Authorization and Approval
Table of Contents
Mission Statement
Statement of Compliance and Matrix Comparison
Introduction and Description
Organization and Responsibility
Quality Assurance Objectives
Personnel Qualification and Training
Instructions and Procedures
Procurement Document Control
Material Receipt and Control
Material Storage and Control
Control of Process
Preventative Maintenance
Control of Measurement and Test Equipment
Data Reduction, Verification, and Reporting
Document Control
Internal Quality Control
Audits
Quality Assurance and Inspection Records
Corrective Action
Quality Assurance Reports to Management

MATRIX COMPARISON

NQA-1, Cross Reference to Eberline Analytical Laboratory Q.A. Program Manual

NQA-1- Quality Assurance Requirements for Nuclear Facility Applications (<i>Basic Requirements</i>)		Eberline Analytical Laboratory Quality Assurance Program Manual	
BASIC RQMT	TITLE	QAM SECT	TITLE
1.	Organization	2.0	Organization and Responsibility
2.	Quality Assurance Program	3.0 4.0	Quality Assurance Objectives Personnel Indoctrination and Training
3.	Design Control	N/A	Does not apply
4.	Procurement Document Control	6.0	Procurement Document Control
5.	Instructions, Procedures, and Drawings	5.0	Instructions and Procedures
6.	Document Control	13.0	Document Control
7.	Control of Purchased Items and Services	7.0	Material Receipt and Control
8.	Identification and Control of Items	8.0	Material Storage and Control
9.	Control of Process	9.0	Control of Process
10.	Inspection	14.0	Internal Quality Control
11.	Test Control	14.0	Internal Quality Control
12.	Control of Measurement and Test Equipment	11.0	Control of Measurement and Test Equipment
13.	Handling, Storage, and Shipping	8.0	Material Storage and Control
14.	Inspection, Test, and Operating Status	14.0	Internal Quality Control
15.	Control of Nonconforming Items	8.0	Material Storage and Control
16.	Corrective Actions	17.0	Corrective Actions
17.	Quality Assurance Records	16.0	Quality Assurance and Inspection Records
18.	Audits	15.0	Audits
	N/A	N/A	Title Page
	N/A	N/A	Authorization and Approval Statement
	N/A	1.0	Introduction and Description
	N/A	10.0	Preventive Maintenance
	N/A	12.0	Data Reduction, Verification, and Reporting
	N/A	18.0	Quality Assurance Reports to Management

MATRIX COMPARISON

10 CFR Part 50, Appendix B Cross Reference to Eberline Analytical Laboratory Q.A. Program Manual

NRC 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."		Eberline Analytical Laboratory Quality Assurance Program Manual	
Criterion No.	TITLE	QAM SECT	TITLE
I	Organization	2.0	Organization and Responsibility
II	Quality Assurance Program	3.0	Quality Assurance Objectives
III	Design Control	N/A	Does not apply
IV	Procurement Document Control	6.0	Procurement Document Control
V	Instructions Procedures, and Drawings	5.0	Instructions and Procedures
VI	Document Control	13.0	Document Control
VII	Control of Purchased Material, Equipment, and Deliverables	7.0	Material Receipt and Control
VIII	Identification and Control of Materials, Parts, and Components	8.0	Material Storage and Control
IX	Control of Special Process	9.0	Control of Process
X	Inspections	14.0	Internal Quality Control
XI	Test Control	14.0	Internal Quality Control
XII	Control of Measuring and Test Equipment	11.0	Control of Measurement and Test Equipment
XIII	Handling, Storage, and Shipping	8.0	Material Storage and Control
XIV	Inspection, Tests, and Operating Status	14.0	Internal Quality Control
XV	Nonconforming Materials, Parts or Components	7.0	Material Receipt and Control
XVI	Corrective Actions	17.0	Corrective Actions
XVII	Quality Assurance Records	16.0	Quality Assurance Inspection Records
XVIII	Audits	15.0	Audits
		N/A	Title Page
		1.0	Introduction and Description
		10.0	Preventative Maintenance
		12.0	Data Reduction, Verification, and Reporting
		18.0	Quality Assurance Reports to Management

MATRIX COMPARISON

DOE Order 414.1C Cross Reference to Eberline Analytical Laboratory Q.A. Program Manual

DOE Order 414.1 C "Quality Assurance"			Eberline Analytical Laboratory Quality Assurance Program Manual
Criterion No.	TITLE	QAM SECT	TITLE
1.	Program	1.0 2.0 3.0 12.0 13.0	Introduction Organization and Responsibility Quality Assurance Objectives Data Reduction, Verification, and Reporting Document Control
2.	Personnel Training and Qualification	4.0	Personnel Indoctrination and Training
3.	Quality Improvement	17.0	Corrective Actions
4.	Documents and Records	16.0 18.0	Quality Assurance Records Quality Assurance Reports to Management
5.	Work Process	5.0 9.0 10.0 14.0	Instructions and Procedures Control of Process Preventive Maintenance Internal Quality Control
6.	Design	N/A	Does not apply
7.	Procurement	6.0 7.0 8.0	Procurement Document Control Material Receipt and Control Material Storage and Control
8.	Inspection and Acceptance Testing	11.0 14.0 15.0	Control of Measurement and Test Equipment Internal Quality Control Audits
9.	Management Assessment	2.0	Organization and Responsibility
10.	Independent Assessment	15.0	Audits
N/A		N/A	Title Page
N/A		N/A	Authorization and Approval Statement

MATRIX COMPARISON

DoD and DOE Consolidated Quality Systems (QSM) for Environmental Laboratories Cross Reference to
 Eberline Analytical Laboratory QA Program Manual.

This cross reference applies also to NELAC Chapter 5.4.2.3

NELAC Chapter 5 "Quality Systems"		Eberline Analytical Laboratory Quality Assurance Program Manual	
4.2.6 RQMT	TITLE	QAM SECT	TITLE
	Title Page		Title Page
(a)	Policy statement, objectives, commitment by top management	1.0 3.0	Introduction and Description Quality Assurance Objectives
(b)	Organization and Management structure, Org Charts	2.0	Organization and Responsibility
(c)	Relationship between management, technical operations, support services and the quality system	2.0	Organization and Responsibility
(d)	Document control and records retention	16.0	Quality Assurance & Inspection Records
(e)	Job Descriptions	4.0	Personnel Indoctrination and Training
(f)	Approval signatories, signed concurrences	A&A	Authorization and Approval Statement
(g)	Traceability of measurements	14.0	Internal Quality Control
(h)	List of test methods	9.0	Control of Process
(i)	Review for facility and resource availability	9.0	Control of Process
(j)	Calibration or verification test procedures	5.0	Instructions and Procedures
(k)	Procedures for handling submitted samples	9.0	Control of Process
(l)	Major equipment and measurement standards	9.0 11.0	Control of Process Control of Measurement & Test Equipment
(m)	Calibration, verification, & maintenance	11.0	Control of Measurement & Test Equipment
(n)	Inter laboratory comparison, proficiency testing, reference material, internal Q.C.	14.0	Internal Quality Control
(o)	Corrective actions	17.0	Corrective Actions
(p)	Departures from policy/procedures	5.0	Instructions and Procedures
(q)	Complaints	1.0	Introduction and Description
(r)	Confidentiality and Proprietary rights	1.0	Introduction and Description
(s)	Audits and Data reviews	12.0 15.0	Data Reduction, Verification, and Reporting Audits
(t)	Personnel experience and training	4.0	Personnel Indoctrination and Training
(u)	Ethical and legal responsibilities	1.0	Introduction and Description
(v)	Analytical results reporting	12.0	Data Reduction, Verification, and Reporting
(w)	Table of Contents	TOC	Table of Contents

MATRIX COMPARISON

10 CFR Part 830.122 Cross Reference to Eberline Analytical Laboratory Q.A. Program Manual

10CFR 830.122 "Quality Assurance Criteria"			Eberline Analytical Laboratory Quality Assurance Program Manual
Criterion No.	TITLE	QAM SECT	TITLE
830.122 (a)	Management/Program	1.0 2.0	Introduction Organization and Responsibility
(b)	Management/Personnel Training and Qualification	4.0	Personnel Indoctrination and Training
(c)	Management/Quality Improvement	3.0 14.0 17.0	Quality Assurance Objectives Internal Quality Control Corrective Actions
(d)	Management/Documents and Records	5.0 9.0 12.0 13.0 16.0 18.0	Instructions and Procedures Control of Process Data Reduction, Verification, and Reporting Document Control Quality Assurance Records Quality Assurance Reports to Management
(e)	Performance/Work Process	7.0 8.0 10.0 14.0	Material Receipt and Control Material Storage and Control Preventive Maintenance Internal Quality Control
(f)	Performance/Design	N/A	Does not apply
(g)	Performance/Procurement	6.0	Procurement Document Control
(h)	Performance/Inspection and Acceptance Testing	11.0 14.0 15.0	Control of Measurement and Test Equipment Internal Quality Control Audits
(i)	Assessment/Management Assessment	2.0	Organization and Responsibility
(j)	Assessment/Independent Assessment	2.0 15.0	Organization and Responsibility Audits
N/A		N/A	Title Page
N/A		N/A	Authorization and Approval Statement

MATRIX COMPARISON

EPA SW-846 Cross Reference to - Eberline Analytical Laboratory Q.A. Program Manual

EPA SW-846 (Essential Elements)		Eberline Analytical Laboratory Quality Assurance Program Manual	
BASIC RQMT	TITLE	QAM SECT	TITLE
1.	Title Page	N/A	Title Page
2.	Table of Contents	N/A	Table of Contents
3.	Project Description	1.0	Introduction and Description
4.	Project Organization and Responsibility	2.0	Organization and Responsibility
5.	Q.A. Objectives	3.0	Quality Assurance Objectives
6.	Sampling Procedures	N/A	Does not apply to laboratory
7.	Sample Custody	9.0	Control of Process
8.	Calibration Procedures and Frequency	11.0	Control of Measurement and Test Equipment
9.	Analytical Procedures	5.0 9.0	Instructions and Procedures Control of Process
10.	Data Reduction, Validation, and Reporting	12.0	Data Reduction, Verification, and Reporting
11.	Internal Quality Control Checks	14.0	Internal Quality Control
12.	Performance and System Audits	15.0	Audits
13.	Preventive Maintenance	10.0	Preventive Maintenance
14.	Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completion	14.0	Internal Quality Control
15.	Corrective Action	17.0	Corrective Actions
16.	Quality Assurance Reports to Management	18.0	Quality Assurance Reports to Management
N/A		N/A	Authorization and Approval Statement
N/A		4.0	Personnel Indoctrination and Training
N/A		6.0	Procurement Document Control
N/A		7.0	Material Receipt and Control
N/A		8.0	Material Storage and Control
N/A		13.0	Document Control
N/A		16.0	Quality Assurance and Inspection Records

MATRIX COMPARISON

EPA QA/R-5 "EPA Requirements for Quality Assurance Project Plans"

EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans"		Eberline Analytical Laboratory Quality Assurance Program Manual	
RQMT	TITLE	SECT	TITLE
A	Project Management		
A1	Title and Approval Sheet		Title Page Authorization and Approval (A&A) Statement
A2	Table of Contents		Table of Contents Page Headers (document control)
A3	Distribution List		Title Page
A4	Project/Task Organization	1.4 2.1 2.2 2.5	Introduction Organizational Structure Responsibility Organization Charts
A5	Problem Definition/Background	3.0 9.0 14.0	Quality Assurance Objectives Control of Process Internal Quality Control
A6	Project/Task Description	9.0	Control of Process
A7	Quality Objectives and Criteria	3.0	Quality Assurance Objectives
A8	Special Training/Certification	4.0	Personnel Indoctrination and Training
A9	Documents and Records	5.0 9.2 13.0 16.0	Instructions and Procedures Documented Procedures Document Control Quality Assurance and Inspection Records
B	Data Generation and Acquisition		
B1	Sampling Process Design (Experimental Design)	N/A	
B2	Sampling Methods	N/A	
B3	Sample Handling and Custody	14.4	Sample Custody
B4	Analytical Methods	5.0 9.0	Instructions and Procedures Control of Process
B5	Quality Control	14.0	Internal Quality Control
B6	Instrument/Equipment Testing, Inspection, and Maintenance	10.0 11.0	Preventive Maintenance Control of Measurement and Test Equipment
B7	Instrument/Equipment Calibration and Frequency	11.0	Control of Measurement and Test Equipment
B8	Inspection/Acceptance of Supplies and Consumables	7.0 8.0	Material Receipt and Control Material Storage and Control
B9	Non-direct Measurements	10.0	Data Reduction, Verification, and Reporting
B10	Data Management	10.0	Data Reduction, Verification, and Reporting
C	Assessment and Oversight		
C1	Assessments and Response Actions	15.0 17.0	Audits Corrective Action
C2	Reports to Management	18.0	Quality Assurance Reports to Management
D	Data Validation and Usability		
	Data Review, Verification, and Validation	12.0	Data Reduction, Verification, and Reporting



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EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans"		Eberline Analytical Laboratory Quality Assurance Program Manual	
RQMT	TITLE	SECT	TITLE
D1		14.3	Data Verification
D2	Verification and Validation Methods	12.0	Data Reduction, Verification, and Reporting
D3	Reconciliation with User Requirements	12.0	Data Reduction, Verification, and Reporting

1.0 INTRODUCTION AND DESCRIPTION

1.1 PREFACE

Eberline Analytical – Oak Ridge Laboratory is a radiochemistry laboratory that specializes in providing services for radiological assays to the environmental industry. Radionuclides are quantified within materials such as surface water, ground water, drinking water, wastewater, soil, sediment, sludge, vegetation, and hazardous waste. Bioassay (urine) analysis is performed for total uranium. The objective of the laboratory is to produce the highest quality data that are accurate, precise, legally defensible, and meet our clients data needs and requirements in a timely and cost effective manner.

The management of Eberline Services, Oak Ridge Laboratory is committed to a rigorous Quality Assurance (Q.A.) Program. While this commitment is necessary for the normal conduct of business, our basic policies dictate the highest standards of ethics and integrity in the conduct of our affairs. This philosophy and the specific procedures to attain policy objectives from the framework of our Q.A. Program. We will provide only those services that are within our qualifications and with confidence that our Q.A. Program and all related operating procedures dictate reliable performance of those services.

1.2 PURPOSE

This manual outlines management's Q.A. policy and establishes a requirement that procedures be promulgated and implemented to accomplish all of the quality assurance elements necessary to fulfill our responsibility to meet or exceed client or regulatory specifications. It also provides a means for creating mutual understanding regarding our Q.A. program and reliability techniques with our subcontractors, suppliers, and clients. This Eberline Services-Oak Ridge Laboratory Quality Assurance Program provides the structure, policies and responsibilities for the execution of quality control and quality assessment operations to assure that the laboratory meets defined standards of quality.

1.3 SCOPE

This Quality Assurance Program Manual provides guidance to meet operational Q.A. requirements.

In addition to the documents identified in the Cross Reference Section, this Manual complies with applicable requirements of the following the latest revisions of regulations below:

- 1.3.1 NRC 10 CFR Part 21, "Reporting of Defects and Non-compliance."
- 1.3.2 ANSI/ANS-10.3-, "Documentation of Computer Software."
- 1.3.3 NRC Regulatory Guide 4.15, Rev. 1, "Quality Assurance for Radiological Monitoring Programs - Effluent Streams and the Environment."
- 1.3.4 U.S. EPA QA/R-5, "EPA Requirements for Quality Assurance Program Plans."
- 1.3.5 DOE Order 414.1C "Quality Assurance."
- 1.3.6 ISO/IEC 17025:2005, "General Requirements for the Competence of Calibration and Testing Laboratories."
- 1.3.7 USEPA Directive 2185, "Good Automated Laboratory Practices" (GALP).

1.3.8

1.3.9 A National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 "Quality Systems", July 2003.

1.3.10 USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, EPA 815-R-004, January 2005.

1.3.11 DoD/DOE Consolidated Quality Systems Manual for Environmental Laboratories

1.3.12 The NELAC (TNI) Standards, Volume 1 (September 2009)

1.4 INTRODUCTION

Quality assurance, as outlined herein, is a tool that allows management to utilize the expertise and experience of all personnel on the job. It requires each worker to be aware of his/her work environment and to continually evaluate methods and processes to ensure that the best and correct operation is being performed. It requests each employee to identify and suggest any improvement to the processes while performing an operation. Improvements or changes shall be coordinated with management who will validate improvement and disseminate the information to all affected personnel. Management shall also, as needed, change procedures and provide additional training. This program also requires that all personnel be qualified, and trained on a continuing basis to maintain that qualification and be assimilated into the Oak Ridge Laboratory quality culture.

Management will provide resources, tools, equipment, scheduling, and training to ensure personnel can perform their duties effectively.

1.4.1 Management will also ensure that internal assessments are performed annually to evaluate management and processes with feedback for review with a goal of improving all areas of operations.

1.4.2 It is only by having a quality assurance culture, with all personnel involved, that a system, service, or product can be provided with full assurance that the best possible work, the best possible product, or the best possible service has been provided.

1.4.3 In order to ensure that this manual is an effective management tool, subjects that are not normally considered quality assurance, i.e. safety, security, etc., are addressed in other management documents.

1.4.4 The following titled designations of positions are used within the Oak Ridge, TN Laboratory:

Laboratory Manager: Refers to the General Manager of the Oak Ridge Laboratory.

Radiation Safety Officer (RSO): Refers to the RSO of the Oak Ridge Laboratory.

Emergency Coordinator: Refers to the individual who is responsible for overseeing and directing activities and protocols associated with emergencies and disasters..

Project Manager: Refers to an individual who is responsible for client service activities and is the single point of contact with a client for the laboratory.

Supervisor: Refers to individuals within the laboratory who are responsible for the operational functions of a group of personnel.

Q.A. Manager: Refers to the individual who is responsible for the Laboratory's Q.A.

Program.

1.5 DESCRIPTION

This document outlines the organization of the Q.A. functions within the laboratory. It depicts the lines of authority, and lists the duties and responsibilities within the organization. It provides direction for the preparation of Procedures Manuals, which provide the detailed methods of processes and analyses that accomplish the goal of quality data in terms of precision, accuracy and reproducibility.

1.6 CONFIDENTIAL AND PROPRIETARY INFORMATION

Oak Ridge Laboratory employees are exposed to confidential and/or proprietary information pertaining to the company and its clients. Information concerning the report of analysis, radiation dosimetry records, audit reports, calibration reports, and other documents relating to a project are considered confidential. This information is to be released only to the client or to the client's authorized representative. Each employee will sign an agreement with the Oak Ridge, TN Laboratory concerning the security of proprietary and confidential information. A copy of the agreement will be retained in the employee's personnel file (at the corporate office in Albuquerque, NM).

1.7 TECHNICAL COMPLAINTS

Technical complaints will be addressed by the Laboratory Manager, Project Manager, Quality Assurance Manager, or staff member with expertise in the area of complaint. If the complaint is not valid, every attempt will be made to satisfy the client. If the complaint is determined to be valid, the cause of the complaint shall be identified and corrected as soon as feasible. Verification that the cause for a valid complaint has been corrected is the responsibility of the individual addressing the complaint. Details of all technical complaints shall be recorded and maintained in the customer's project file. Clients are also encouraged to provide feedback on the Eberline Analytical website via a statement on each client report.

1.8 ETHICAL AND LEGAL RESPONSIBILITIES

Eberline Services-Oak Ridge Laboratory utilizes a clearly stated ethics policy that is discussed with all new employees during orientation. Each employee is required to understand the high standards of ethics and integrity required in order to perform their duties and to ensure the integrity of the data reported in connection with their employment at the Oak Ridge Laboratory. Each employee will understand that intentionally reporting data that are not the actual values obtained, intentionally reporting dates and/or times or data analyses that are not the actual dates and/or times of analyses, intentionally representing another individual's work as their own; or any other action that may affect the integrity of the data reported by the laboratory; will be the cause for dismissal.

1.9 ACCREDITATIONS

Through applications, pre-qualification, performance testing, and external auditing programs; the laboratory has been granted certification by different agencies, organizations, and states. The Laboratory maintains proficiency as required by the clients and regulatory certifying agency. The Quality Assurance Manager maintains credentials and lists of certifying agencies. The list of certifications maintained by the Oak Ridge Laboratory includes:

State of Tennessee, Department of Health – Laboratory Division

State of California, Department of Public Health – ELAP Branch

State of South Carolina, Dept of Health & Environmental Control, Environmental Lab Certification Program



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State of Utah, Department of Health Bureau of Laboratory Improvement
State of New Jersey, Department of Environmental Protection, Office of Quality Assurance
State of New York, Department of Health, Environmental Lab Approval Program
State of North Dakota, Dept. of Health Environ. Lab. Certification Program - Chemistry Division
State of Nevada, Dept. of Conservation Bureau of water Quality Environmental Lab Services
State of Louisiana, Department of Environmental Quality
State of Texas, Texas Commission of Environmental Quality
State of Alabama, Department of Environmental Management
Commonwealth of Virginia, Dept. of General Services Division of Consolidated Lab Services
State of Washington, Department of Ecology
Perry Johnson Laboratory Accreditation, Inc.
Department of Energy (DOE)
Department of Defense (DoD)

2.0 ORGANIZATION AND RESPONSIBILITY

2.1 ORGANIZATIONAL STRUCTURE

The Laboratory Manager has overall responsibility for this Quality Assurance Program (hereafter referred to as the Program). In this capacity, he has delegated the responsibility for formulation, implementation, and execution of the Program to the Laboratory Q.A. Manager.

Current organizational charts, identifying key individuals and the structure of the laboratory, are included in the "Statement of Qualifications." Additional organizational structure, functional responsibilities, levels of authority, and lines of communication for management, direction, and execution of the Program are documented below.

2.2 RESPONSIBILITY

Laboratory Management will periodically assess the integrated quality assurance program, its performance, and its effectiveness. Problems that hinder the organization from achieving its objectives will be identified and corrected.

Management will provide training and qualification to ensure quality products and services. Every employee is responsible for supporting the QA program policies, procedures, and guidance with each employee being responsible for their work. Professional qualifications and experience of all individuals and positions are maintained. Position descriptions and resumes are kept on file in the QA office. The specific duties of selected personnel are described below. Other job descriptions are located within an employee's training file in the QA office.

2.2.1 Laboratory Manager

The Laboratory Manager, under the authority of the President of Eberline Analytical Corporation, is responsible for the overall laboratory productivity and optimization of the efforts of the analytical staff and those who directly support the analytical effort. Staff interacts with the Lab Manager throughout the day. The Laboratory Manager is responsible for the implementation of regulatory standards, and national program requirements (ISO/IEC 17025:2005, NELAP, TNI, DOE, and DoD). The Laboratory Manager is responsible for directing all aspects of the laboratory operations. The Laboratory also fills the role of purchasing manager by serving as the point of contact for laboratory materials/services purchases by generating and submitting purchase orders for corporate accounting.

The duties of the Laboratory Manager include the following.

- Overall direction and general administration.
- Daily operation of the laboratory.
- Review of analytical procedures and practices.
- Recruitment, hiring, assignment, evaluation and termination of personnel.
- Training and professional development of staff.
- Review of proposals, bids, pricing and quotations.
- Perform an annual assessment of the laboratory operation.
- Ensure compliance with regulatory standards and national program requirements including ISO/IEC 17025:2005, NELAP, TNI, DOE, and DoD.

2.2.2 Quality Assurance Manager

As focal point for QA/QC, the Quality Assurance Manager operates independently from line management while reporting to the Laboratory Manager. The QA Manager has sufficient authority and organizational freedom to identify quality problems, to initiate, recommend or provide

solutions; to verify implementation of solutions, and if necessary, to stop work until the problem is resolved. The QA Manager has independence from cost scheduling, and production considerations. In his capacity, he has the authority to control processing, delivery, installation, or use of items or services until proper disposition of an identified non-conformance, deficiency, or condition adverse to quality. The QA Manager has a direct line of communication to the President of Eberline Analytical Corporation for matters of quality.

The duties and responsibilities of the QA Manager are as follows.

- Develop and implement QA procedures, instructions and plans to maintain and improve quality system.
- Maintain surveillance over all applications of the QA Program; make recommendations for resolution of problems, or further evaluation by management.
- Perform internal audits and monitor external audits; write responses, and ensure corrective actions.
- Issue non-conformances and formal corrective action(s).
- Issue stop-work orders for work that is not in compliance with requirements.
- Direct, and maintain records of analytical performance evaluation programs to ensure full and prompt participation and evaluation of results and derivation of all benefits relating there from.
- Direct, and maintain records of laboratory certification programs.
- Authorized to sign and designate other personnel to sign client related Certificates of conformance and/or non-conformance.
- Ensure compliance with regulatory standards and national program requirements including ISO/IEC 17025:2005, NELAP, TNI, DOE, and DoD.

2.2.3 Project Manager (i.e. Client Services Manager)

The Project Manager reports directly to the Laboratory Manager and is the primary contact for clients requesting information on lab capabilities including pricing and status of projects. The Project Manager manages/oversees client services by communicating client requirements to operations groups, updating clients on progress of samples through the laboratory, and preparing subsequent reports and invoices.

- The duties and responsibilities of the Project Manager are as follows
- Respond to client inquiries with information about services provided in areas of current turnaround times, pricing, sampling information and related matters
- Track the progress of samples through the laboratories and communicates any delays or problems to appropriate personnel/clients
- Technically review orders and contracts for work received
- Ensure compliance with regulatory standards and national program requirements including ISO/IEC 17025, NELAP, TNI, DoD, and DOE.

2.2.4 Health and Safety Manager

The Health and Safety Manager reports directly to the Laboratory Manager and oversees the daily implementation of the laboratory's health and safety program. The program includes an integrated chemical hygiene plan, safety orientation and training, radiation safety plans and training, sample disposal and shipment, and safety checks and audits.

- The duties and responsibilities of the Health and Safety Manager are as follows.
- Administer chemical hygiene, safety, fire extinguisher, etc. training.
- Management of sample disposal in conformance with the waste disposal policy.

- Packaging and shipment of samples, or designation thereof, following DOT regulations.
- Maintain Material Safety Data Sheet (MSDS) documentation.
- Direct spill response.
- Direct safety checks and audits.
- Ensure compliance with regulatory standards and national program requirements including ISO/IEC 17025:2005, NELAP, TNI, DoD, and DOE.

2.2.5 Technical Director

The Technical Director reports directly to the Laboratory Manager and provides technical direction or advice for the laboratory operations and/or special programs, projects, or activities.

- The duties and responsibilities of the Technical Director are as follows.
- Perform technical analysis for specific projects.
- Make recommendations for research and development.
- Certify that personnel with appropriate education and/or technical background perform testing
- Design systems, procedures, and documentation as necessary.
- Assist chemistry supervisors and technicians in technical interpretation of program requirements.
- Monitor the validity of analyses performed and data generated to assure reliable data
- Consult with clients, make recommendations regarding analytical schemes.
- Ensure compliance with regulatory standards and national program requirements including ISO/IEC 17025:2005, NELAP, TNI, DoD, and DOE.

2.2.6 IT Manager (i.e. LIMS Manager)

The IT Manager works under the direction of the Laboratory Manager, and is directly responsible for the maintenance, management, and administration of the LIMS system. In addition to LIMS, the IT Manager also oversees systems, network, and database administration.

- The duties and responsibilities of the IT Manager are as follows.
- Install new software releases and system upgrades
- Configure and maintain organization's network
- Perform systems backups on internal and external web network servers
- Provide help desk support
- Monitor LIMS system configuration to ensure data integrity

2.2.7 Data Review Department Staff

The Data Review Department has been structured to handle the specific project requirements of our clients. The Department is responsible for producing quality control (QC) reports, for ensuring proper assembly of data packages and production of electronic data deliverables (EDDs) that meet the requests of the clients. Data Review personnel, in concert with the QA Manager, will assess the requirements of the various programs and client specific requirements, then interact with the appropriate laboratory personnel to ensure compliance with the client's statement of work. These efforts improve the accuracy and efficiency with which QC reports and data packages are prepared and forwarded to the client. Data deliverables are those items associated with the analyses of samples that are provided to the client.

Data Review staff responsibilities include the following.

- Assuring that analytical data have been correctly entered in the final report.

- Assuring that data are not released without reviews.
- Assuring that all data are released to the correct contact person.
- Producing QC reports.
- Assembling Data Packages.
- Ensuring that submitted EDD are complete, verified and in appropriate format.

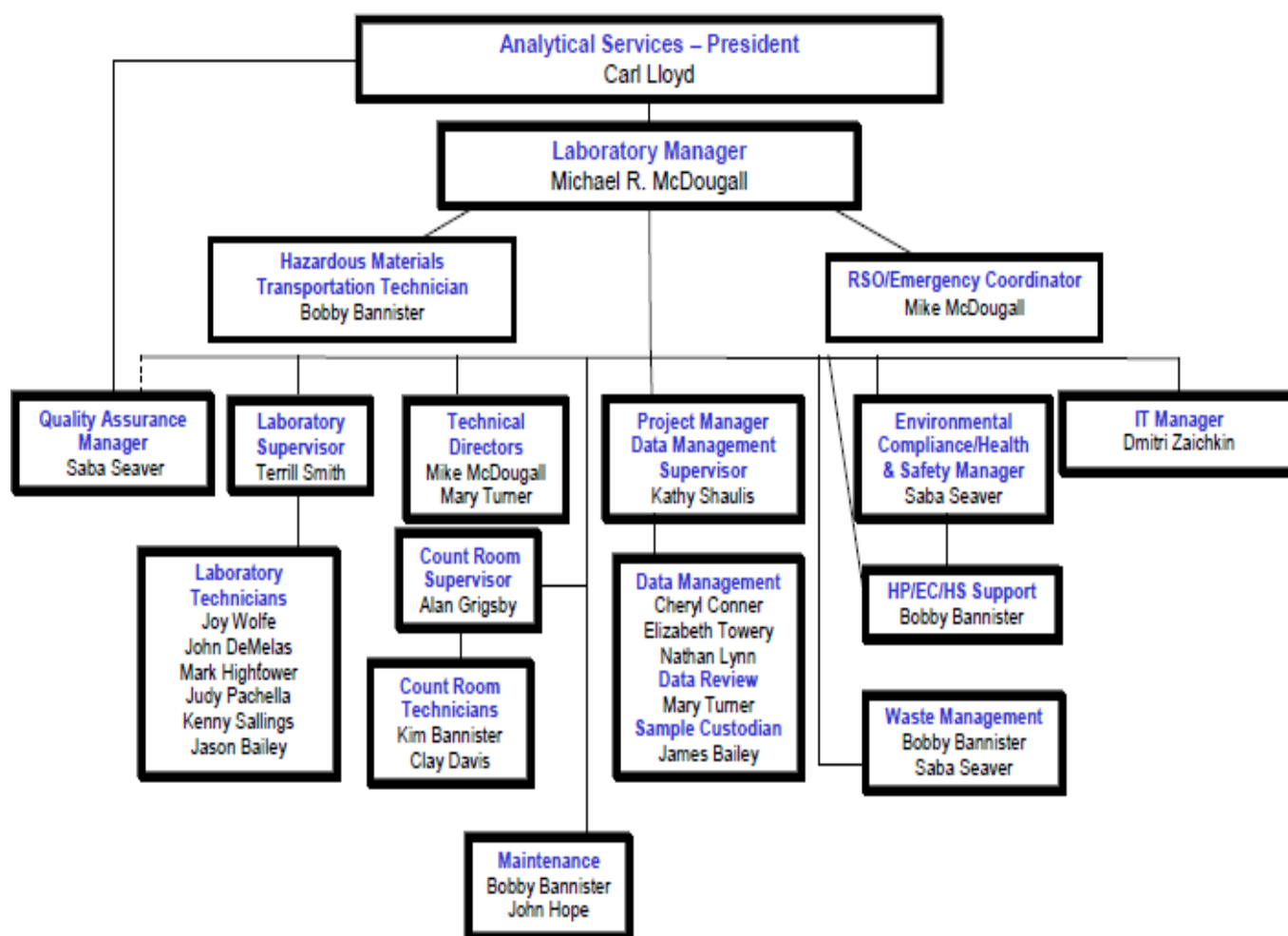
2.3 ASSESSMENT

- 2.3.1 The Laboratory Manager will perform routine and continuous assessment of the management system to identify, correct, and prevent management problems that hinder achievement of the organization's objective. The assessment will focus on broad categories of management issues to determine the effectiveness of the integrated management system.
- 2.3.2 Laboratory Manager's assessments will not be conducted to verify conformance to regulations, product standards, or established procedures, but will evaluate customer and employee perceptions relative to the following key issues.
- Mission and strategic objectives of the organization.
 - Employees' role in the organization.
 - Customers' expectations and degree to which expectations are being met.
 - Opportunities for improving quality and cost effectiveness.
 - Recognizing and enhancing human resource capabilities.
- 2.3.3 Results of the Laboratory Manager's management assessment and recommendations will be documented annually. Decisions and related actions resulting from the recommendations will be properly followed up and evaluated for their effectiveness. Moreover, the opportunity for customer feedback is afforded by means of an on-line customer feedback/satisfaction survey on the laboratory website.

2.4 ORGANIZATION CHARTS

- 2.4.1 The Oak Ridge Laboratory Organization is illustrated in Figure 2.1

Figure 2.1
Eberline Analytical Laboratory Organization



3.0 QUALITY ASSURANCE OBJECTIVES

3.1 OBJECTIVES

The Eberline Analytical Laboratory Q.A. Program is organized to meet the following objectives.

- 3.1.1 To ensure performance of those actions that provide confidence that quality is achieved.
- 3.1.2 To provide an effective control for the verification of characteristics of all systems, services, and processes that produce data of the required quality.
- 3.1.3 To ensure that systems, services, processes, and deliverables meet the rigid quality and reliability standards of the Oak Ridge Laboratory. Also, to ensure that individual client criteria pursuant to these standards are met.
- 3.1.4 To provide a continuing monitoring service for review of operating procedures, and for overall effectiveness and evaluation of the Q.A. Program. Also, to provide observations and recommendations for improvement in all areas of laboratory operations where quality may be affected.
- 3.1.5 To ensure the program provides valid records of the control measures applied to all factors bearing on the result of investigations.
- 3.1.6 To ensure the assessment of results provides feedback to improve the process.
- 3.1.7 To foster a culture of commitment to achieve a rising standard of quality that demands that the methods utilized to achieve the quality systems, services, processes, and deliverables be continuously monitored and improved.

3.2 QUALITY IMPROVEMENT

Operational processes will be reviewed continually by management and employees to detect and prevent problems and to ensure quality improvement. Any item or process that does not meet established requirements will be identified, controlled, and corrected. The cause of problems will be identified with corrections made to prevent recurrence. Item reliability, process implementation, and quality-related information will be reviewed and the data analyzed to identify items and processes needing improvement.

3.3 RESPONSIBILITIES

Employees are an integral part of the organization and are responsible to be aware of their work environment, to review operational processes and materials utilized, to identify any problems, and to make suggestions and recommendations for improvement. Employees are empowered to make and/or recommend corrections to improve operations and to prevent recurrence of the problems. Employees are also empowered, through their supervisor, to stop work where detrimental ethical, contractual, quality, safety, or health conditions exist. Management will immediately be made aware of any situations requiring work stoppage.

All employees are responsible for supporting the Program in principle and in detail and shall retain responsibility for the quality of their work.

Management is responsible to be actively involved in the quality improvement process to ensure proper focus is maintained and for resolution of difficult issues. Management will maintain a "no fault" attitude to encourage employees to identify problems that compromise safety and reliability. Management will consider all recommendations for quality improvement and will recognize employee contributions.

3.4 CORRECTIONS

Items and processes that do not meet established requirements must be identified, documented, analyzed, and resolved. Corrective actions will be implemented and followed up to ensure effectiveness.

No laboratory analytical data will be revised or corrected after reporting to clients without full documentation of the process. The documentation must show: a) what necessitated the change; b) details of the change in terms of re-run records or recalculation; c) approval process for the change; d) formal client notification.

4.0 PERSONNEL QUALIFICATION AND TRAINING

4.1 QUALIFIED PERSONNEL

- 4.1.1 The Oak Ridge Laboratory personnel who perform activities that affect quality will have education, experience and training to ensure that suitable proficiency is achieved and maintained. A job description, identifying position qualification and duty requirements, will be included in each individual's training records.
- 4.1.2 All personnel will have training outlining their ethical and legal responsibilities, including the potential punishment and penalties for improper, unethical, or illegal actions.
- 4.1.3 Personnel performing technical functions or processes will have known and documented related work experience and minimum qualifications of education.

4.2 RESPONSIBILITY

- 4.2.1 Supervisors are responsible for initial evaluation of capabilities and qualifications of assigned personnel and will assign those personnel to perform functions based on the individual's qualifications and abilities.
- 4.2.2 Supervisors and managers are responsible for the day-to-day monitoring of assigned personnel for evidence of unethical, improper, or illegal activities.
- 4.2.3 Appropriate training is the responsibility of the supervisors with support from management. Training will address specific needs and will vary according to each job's requirements and previous experience of the employee, and will ensure:
 - 4.2.3.1 Understanding of the fundamentals of the work and its context,
 - 4.2.3.2 Understanding of the processes and tools being used, the extent and sources of variability in those processes and tools, and the degree to which control over the variability is maintained,
 - 4.2.3.3 Emphasis on correct performance of the work, understanding why quality requirements exist, and potential consequences of improper work, and
 - 4.2.3.4 Emphasis on "doing it right the first time." A particular emphasis is placed on employee safety.
- 4.2.4 Management will provide ALL employees the resources, tools, equipment, scheduling, and structured training to ensure personnel can perform their duties effectively. New employees will receive detailed information concerning the general corporate policies and the specific laboratory safety practices, and security policies. Training shall be conducted on an individual basis to achieve and maintain suitable proficiencies. The training will include, but will not be limited to:
 - Ethical and Legal responsibilities
 - Health and Safety
 - Radiation Protection
 - Waste Management
 - Quality Assurance
 - Laboratory Procedures
 - LIMS Operation

- 4.2.5 Access to all laboratory documents and procedures will be available at all times to all employees who will be expected to familiarize themselves with these documents.
- 4.2.6 Milestone achievements or unique training will be noted by the supervisors via entry in the training records. Available certificates of training, education, or awards will also be maintained with the individual's training records.
- 4.2.7 Supervisors will monitor individual work habits to ensure proficiency is maintained, to note progressive improvement, and to identify any needed supportive training. Additional training requirements will be developed by the individual's supervisor.
- 4.2.8 As needed, employees will be informed of the requirements of special clients/programs necessary to achieve their duties and responsibilities. Familiarization will be made a matter of record.
- 4.2.9 All personnel training records will be maintained in the QA office. The details for maintenance of training requirements and records are outlined in the Oak Ridge Laboratory Management Procedure, MP-042 "Personnel Training."

5.0 INSTRUCTIONS AND PROCEDURES

5.1 POLICY

Eberline Analytical Laboratory policy uses written and approved procedures for routine activities and for analytical and operational processes. Applicable Laboratory procedures are available to all personnel. The most current revision of the appropriate procedure will be maintained and documented on the laboratory computer server. Departures from routine procedures due to non-standard situations or specific requests from clients will be approved by management and fully documented.

In addition to analytical procedures (AP) the laboratory maintains Management Procedures (MP) that describe the policy and approach for performing quality functions. Separate procedures for Health and Safety, Radiation Protection and Waste Management, are also maintained.

5.1.1 ANALYTICAL PROCEDURES

Analytical procedures are descriptions of particular protocols for testing or operations. Analytical procedures will be developed based on published reference procedures for each test or process, and authorized for use by the Laboratory Manager.

5.1.2 Qualification requirements for personnel performing operations and criteria used to determine the proficiency of the operator will be documented.

5.1.3 Each technical procedure will include a list of Personal Protective Equipment (PPE) required for the operation being performed. Training for the identification, operation, use, limitations, and disposal of the PPE will be conducted.

5.1.4 Each technical procedure will identify any chemicals/reagents required for completion of the operation. Material Safety Data Sheets (MSDSs) for those chemicals/reagents will be readily available, and training applicable to the MSDSs will be conducted.

5.1.5 Training will be conducted to the procedures used for processing wastes generated within the appropriate chemistry laboratory.

5.2 PROCEDURE MANUALS

Procedure manuals consist of the individual analytical procedures for a laboratory area or for an operation combined into one document. The procedures within the manual define all parameters of the operations being performed to include required accuracy and completeness of specific measurement parameters involved. Procedures will be incorporated into procedure manuals. Signature on the Authorization and Approval page applies to all procedures in the manual.

5.3 FORMAT AND DISTRIBUTION

5.3.1 Procedures will comply with the format prescribed in the laboratory management procedure (MP-004, Preparation and Modification of Procedures and Guidance Documents) and will be approved by the QA Manager and the Laboratory Manager.

5.3.2 Employee access to the most current revision of procedures and manuals will be through the Laboratory computer server. Any distribution of controlled copies of any Laboratory procedure will be in accordance with the laboratory's document control protocol.

5.3.3 The Laboratory Manager is responsible for the maintenance and security of the original electronic version of all laboratory procedures and manuals and for ensuring that the most current revision of the procedures and manuals are promptly posted and accessible to all employees.

5.4 REVIEW

Laboratory technical procedure, manuals and Quality Assurance Plan will be reviewed annually and whenever program or procedural changes occur with updates as appropriate. Such reviews will be documented. All effected laboratory personnel and document holders will be made aware of any changes. Training of laboratory personnel on new changes will be conducted as necessary.

5.5 REVISION

- 5.5.1 The appropriate supervisor, or designated representative, is responsible for revisions or changes to the applicable procedure manuals.
- 5.5.2 Revisions are reviewed and approved by the organization(s) and personnel responsible for the original document. When possible, revisions or changes will be accomplished on a page replacement basis.
- 5.5.3 The Q.A. Manager will be advised of any changes in procedures required to satisfy specifications of the client.
- 5.5.4 The final revision shall be reviewed, approved, and authorized by the Laboratory Manager and Q.A. Manager. The electronic copy is placed on the laboratory server for access.
- 5.5.5 The Q.A. Manager will be responsible for the electronic retention of past revised and superseded procedures. The Q.A. Manager will also be responsible for maintaining the server location where current revisions are stored for employee reference.

6.0 PROCUREMENT DOCUMENT CONTROL

6.1 PURCHASING

Procurement of material, components, supplies, reagents, equipment, and services necessary to carry on the business interests of Eberline Analytical Laboratory is initiated by purchase requisition and controlled by the use of an authorized purchase order number. To the extent necessary, purchase orders will require suppliers to have a Q.A. program consistent with the requirements of this document. Detailed information on procurement is outlined in MP-033 "Procurement of Quality Related Items/Services".

6.2 PURCHASE REQUISITION REVIEW

Purchase requisitions or change orders are reviewed by purchasing department personnel to ensure conformance to the procurement requirements. As applicable, quality related requisitions are reviewed by Q.A. personnel prior to being processed. Change orders undergo the same review process.

6.3 CERTIFICATION/CERTIFICATE OF CONFORMANCE

All materials and processes requiring certification and certificates of conformance are identified on the face of the purchase requisition. Adequate information is provided to ensure supplier compliance to the required specifications. The Q.A. Manager is responsible for the retention, filing, and recall of material certification or certificates of conformance.

6.4 SUBCONTRACTS

When subcontracting analytical work, Eberline Analytical Laboratory Management will ensure that the subcontractor can meet all the technical specification, maintain the appropriate certification (NELAP, DOE, DoD, State) and that the prospective subcontractor has a QA program consistent with the requirements of this document. The Oak Ridge Management will secure the client approval for subcontracting their analytical work prior to commencement of the subcontract. The Q.A. Manager is responsible for evaluation and acceptance of the subcontractor's Q.A. program.

6.5 VENDORS

- 6.5.1 For procurement of quality-related items or services, the Q.A. Manager is responsible for vendor evaluation and approval. Analytical service vendor evaluation and qualification will be through accreditation as a secondary standard calibration laboratory (NVLAP, NIST); an audit by Oak Ridge Laboratory personnel or an acceptable audit agency; or facility inspection, test reports, or receipt inspections, when the quality of the materials or service can be verified by these methods. Documentary evidence that products and services conform to procurement requirements will be provided and retained. A list of approved vendors will be maintained by the Procurement Office.
- 6.5.2 The effectiveness of the control of quality by contractors and subcontractors will be assessed at intervals consistent with the importance, complexity, and quantity of the product or services.
- 6.5.3 The purchasing department is responsible for maintaining a record of quality related materials received from vendors including any reports for non-conforming material.

6.6 QUALITY RELATED SERVICES

Q.A. personnel will review the purchase requisitions for quality related services. Those services that are determined to be quality related will include, as applicable, a statement, or wording, in the body of the purchase order or by attachment identifying the applicable requirement.

7.0 MATERIAL RECEIPT AND CONTROL

7.1 POLICY

Only material components, supplies, reagents or standards with acceptable quality characteristics and from qualified vendors will be allowed into the laboratory.

7.2 RESPONSIBILITY

Receipt and initial verification of all materials and equipment received by the Oak Ridge Laboratory, either purchased or contract (client) supplied, is the responsibility of the receiving or designated individual. Technical verification for materials and equipment will be performed by the requisitioner or Q.A. Manager, whichever is applicable. Quality related purchase order items will be receipt inspected by Q.A. personnel.

7.3 MATERIAL CONTROL

Purchased material is controlled by the Laboratory Supervisor or designated individual.

7.3.1 The receiving and stock control clerk, or designated individual, is responsible for the expedient and correct routing of all initially accepted received materials to stock, or to the requisitioner.

7.3.2 Purchasing department personnel are responsible for maintaining a record of materials received from vendors, including Rejected Material Report or equivalent form, for any non-conforming material.

7.4 NON-CONFORMING MATERIAL

When received material, affecting quality, has been determined to be non-conforming, the requisitioner will work with the purchasing agent and will be responsible for proper processing.

7.5 RECORDS

Records of receipt of services and supplies that affect the quality of laboratory operation will be identified with date of receipt, expiration date, source, lot or serial identifier, and calibration or certification records as appropriate.

8.0 MATERIAL STORAGE AND CONTROL

8.1 POLICY

All materials and supplies in storage will have the necessary protection to preclude deterioration, corrosion, or damage during storage life and will carry identification sufficiently clear to ensure that only those materials specified by process instructions will be withdrawn from material storage and issued for processing.

Only analytical grade chemicals and reagents, bearing such grade identification will be utilized by the Laboratory. Each container will be assigned a unique identification number upon receipt. The date of receipt will be posted on each container. The use and the retention (shelf life) of such chemical will be monitored by the Laboratory Supervisor.

All standards used by the Laboratory must be NIST certified. Each standard must be accompanied with a certificate showing the name, composition, concentration, reference number and NIST Certification. The use and distribution of these standards will be monitored by the LIMS. The certificate and certification documents of standards will be controlled by the QA department.

8.2 RESPONSIBILITY

Only authorized personnel will have access to, and the responsibility for, control and issue of materials or supplies. Materials and supplies will be stored to allow for ready identification. Care will be taken to preclude mixing of rejected material and supplies with those that are qualified for issue.

9.0 CONTROL OF PROCESS

9.1 STANDARD PRACTICES

Standard practices applicable to services provided by the Oak Ridge Laboratory are contained in documented procedures and this Q.A. Program Manual. Every effort is made to implement and fulfill the requirements of Federal and local laws, rules, guidance(s), and directives as may be applicable to the operational practices within the Oak Ridge Laboratory. These may include but are not limited to:

- 9.1.1 Federal and State rules and regulations.
- 9.1.2 Consensus standards related to the services performed (e.g., American National Standards Institute).
- 9.1.3 Regulatory Guides published by the Nuclear Regulatory Commission, Department of Energy, the Environmental Protection Agency, and the Department of Defense.
- 9.1.4 Specific contractual agreements with clients.
- 9.1.5 Where conflicts may occur among any of the above items, the client will be notified and requested to specify the practice to be followed.

9.2 DOCUMENTED PROCEDURES

Routine analytical operating procedures are documented. Each laboratory procedure includes quality control criteria that are applicable to that process. The laboratory management will develop, promulgate, and implement procedures that document the operations performed in the laboratory. Additionally, the following general procedures or documents, as applicable, will be developed:

- 9.2.1 Quality Assurance Procedures
- 9.2.2 Radiation Safety Manual and Procedures
- 9.2.3 Sample Control Procedures
- 9.2.4 Purchasing Policies and Procedures
- 9.2.5 Data Review Procedures
- 9.2.6 Environmental Compliance Procedures
- 9.2.7 Safety Procedures
- 9.2.8 Chemical Hygiene Plan
- 9.2.9 Hazard Communications Program
- 9.2.10 LIMS Procedures
- 9.2.11 Management Procedures
- 9.2.12 Analytical Procedures

9.3 RESPONSIBILITY

The Laboratory Manager, or designated representative, determines which instructions or procedures require quantitative or qualitative acceptance criteria and specify the appropriate criteria on special contracts or projects.

9.4 WORK POLICY

All work to be performed by the Oak Ridge Laboratory on client samples is authorized by the client and controlled through a Laboratory Information Management System (LIMS) work order document which incorporates the client's requirements. (Or by some other document deemed necessary by the Laboratory Manager or Project Manager as directed by the customer)

- 9.4.1 The work order specifies those analyses necessary to assure compliance with contractual obligations.
- 9.4.2 The Project Manager or designated personnel –under the authority of the Laboratory Manager, are responsible for notifying the Q.A. Manager and performing laboratory departments, through the appropriate supervisor, of all contract requirements including reporting format and quality control criteria. This may be done by reference to other documents (e.g., Purchase Order, statement of work, technical specifications, etc.) that delineates the contract requirements.
- 9.4.3 The Project Manager or designee –under the authority of the Laboratory Manager-, will ensure planning, scheduling, and resources are considered when contracting for or accepting work.
- 9.4.4 When subcontracting analytical services, the Project Manager or designated individual under the authority of the Laboratory manager-, will assure that:
 - The client is notified in writing of the intention to subcontract any portion of the testing to another party.
 - If the work is covered under NELAP, the work will be placed with a laboratory accredited under NELAP for the tests to be performed.
 - Records, demonstrating that the above requirements have been met, are retained in the project folder.

10.0 PREVENTIVE MAINTENANCE**10.1 POLICY**

Preventive maintenance is performed as required on instrumentation and equipment to prevent down time and to ensure reliable performance. The laboratories maintain instrument redundancy that precludes the requirement for a repair and maintenance capability for instrumentation. Maintenance and/or repair of equipment are performed by the equipment manufacturer or authorized representative under contract or purchase order.

10.2 MAINTENANCE

Preventive maintenance procedures will be developed for use where instructions are not provided in the manufacturer supplied operator's manual. As applicable, each department will maintain a major equipment and measurement standards list. A record of instrument maintenance, calibration, and repair, if applicable, will also be maintained. The supervisors and operating personnel are responsible for complying with the department maintenance schedule.

10.3 SPARE PARTS

Supervisors will ensure that an adequate inventory of spare parts and consumables is requisitioned and maintained for instrumentation in their area in order to prevent down time or compromise operating conditions.

11.0 CONTROL OF MEASUREMENT AND TEST EQUIPMENT**11.1 MEASUREMENT AND TEST EQUIPMENT CALIBRATION POLICY**

This section establishes the controls and calibration requirements for all analytical and nuclear measurement equipment. An equipment list will be maintained indicating calibration status.

- 11.1.1 All equipment whose operation and function directly affect the quality of service will be inspected/calibrated at established intervals. As applicable, equipment will be suitably identified to reflect calibration status. If an instrument is determined to be out-of-tolerance, it will be segregated, or otherwise clearly identified as inoperable. Records of each calibration will be kept in appropriate logbooks or files. Instruments whose calibrations are performed during method operations are calibrated and controlled in accordance with the method requirements. Run logs will be maintained for this category of instrumentation.
- 11.1.2 The equipment used to determine the quality characteristics and accuracy of instruments will be checked and verified either internally (dependent upon capability), or by qualified calibration services.
- 11.1.3 Frequency of inspection/calibration will be based on use of the equipment or instrument, environmental conditions in which it is used, its inherent stability, manufacturer's recommendation, and the wear or deterioration resulting from its use.
- 11.1.4 Certified standards are used for all primary calibrations. National Institute of Standards and Technology (NIST) or NIST traceable, Environmental Protection Agency (EPA), New Brunswick Laboratory (NBL), or Department of Energy (DOE) standards are used, when available, for the primary calibrations or verification of primary calibrations.
- 11.1.5 All preparations of standard solutions are recorded in a standards preparation logbook or file. Identities of standards are such that a secondary standard or dilution can be traced, through subsequent actions, back to the initial certification. Records of these reference standards are organized in a secure location in the QA office.
- 11.1.6 Quality control check standards are used to record instrument sensitivity and linearity and to verify proper response. Methods and calibration entries are dated, initialed, and documented by the analyst.
- 11.1.7 Measuring and test equipment are tagged as to calibration or operating status for periodic processes performed on a scheduled interval of greater than one month. For processes performed more frequently, separate documentation will be available for verification of operational status. Instruments that are too small to be tagged or are subject to a wide variety of calibrations shall have separate documentation of status available.

11.2 RESPONSIBILITY

Testing and/or calibration of equipment and instruments will be performed under the direction of the supervisor, the department manager, or the operations manager and performed under suitable environmental conditions.

11.3 PROCEDURES

All tests and calibrations will be performed in accordance with written procedures that contain provisions for ensuring that all prerequisites for the given test have been met, including appropriate equipment to be used.

11.4 CERTIFICATION AND CERTIFICATES OF CALIBRATION

- 11.4.1 To the extent possible, calibration will be traceable to NIST. Records of traceability will be maintained along with records of routine calibrations of each instrument or measurement system. Where no NIST traceability exists, the basis used for calibration will be documented.
- 11.4.2 Equipment records will be maintained to indicate past and current status, and to provide reproducibility and traceability of results.

11.5 RADIOACTIVE SOURCE CALIBRATION

Radioactive sources used as calibration standards will be periodically calibrated and controlled. Current calibration certificates will be kept on file.

11.6 CALIBRATION RECORDS

Supervisors will ensure that calibration data for instruments and radioactive sources is recorded in the instrument logbook, on data work sheets, on computer files and/or control charts. When required, new calibration charts will be prepared when there is measurable change in calibration effect on instruments that have been calibrated. If an instrument is determined to be out of tolerance, it will be segregated or otherwise clearly tagged as inoperable and not used until repaired.

11.7 REPORTS GENERATED FROM USE OF A DEFICIENT INSTRUMENT

If a major deficiency in an instrument or device is detected during periodic calibration procedures, the technician will immediately notify the supervisor, the operations manager, and the Q.A. Manager. A conference will immediately be scheduled to investigate and decide what corrective action is to be taken on past data and reports resulting from the use of the deficient instrument or device. A record of corrective actions will be maintained.

11.8 PERFORMANCE CHECKS OF RADIATION SCREENING INSTRUMENTS

Performance checks will be made to ensure the continuing capability of radiation screening instruments. Procedures will include efficiency checks and background determinations. The procedure and frequency of each check is optimized for each detector system to provide assurance of the detector's performance. Documentation of the checks and the results are kept for all operations.

12.0 DATA REDUCTION, VERIFICATION, AND REPORTING**12.1 USE OF COMPUTER HARDWARE AND SOFTWARE**

Computer programs used in the production or support of client data are either purchased, or developed using approved development methodology. Such programs are independently validated, verified, and documented. Changes are controlled to assess the potential impact of the change on the performance of the program.

12.2 DATA REDUCTION AND VERIFICATION

Sample receipt and distribution through the laboratory is documented by the Sample Custodian. Sample handling, subsampling, and preparation for counting measurement are documented by the laboratory technicians.

12.2.1 The successful completion of an analysis is monitored by the Counting Room staff. The Laboratory Manager, or designated individual, performs the final review and approves the data.

12.2.2 Calculation methods, transcriptions, and data flow, plus times and locations of the various tiers of review are detailed in the specific procedure.

12.3 REPORTING

The Project Manager or designated individual is responsible for providing the client with the required analytical results. Reports to clients will be reviewed for accuracy and completeness and, where required, analytical methods and minimum/method detection limits (MDL) will be reported. Laboratory reports of analyses will be signed by an authorized individual who, along with the person who signed the data sheets, can attest to the fact that the data was generated in accordance with established procedures.

13.0 DOCUMENT CONTROL**13.1 POLICY**

The primary formal communication methods within the Oak Ridge Laboratory departments are documents that inform or direct activities affecting purchasing, sample analyses and reporting, instrument calibration and/or testing, radiation controls, proper handling of wastes, radiation safety, and Health and Safety. These documents are controlled by the Q.A. Program Manual, Operating Procedure Manuals, other documented procedures, or by interoffice memoranda. Drawings and specifications are not controlled as separate documents but are included in controlled procedures where applicable. The QA Office controls logbooks used to document the analysis of samples (see MP-023, Documentation of Analytical Laboratory Notebooks).

13.2 RESPONSIBILITY

13.2.1 The Q.A. Manager is primarily responsible for maintaining files of all controlled documents and will:

- Review the Quality Assurance Program Manual and provide recommendations for updating.
- Ensure that all holders of controlled documents receive updates to the documents.
- Maintain files of controlled document distribution indicating document title, number, revision number, assigned date, and the name of the individual to whom the document is assigned.
- Forward revisions of controlled documents to assigned individuals. An acknowledgment form will accompany each document revision for verification of receipt and to provide disposition instructions for the superseded pages
- Maintain a Master List of current procedures which includes procedure number, procedure title, current revision number, and date on which the current revision became effective. The list will be continually updated to reflect all new revisions or new procedures issued. An electronic copy of this list shall be available for employee reference at all times.

13.2.2 Uncontrolled copies of controlled documents will be distributed only if marked "Uncontrolled."

13.2.3 Superseded and/or obsolete documents are isolated from use or destroyed. Upon training to new revisions, employees sign to verify the destruction of all uncontrolled copies of obsolete revisions.

13.2.4 Each employee is responsible for requesting revisions or changes to operating procedures for their area of responsibility.

13.2.5 The Q.A. Manager will be advised of any changes in procedures required to satisfy client specific requirements.

13.2.6 Client information and records such as contract requirements, project descriptions, analytical data and results submitted to the client; and all laboratory records associated with such submittal will be maintained by the laboratory for a minimum of 5 (Five) years. Clients will be contacted and queried for disposition instructions for their related documentation.

13.2.7 If or when the laboratory may transfer ownership, is decommissioned, or goes out of business, ALL clients will be notified and asked to provide specific direction regarding the transfer or disposition of documents and records related to their project(s).

14.0 INTERNAL QUALITY CONTROL

14.1 LABORATORY ANALYTICAL SERVICES

Precautions are taken in the chemistry laboratories to avoid cross-contamination of samples and to ensure the reporting of accurate results. Quality control samples are analyzed along with routine samples to indicate when results may be in error due to improper operation or calibration of equipment, inadequate training of personnel, a deficiency in the procedure, or cross-contamination from other samples.

- 14.1.1 Laboratory Precision - Laboratory management personnel are responsible to ensure that analytical results are reproduced internally within acceptable limits.
- 14.1.2 Precision and Accuracy - Replicate standards and/or samples are used to estimate the precision of each analytical test procedure for a known matrix. Data control limits are established to satisfy the requirements of specific measurements based on prior knowledge of the measurement system and method validation studies. Certified standards and/or spiked samples are used to estimate chemical recovery and accuracy for these procedures for known matrices.
- 14.1.3 Calibration and Performance Checks of Nuclear Measurement Systems - Reference standards are used for calibrating nuclear measurement systems. In addition to calibration of all instrumentation, routine monitoring is performed to ensure the continuing integrity of the instrument performance. All quality control samples utilized to verify acceptability of instrument calibrations shall be prepared from a source independent of reference standards used for calibrating. This per batch laboratory control sample continually confirms the integrity of the calibration, thus fulfilling the requirements of initial calibration verification (ICV). Additional monitoring parameters performed include efficiency checks, background determinations, and energy calibrations. The procedure and frequency of each check is optimized for each detector system to provide assurance of the detector's performance. Documentation of the checks and the results are kept for all systems. The supervisor is responsible for these calibration and performance checks.
- 14.1.4 Duplicate Analysis - Duplicate aliquots of randomly selected samples will be processed on a routine basis. The analyst will always process samples in accordance within approved operating procedures. The evaluation of the duplicate analysis will be based on examination of the difference between the duplicates. A statistical analysis of the data may be performed when a cursory evaluation indicates problems with the results. If the two results agree within the three standard deviation limits, a more detailed evaluation will generally not be necessary. Results of duplicate analyses will be included in the monthly Q.C./Q.A. report.
- 14.1.5 Detection and Elimination of Bias - Where possible, calibration will be with standards that are traceable to NIST. However, traceability to NIST is not always possible and reliance on other suppliers may be necessary (e.g., International Atomic Energy Agency, U.S. Department of Energy, U.S. Environmental Protection Agency, or commercial supplier such as Analytics, Amersham Biosciences, AEA Technology, etc.). Standards in the appropriate geometry or form will be used to determine efficiency of instruments on a periodic basis. In the calibration process, the ideal standard will be a known quantity of the radionuclide to be measured, prepared in exactly the same geometry as the samples and counted under the same conditions. In this way, factors such as self-absorption, backscatter, sample geometry, and detector efficiency will be accounted for empirically.

- 14.1.6 Spiked Samples - A known quantity of calibrated radioactive standard solution will be added to an aliquot of the sample or to a "blank" sample for replicate analysis. When the entire analytical system is operating properly, the laboratory record will demonstrate the accuracy and precision of the data. Divergent data from the spiked sample will point out problem areas. If the data is consistently higher or lower than the known value, bias in the analytical procedure is indicated. This may require a search for personnel errors, re-standardization of carriers or tracers, and/or recalibration of counting equipment.
- 14.1.7 Background Determination - The type of equipment and environmental factors contribute to variation in the counting rate of instrument background. The background of each system instrument will be determined and recorded with sufficient frequency to provide a firm statistical basis for that measurement and to ensure response to potential instrument problems or other artifacts such as controlled contamination.
- 14.1.8 These background determinations will include use of the items that most closely duplicate the analytical configuration in type, geometry, and with any associated fixtures. In some cases, true blanks are not available, but the closest practicable analog is used.
- 14.1.9 Some systems are sufficiently stable to require no change in backgrounds used for data reduction (e.g., uranium daughter gamma-rays found in gamma spectra due to adjacent building materials and earth). In this case, backgrounds will be compared to historical data to insure sufficient stability. Other systems experience enough variability to require computed backgrounds based upon running averages.
- 14.1.10 Background data will be recorded in the logbook or computer file for that specific instrument along with calibration data and instrument maintenance records.
- 14.1.11 Blanks - Blank samples are routinely analyzed to verify control of contamination and process. Results of processed blanks will be included in the monthly Q.C./Q.A. report.
- 14.1.12 Collaborative Testing - The Oak Ridge Laboratory participates in collaborative testing or inter-laboratory comparison programs. Natural or synthetic samples prepared to contain known concentrations of certain radionuclides are sent to participating laboratories by an independent referee group such as the DOE Radiological and Environmental Sciences Laboratory DOE, Idaho Falls, Idaho (MAPEP); by a NELAC approved provider such as the Environmental Resources Agency (ERA), Environmental Measurements Laboratory (EML), or by customer(s).

These programs enable Oak Ridge Laboratory personnel to document the precision and accuracy of radioactivity measurements, identify instrumental and procedural problems, and compare performance with other laboratories.

14.2 QUALITY CONTROL AND DATA REPORTS

14.2.1 Quality Control Reports

Quality control results will be summarized, and include with every sample/group of samples.

14.2.2 Data Reports

Routine performance requires documentation of all pertinent information with the basic documents dated and initialed or signed. Required documentation will be the initial work order, Chain-of-Custody (CoC), or document that records all pertinent information such as the identity of the sample and analyses to be performed. The data report will include technical analysis notes, logbooks, work sheets all raw data and other information used in performing the analysis. The report of analysis will be the final report of the data to the client and is issued in accordance with the laboratory's procedure for review and processing, as well as any client specific requirements.

14.3 DATA VERIFICATION

Routine performance requires inclusion of all pertinent information with basic documents dated and initialed or signed. The work order has recorded such information as the identity of the samples and analyses to be performed. All raw data and other information used in performing the analyses are documented.

14.3.1 Electronic Deliverables Verification - Project managers, or designated individuals, are responsible for ensuring that electronic deliverables are complete and accurate.

14.4 Sample Custody

Samples are assigned a unique laboratory identification number, marked on a label that is applied directly to the container and which identifies the work order and laboratory fraction. Sample control personnel are designated sample custodians for strict (legally defensible) CoC samples. Locked buildings, refrigerators, freezers, and cabinets are available for CoC samples. Sample custody forms or technician analysis notes are used for tracking all samples through the analytical process. Details for radiological survey of samples, sample security, sample disposal, etc. are outlined in approved Sample Control Procedures. Sample chemistry and nuclear counting requirements are assigned by the Laboratory Manager, or designated individuals.

15.0 AUDITS

15.1 POLICY

Eberline Analytical Laboratory has established a comprehensive system of planned and documented audits to verify compliance with all aspects of the Q.A. Program. An audit is defined as a documented activity performed in accordance with written procedures or checklists to verify, by examination and evaluation of objective evidence, that applicable elements of the Q.A. Program have been developed and effectively implemented in accordance with specific requirements. Audits will be performed by persons not having direct responsibility for those areas being audited.

15.1.1 Customer Access to the Eberline Analytical Laboratory Facilities and Personnel - The client is frequently responsible for auditing the Oak Ridge Laboratory's performance relative to contractual requirements. The exact nature of this responsibility is relative to the nature of the regulatory or licensing requirements, the significance of the services, and the technical expertise available or inherent within the client's organization. The need for, and frequency of, client audits is dependent upon the above factors. A client may authorize an independent agency to perform an audit on its behalf. When possible, the facilities, equipment, and records (proprietary information excluded) of Eberline Analytical Laboratory will be made available for client inspection along with the necessary personnel to permit verification of quality characteristics.

15.1.2 The Q.A. Manager will coordinate and participate in audits conducted by the client or the client's representative.

15.1.3 Internal Audits - The Q.A. Manager will audit the laboratory operations to verify compliance with established procedures and requirements set forth in the Q.A. Program Manual. Use of a checklist will insure items in compliance are noted as well as any requirements for improvement.

15.1.4 External Audits - External audits of organizations providing services to the Analytical Services Group are scheduled at a frequency commensurate with the status and importance of the activity.

15.2 RESPONSIBILITY

Audits will be directed by the Q.A. Manager with assistance from designated personnel.

15.2.1 The Q.A. Manager will be responsible for an independent quality assurance audit of each department.

15.2.2 The Q.A. Manager will be responsible for assuring that audits are performed by knowledgeable professionals.

15.3 DOCUMENTATION

Audit results will be documented by the Q.A. Manager.

15.3.1 The Laboratory Manager shall be provided a copy of the audit report.

15.3.2 The QA Manager will determine if there are any corrective actions required and the individual responsible for implementing the corrective action

15.4 DEFICIENT AREAS

15.4.1 The responsible Manager will ensure correction of the identified deficiencies.

- 15.4.2 The Q.A. Manager will verify that action is taken to correct any deficiency and will take follow-up action to ensure that corrections have been completed.
- 15.4.3 The Q.A. Manager will ensure close out, with documentation, of the audit after corrective actions have been completed.
- 15.4.4 For uncorrected or unresolved deficiencies, after due diligence, the Q.A. Manager will petition the Laboratory Manager to bring to bear his authority for resolution of the deficiencies.

15.5 FREQUENCY OF AUDITS

The Q.A. Manager will ensure internal audits are conducted on an annual basis. Additional selective audits will be conducted when one or more of the following conditions exist:

- 15.5.1 When significant changes are made in functional areas of the Q.A. Program, including significant reorganization or procedure revisions.
- 15.5.2 When assessment of the Program's effectiveness is considered necessary.

16.0 QUALITY ASSURANCE AND INSPECTION RECORDS

16.1 POLICY

Records that provide objective evidence of the quality of work are generated and maintained. These records include controlled logbooks, customer instructions, sample analyses data sheets, and results of reviews, inspections, tests, audits, corrective actions, reports, and training records. Also included are related data such as personnel qualifications, procedures, and equipment records.

16.2 RESPONSIBILITY

The responsibility for initiation, completeness, and reliability of Q.A. records is vested in the appropriate supervisor, with periodic verification checks by the Q.A. Manager. All Oak Ridge Laboratory personnel performing processes or services associated with the work being performed will assist in the efforts.

16.3 RECORDS

- 16.3.1 Inspection and test records will, at a minimum, identify the inspector or data recorder, the type of observation, the results, the action taken in connection with any deficiencies noted, and the date of the inspection or test.
- 16.3.2 All required records will be legible and of a quality that can be copied. Records shall be completed using reproducible ink. Errors or incorrect entries will be lined through with a single line, dated, and initialed by the recorder.
- 16.3.3 Correspondence from clients may be made available for inspection at the discretion of client representatives and authorization from the originating organization.
- 16.3.4 Q.A. records will be identified and controlled by customer number and/or client identification as applicable.

16.4 STORAGE OF RECORDS

- 16.4.1 Quality assurance records will be firmly attached in binders, placed in folders or envelopes, and, if applicable, cross referenced by client identification and stored in a secure area.

- 16.4.2 Q.A. records will be properly stored and made available to the client upon request.
- 16.4.3 Records will be maintained in a secured and protective storage area.
- 16.4.4 Records will be identified and be retrievable.
- 16.4.5 CoC records are included with the sample set records.
- 16.4.6 Longer retention or duplication of records is available at the specific direction from the client.
- 16.4.7 Laboratory management will be responsible for governing access to, and controlling the records.
- 16.4.8 Analytical reports and source calibration data will be retained for a minimum of five years after results are reported to the client.
- 16.4.9 Procurement records will be retained for a minimum of five years or as required by the contract.
- 16.4.10 All records and analyses performed pertaining to (NELAC) accreditation will be kept for a minimum of 5 years and would be available for inspection by the accrediting authorities during this period even without prior notification to the laboratory.

17.0 CORRECTIVE ACTION

17.1 POLICY

The Oak Ridge Laboratory policy is to ensure continuous acceptable quality levels for services provided. Conditions adverse to quality will be identified and corrected as soon as practical.

17.2 CORRECTIONS

17.2.1 CORRECTIVE ACTION REPORT (CAR)

In the case of a significant condition adverse to quality, the cause of the condition shall be determined and corrective action taken to preclude recurrence. The identification, cause, and corrective action shall be documented and reported to appropriate levels of management. Follow-up action shall be taken to verify implementation of this corrective action and documented via a Corrective Action Follow-Up form. The Corrective Action Report (CAR) Form shall be used to document this condition. Typically, the Q.A. Manager will initiate investigation and corrective action by issuing a Corrective Action Report (CAR) in any of the following situations:

- When an audit reveals circumstances that will adversely affect quality (Audit Finding) as determined by the Q.A. Manager.
- When any results of an inter-comparison study are out of control, or for non-participation.
- When procedural or technical problems arise and the Q.A. Manager determines that they will significantly affect quality.

17.3 NON-CONFORMANCE REPORT (NCR)

A non-conformance is a deficiency in a characteristic, procedure, or documentation that renders the quality of an item unacceptable, however, is not considered a significant condition that would

require an investigation by use of a CAR. In the laboratory, non-conformances can include physical defects, incorrect or inadequate documentation, and deviations from an established protocol, plan, or documented technical requirement. This condition is documented using a Non-Conformance Report (NCR) Form.

17.4 RESPONSIBILITY

All laboratory personnel are responsible to communicate any evidence of unacceptable quality performance to their supervisor, the responsible manager, and/or the Q.A. Manager.

17.4.1 The responsible manager will ensure investigation of a condition adverse to quality, determine assignable cause, and provide recommendation(s) for corrective action.

17.4.2 The responsible manager will ensure action is initiated to correct the assignable cause of the adverse condition and to determine and initiate the specific corrective action(s) necessary to preclude recurrence.

17.4.3 The Q.A. Manager will review CARs, NCRs, and routine Q.C. reports for evidence of unacceptable quality.

17.4.4 Copies of the completed CARs and NCRs will be kept on file by the Q.A. Manager.

17.5 CLIENT NOTIFICATION

The client will be notified when any Corrective Action is initiated due to evidence of unacceptable quality that is related to their contract.

18.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

18.1 POLICY

Eberline Analytical Laboratory policy is to keep management apprised of all quality assurance problems, actions taken to correct them, and any actions taken to prevent recurrence.

18.2 QUALITY ASSURANCE REPORTS

18.2.1 Quality Assurance Reports are prepared quarterly by the QA Manager and submitted to upper management. The reports shall include discussion of inter-comparison studies, status of corrective actions, and quarterly QA objectives.

18.2.2 The Q.A. Manager will report all general or system audit results, problems, corrective actions, and replies.

Document Revision History

Revision	Effective Date	Changes From Previous Revision
7	8/1/13	- Document Revision History table implemented - Added Emergency Coordinator to title designations of positions in Section 1.4.4 - Updated list of accreditations in section 1.9 to reflect all current certifications - Updated Laboratory Organization Chart - Removed requirement for employees to maintain hard copies of procedures in work area.
8	8/1/14	- Updated ISO/IEC 17025 references throughout procedure to specify ISO/IEC 17025:2005 - Added IT Manager (i.e. LIMS Manager) to Section 2.0 Organization and Responsibility - Added Project Manager (i.e. Client Services Manager) to Section 2.0 Organization and Responsibility - Added purchasing management to the list of Laboratory Manager responsibilities in Section 2.2.1 - Added language in Section 2.2 to explicitly state job description requirements for Technical Director and Quality Manager defined under NELAC
9	8/1/15	- Changed references to the QAP Manual in Matrix Comparison Tables from "Oak Ridge, TN Laboratory" to "Eberline Analytical Laboratory" - Updated the Matrix Comparison Table on page 10 to cross-reference DoD/DOE Consolidated QSM; removed obsolete DOE QSAS and DoD QSM references - Removed obsolete documents in Section 1.3 - Updated Figure 2.1 (Organization Chart) to reflect staff changes - Revised Section 5.3.1 to reference MP-004 <i>Preparation and Modification of Procedures and Guidance Documents</i>; removed reference to obsolete procedure MP-021. - Added specific reference to MP-033 <i>Procurement of Quality Related Items/Services</i> to Section 6.1 (Purchasing)



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		• Changed employee title from Sample Receiving Technician to Sample Custodian in Section 12.2 • Removed item 15.2.3 to reflect current practice
10	8/8/16	• Updated Laboratory Organization Chart to reflect personnel changes. • Added language to Section 14.1.3 to clarify fulfillment of QSM initial calibration verification requirements.

APPENDIX C:

Laboratory Specifications

ANALYTICAL SPECIFICATIONS SUBSURFACE SOIL SAMPLES

Provide labor, materials, and equipment to perform analyses of soil samples in accordance with the following requirements:

A. GENERAL

- Analyses to be performed by standardized, industry-accepted methods (e.g., EPA 901.1 or equivalent for gamma-ray spectrometry, etc.).
- Copies of procedures for sample preparation and analysis, interpretation of results, and quality assurance/quality control to be provided to ENTACT on request.
- Laboratory license or authorization to receive/possess radioactive materials at quantities and concentrations anticipated for this project to be provided on request.
- Laboratory to provide, on request, proof of satisfactory performance evaluations from National Environmental Laboratory Accreditation Program (NELAP), Department of Energy Consolidated Accreditation Program (DOECAP), or mutually agreeable equivalent for the analytical procedures being requested for this project.
- The client reserves the right to perform an audit of the laboratory activities, relative to these requested services, at a mutually agreeable time.

B. ANALYSES

- The sample will be weighed, dried and homogenized and re-weighed after drying to enable results to be reported in terms of concentration per dry weight (pCi/g). The wet weight to dry weight ratio is to be determined and reported for each sample.
- Aliquots of soil sufficient to perform the requested gamma spectral analyses will be extracted from the homogenized soil. Each aliquot is to be weighed.
- An aliquot of the sample will be sealed in a calibrated-geometry container and held for a minimum of 21 days to assure radon/radon daughter equilibrium up to the lead-210 member of the radium-226 decay series.
- Samples are to be analyzed after the 21-day radon ingrowth hold time using high-resolution gamma-ray spectrometry. Results are to be reported for all detected gamma emitters. In addition, the results for the following radionuclides will be reported even if they do not meet minimum detectable criteria:
 - bismuth-214,
 - lead-214,
 - actinium-228,
 - lead-210, and
 - potassium-40.
- Retain the analyzed samples, pending further instructions from ENTACT.

C. DETECTION LIMITS

If a named radionuclide of concern is not detected in the sample, the minimum detectable concentration reported for that analyte in that sample will not exceed the detection limit presented in Table 1.

Detection Limits for Named Radionuclides		
Radionuclides	Required Detection Limit (pCi/g)	Analytical Method (pCi/g)
Ac-228	0.2	EPA 901.1 Modified (Gamma Spec)
Bi-214	0.2	EPA 901.1 Modified (Gamma Spec)
Pb-214	0.2	EPA 901.1 Modified (Gamma Spec)

Table 1 - Detection Limits for Named Radionuclides

D. DATA PACKAGES

When reporting data, the laboratory will provide summaries of analytical results to Don Halter and Erich Fruchtnicht of ENTACT by email as they become available. GEL and Eberline will provide final data reports and Electronic Data Deliverables, once completed and reviewed, via email. GEL provides an online portal to which all data can be uploaded including COCs, SOPs, and any other relevant sample documentation. Complete data packages containing the reported results should include the following information:

1. Identification of any problems encountered during analysis,
2. Identification of sample numbers assigned in the field and at the laboratory for all samples in the data package, including indication of the quality control sample numbers associated with batches of Site sample numbers,
3. Documentation of the chain of custody for all samples in the data package,
4. Report of analyte concentrations and units for all samples in the data package, including all quality control samples,
5. Documentation of raw laboratory data for all samples in the data package,
6. Documentation of instrument detection limits for each analyte in the data package,
7. Documentation of relative percent difference results for all quality control samples reported in this manner (spikes, calibration checks, duplicates, method blanks, and laboratory control samples),
8. Documentation of the definitions of all laboratory data qualification codes, and
9. Quality control data packages for equipment utilized in these analyses and covering time period over which these analyses were conducted.

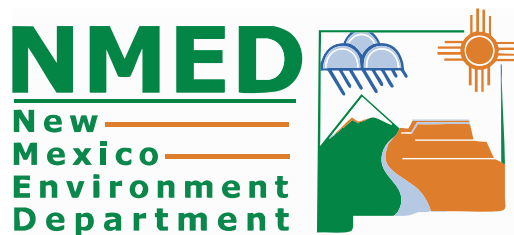
The analytical laboratory will perform checks of data transcription and computation on each data package before transmittal to the client.

E. EDD RECIPIENTS AND COMPLETE DATA (PDF) RECIPIENTS

1. dhalter@entact.com Don Halter
2. efruchtnicht@entact.com Erich Fruchtnicht

SAMPLING AND ANALYSIS PLAN: METHODS TO MEASURE URANIUM ORE CONCENTRATIONS RED BLUFF NO.1 AND ROUNDY SITE MCKINLEY COUNTY, NEW MEXICO

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ABBREVIATIONS AND ACRONYMS

bgs.....	below ground surface
BH.....	Borehole
BLM	Bureau of Land Management
cpm.....	counts per minute
DPT	Direct Push Technology
Eberline	Eberline Services, Inc.
EPA.....	U.S. Environmental Protection Agency
GEL.....	GEL Laboratories, LLC
GPS.....	global positioning system
HPGe	High-Purity Germanium
MARSSIM.....	Multi-Agency Radiation Survey and Site Investigation Manual
MDC.....	Minimum Detectable Concentration
μR/hr	microrentgen per hour
Nal	Sodium Iodide
NORM.....	Naturally Occurring Radioactive Material
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
NMED	New Mexico Environmental Department
pCi/g.....	picoCuries per gram
PNNL.....	Pacific Northwest National Laboratory
RPR.....	Red Bluff and Roundy
SAP	Sampling and Analysis Plan
SS.....	Surface Soils
VSP	Visual Sample Plan

1.0 INTRODUCTION

This sampling and analysis plan (2025 SAP) has been developed to describe the radioactive characterization sampling and analysis activities for the Red Bluff No.1 Mine Site Assessment project located in McKinley County, NM under the State of New Mexico Contract #26-667-2030-00005.

2.0 PURPOSE

The purpose of this investigation is to characterize radioactive material concentrations in soils and rocks within the Red Bluff No.1 and Roundy site boundary (Site) based on results of a gamma radiation level walkover survey, as established during the Phase 1 Site Radiological Survey Plan¹. This 2025 SAP is intended to supplement the guidance and procedures described in the September 2025 Site Radiological Survey Plan¹ and to supersede those procedures where indicated.

Results from this investigation will provide information about:

- Radioisotope soil concentrations in soil at Red Bluff No.1 and Roundy sites at locations of elevated gamma radiation (2x background) discovered during the gamma radiation level walkover survey, and
- Information regarding the depth to which radioisotope concentrations may be elevated.

2.1 SUBSURFACE SAMPLING

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) area classifications (i.e., Class 1, Class 2, Class 3) and other areas requiring sampling bias have been determined based upon the results of the gamma radiation level walkover survey. This sampling plan will be MARSSIM compliant. It is expected that much of the sampling data gathered can be used in the final status plan as well.

2.1.1 Decision Logic and Sampling Process

Decision logic for identifying areas of the Site for subsurface sampling will govern sampling locations. This logic will accommodate the needs of the study and access limitations including but not limited to property owner restrictions, encountering bedrock when drilling, or encountering cultural artefacts at the sample site.

This decision logic and sampling process can be expressed in the following hierarchy:

1. Gamma radiation level walkover survey results will be used to locate those areas onsite that exhibit radiation levels 2x background.
2. Determine extents of the elevated radiation field.
3. Determine the number of samples to adequately assess the area and label sample sites with their GPS locations.
4. Determine what manner of sampling and what probable depth the geology of the identified area supports.
5. Confirm landowner approval of subsurface sampling activities, where applicable.
6. Confirm suitability of sample site (i.e., no cultural artifacts present).
7. Using a small tracked drill rig, GeoProbe™ or similar direct push technology, acquire a core sample at each GPS sample location.
8. Log the core and the borehole with a handheld radiation detector.
9. Separate samples by depth profile according to the core and borehole log data.
10. Proceed to the next sampling location.

This decision hierarchy is depicted in Attachment 1 for convenience.

Item 3 in the decision hierarchy is dependent upon MARSSIM methodology in that classifying areas as either MARSSIM Class 1, 2, or 3 will drive the number of samples within each area and thus the total number of samples to be collected on site. Typically, a closure criteria is pre-selected and the MARSSIM manual guides stakeholders toward meeting those criteria. An important component of the closure criteria is the planned acceptable radionuclide concentrations in the soils at each depth of concern. This acceptable concentration is known as the Derived Concentration Guideline over a wide area (DCGL_w).

In this case, the closure criteria have not yet been finalized awaiting dose modeling scenarios for abandoned uranium mines. Therefore, a preliminary DCGL_w of 5 pCi/g radium-226 (Ra-226) over background Ra-226 concentrations in the first 15 centimeters of soil (the 5/15 rule) and 15 pCi/g Ra-226 over background Ra-226 concentrations averaged over each successive 15 cm depth matching the guidance from *Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico*² has been selected to allow for an initial

¹ (ENTACT, LLC, 2025)

² (Energy, Minerals & Natural Resources Department Mining and Minerals Division and New Mexico Environment Department, 2016)

MARSSIM classification. Revisions may be made as more data becomes available.

The MARSSIM Manual³ describes the difference between the class areas as such:

- Class 1 areas, prior to remediation, are impacted areas with concentrations of residual radioactivity that exceed the $DCGL_W$.
- Class 2 areas are impacted areas where concentrations of residual activity that exceed the $DCGL_W$ are not expected.
- Class 3 areas are impacted areas that have a low probability of containing areas with residual radioactivity.

The MARSSIM manual further defines the maximum size each Class area can be as follows:

MARSSIM Class Area	Permissible Area (m ²)
Class 1	0-2,000
Class 2	2,000-10,000
Class 3	>10,000

Table 1 - MARSSIM Class Area Sizes

As discussed in the Site Radiological Survey Report: Red Bluff No.1 and Roundy Site⁴ (hereafter "the survey report"), the MARSSIM class areas were determined and mapped using the data acquired from the gamma walkover survey. Some areas of the site were inaccessible due to steep terrain and unsafe conditions. Inaccessible areas without radiological data from directly adjacent areas were left unclassified, though they generally meet the criteria for a Class 2 area. They will be investigated further while onsite during the sampling phase. MARSSIM Class 3 areas were highlighted in green, Class 2 areas were highlighted in yellow, and Class 1 areas were highlighted in magenta as shown in Attachment 2. The Class areas were selected following the statistical analysis of gamma response data population.

Class 1 areas are targeted with biased sampling for the pre-remediation sampling. As stated in the survey report⁴, the areas designated as Class 1 featured count rates in excess of 41,500 cpm and are likely to require some form of remedial action. The MARSSIM required sampling process is meant to propose a sampling frequency in each survey unit that will allow for the correct final status decision to be made. This biased sampling approach will aid in determining the depth of the radioactive material in each Class 1 region enabling proper remedial action, while being efficient with resources until the final status survey samples are needed.

Biased radiological samples and geotechnical samples are also planned within the abandoned excavation pits on site to determine their suitability as repositories for future remedial action. The phase of sampling planned for 2025 is focused on acquiring the necessary radiological data to begin the remedial design given the time constraints discussed herein regarding sample hold time and processing. As such, the geotechnical sampling necessary to determine the suitability of the proposed repositories onsite is planned for the January 2026 mobilization along with the radiological sampling for the New Mexico State Land portion of the Red Bluff No. 1 site. An addendum to this 2025 SAP will be submitted at a later date to describe the geotechnical sampling details proposed.

Class 2 and 3 areas will be sampled according to a random-start systematic triangular grid with fixed spacing such that each survey unit has no fewer than 15 samples. The particular sampling locations were placed using Pacific Northwest National Laboratory's (PNNL) Visual Sampling Plan (VSP) software, which is rapidly becoming an industry standard for this purpose. This sampling frequency will enable a 95% confidence that the sample data will correctly conclude the survey unit is contaminated above the closure criteria if in fact that is true, and no more than a 5% chance of concluding the survey unit meets the closure criteria in the event it does not. It is expected that many of these samples may qualify to be included in the final status survey.

A cultural resource survey was completed while the gamma response walkover survey was progressing. The cultural resource survey is meant to identify those areas on the site of cultural significance that will require special handling in the event there are any sampling or remedial activities intended to take place within them. The cultural resource avoidance areas have been identified and incorporated into the sample location planning in preliminary consultation with New Mexico.

Subsequent discussions with the archeological team at the state of New Mexico resulted in removing the standard 100-foot buffer zones around the avoidance zones, and information that indicates the avoidance zone covering the Roundy Shaft area is unlikely to be eligible for consideration as a cultural avoidance zone and likely able to be removed from consideration when planning sample locations. The avoidance zones encompass multiple areas around the site. Two sample locations in the Red Bluff region (1 biased and 1 Class 2) were moved to minimize

³ (USEPA, 2001)

⁴ (ENTACT, LLC, 2025)

impact to the characterization. There were too many impacted Class 2 sample locations in the western Unknown strip mine region of the site to move and maintain compliance with MARSSIM methodology. Those sample locations will not be included in this study.

The sampling locations planned thus far are shown in Attachment 3 with the sample points denoted red representing the systematic triangular grid and those in light blue representing the biased samples. The blue hatched areas are the cultural resource avoidance zones and any activities taking place within the buffer zones around them will be overseen by a qualified archeologist as approved by the state of New Mexico. The archeologist team will be asked to mark the cultural resource avoidance zones by flag or similar method during before the drill crew approaches them and will then assist the drill team as they enter the buffer zone. The black hatched area across the top of the Piedra Triesta region denotes the property understood to be under Bureau of Land Management (BLM) jurisdiction. Only one biased sample is proposed on the Piedra Triesta Class 1 area to characterize the portion of the Class 1 areas that extend onto private land as remedial action is not currently planned for the BLM land. The black crosshatched area in the southwestern region of the Red Bluff No. 1 portion of the site denotes the New Mexico State Land and will be assessed during a separate mobilization currently planned for January 2026. The radiological sampling proposed for the State Land is the same as the rest of the site. The property regional divisions discussed in the survey report⁵ have been preserved for the sampling plan.

2.2 SELECTION OF A SURROGATE RADIONUCLIDE FOR PLANNING

Multiple radionuclides are expected to be present in the soils and rocks at the Site given its prior use as a uranium mine. Gamma spectroscopy will be used to identify and quantify them in the samples to be collected. The selected analytical labs, Eberline Services, Inc. (Eberline) and GEL Laboratories, LLC (GEL), will use the gamma spectroscopic method Environmental Protection Agency (EPA) Method 901.1 Modified on all samples collected at the Site. The radionuclides reported are the gamma emitting progeny in the uranium-238 (Thorium-234, Radium-226, Lead-214, Bismuth-214 and thorium-232 (Radium-228, Actinium-228, Lead-212, Thallium-208) decay chains and Potassium-40.

Some of these radionuclides, like U-238, are difficult to detect, while others, like bismuth-214 (Bi-214), are readily detectable with a variety of instrument types.

When a consistent mixture of radionuclides is present in an area, MARSSIM allows planners to select and use one radionuclide as a surrogate for all the radionuclide in the mixture to simplify calculations and remove duplication. In this mixture, thorium-234 (Th-234) is an easily detected surrogate for U-238 and either lead-214 (Pb-214) or Bi-214 is an easily detectable surrogate for Ra-226. Surrogates detected in samples acquired under this plan will be designated as the isotope they are being used to detect (i.e., Bi-214 and/or Pb-214 will be used to confirm the detected Ra-226 activity).

2.2.1 Sample Hold Times for Adequate Radioisotope Detection Statistics

An important concept often overlooked in planning sampling activities is the sample hold time required to accurately detect the isotopes discussed in Section 2.2 above. All samples will be sealed and held either onsite, at an ENTACT-operated facility, or at Eberline or GEL lab for a period of no less than 21 days before they are analyzed via gamma spectroscopy with an average of 7 days post analysis for data and report generation.

This 21-day hold time allows for an equilibrium, present in undisturbed nature, between Ra-226 and its surrogates (Pb-214 and Bi-214). When disturbed, through sampling, excavation, or any other means, some unknown portion of the radon-222 (Rn-222) gas generated by the decay of Ra-226 is lost. An industry standard assumption is that the equilibrium will be reestablished well enough for an accurate gamma spectroscopic analysis in 21 days as long as the samples remain sealed for the entire duration of the hold time.

Typical lab turnaround is an additional 7 days for analysis, preliminary data generation, and final report generation for an average time from the date the sample was sealed to data receipt of 28 days.

2.2.2 Property Access

Prior to the start of the sampling activities, ENTACT will confirm with the New Mexico Environmental Department (NMED) that property owner access and agreements for drilling/boring activities have been secured. Based on the landowner responses, the team will be able to pre-plan, based on the decision logic discussed in Section 2.1.1, the allotted time needed, and materials required.

⁵ (ENTACT, LLC, 2025)

2.3 SAMPLING SEQUENCE

2.3.1 Borehole Sample Collection

Geologic considerations will influence the target depth of the samples, and a geologist will be consulted as needed. It is unlikely that any samples will need to penetrate bedrock. Typically, subsurface sampling of this type would only require depths of 4 feet, but site conditions will inform the sampling depths and will be determined later. The current plan is to use a tracked GeoProbe direct push technology (DPT) sample 4 feet (the length of one standard DPT tool string) beyond the native layer unless bedrock is encountered first. Based on ENTACT's experience with this type of geology and uranium in this chemical form, it is not expected that surface contamination will extend 4 feet beyond the native layer though it is possible. If core scanning indicates contamination beyond 4 feet it is unlikely that contamination is due to the material at the surface and increasingly likely that subsurface contamination at this depth and beyond represent some remainder of the original ore body.

Samples will be collected from the top 6 inches of soil and each additional foot of depth to acquire a depth profile of the radioactive materials in the soil and rock to plan remediation action in compliance with the assumed 5/15 pCi/g standard remediation criteria (i.e., 5 pCi/g in the top 15 cm, and 15 pCi/g for all depths below at 15 cm increments).⁶ However, after modeling is complete, alternative standards may be used.

The investigation activities will be conducted, where possible, using a tracked Geoprobe™- type DPT rig equipped with a 3" DT45 Geoprobe Dual Tube sampling system with MC7 liners. The Geoprobe will proceed to each marked borehole location and continuous soil cores will be collected and logged. If the planned location cannot be safely reached, the hole will be location adjusted in consultation with an ENTACT Health Physicist. At each boring location, the soil core will be advanced through overburden fill and dredge deposits, terminating at a depth of 4 feet below the native layer or at bedrock, whichever is encountered first. If refusal is met, the borehole location may be offset at the discretion of an ENTACT Health Physicist. The DPT rig will be checked for contamination between borings and will be decontaminated as needed.

Cores from these boreholes will be labeled with a unique sample identification number that will include a reference to the boring designation from the sampling map, the borehole number (if more than one borehole is taken at the same location), the core sequence number or depth interval, an arrow indicating the top of the soil core, and the date.

Soil cores obtained from each borehole will be examined by the accompanying geologist. At a minimum, the geologist will identify the depths that soil transitions from one subsurface unit to the next.

When a sample is collected, the actual sampling location will be verified with calibrated GPS equipment and the coordinates recorded on field forms.

Collection will provide 200-300 grams of soil, sufficient for sample analysis minimum mass requirements from the lab.

2.3.2 Borehole Gamma Logging

Not all samples will require lab analysis. A gamma scintillator probe, such as a Ludlum Model 44-2 or similar, will be lowered into the borehole once the core is removed and the radiation levels at each 15cm increment will be recorded to create downhole logging data. Radiation levels from the borehole logging will be used to determine the in-situ depth and thickness of soil deposits that produce an anomalous radiation reading and drive decisions about which samples will require lab analysis.

Once the borehole has reached its endpoint, a waterproof PVC sleeve will be inserted into the hole. A 1-inch NaI probe with a long cable will be used to record one minute radiation measurements at half foot (6-inch) intervals along the length of each borehole. These measurements will be recorded in counts per minute (cpm) and the depth of each measurement will be recorded as depth bgs in negative feet. For example, the depth of a gamma measurement taken at 3.5 feet bgs will be recorded as "-3.5 feet". This "gamma log" will be used to identify the depth bgs of the subsurface soil layers producing elevated radioactivity.

2.3.3 Soil Core Gamma Scanning

Radioactivity from the soil core will be measured by taking 1-minute integrated gamma measurements at 15 cm intervals using a 3-inch NaI detector along the length of the core(s). Once all measurements have been taken along the tube, they will be averaged, and the highest single value will be compared to the calculated average. If the maximum value exceeds the average by 30% or more, the associated 15 cm interval of soil will be selected for collection and evaluation. Site conditions may result in some variance from this sample selection methodology. Any variance will be discussed in the final sampling report.

⁶ (Energy, Minerals & Natural Resources Department Mining and Minerals Division and New Mexico Environment Department, 2016)

2.4 SAMPLE LABELING

Each soil sample will be assigned a unique alpha-numeric identification code including an abbreviation of the property name, followed by the sample type and a unique sample number. The numeric portion of the sample identification code describing the depth will be separated from the borehole information by a dash "-". The starting and ending depths will be separated by a dash. The identifiers (IDs) expected for this sampling campaign are listed below:

- Sample Type: For subsurface soils extracted by borehole (BH); for surface soils (SS).
- Property ID: Red Bluff and Roundy (RBR)
- Sample Number: 001 through 999, with 001 being the first sample collected at the property.
- Sample Depth: This will consist of start and stop sample depths in feet with a dash between the two depths (i.e., 0-0.5 feet).

For example, Figure 1 below depicts how the first subsurface soil sample collected at the first property would be labeled:

BH-RBR-001-0-1			
BH	RBR	001	0-0.5
Sample Type	Property ID	Location Number	Sample Depth (ft)

Figure 1 - Sample Labelling Convention Example

Each field duplicate sample will be labeled with the same sample identification as the original sample followed by the letter "D". The sealed sample bags will be stored in a secure location in a manner that maintains chain-of-custody requirements until such time as they are ready for shipment.

2.5 HANDLING AND SHIPPING SAMPLES

Samples collected for laboratory analysis will be placed in a sealable plastic sample jar, logged on a chain-of-custody form, and placed in a cooler or equivalent strong, tight container. The chain-of-custody form for the shipment will be placed in the cooler/container along with the sample and remain there, except when the form requires updating, until the cooler is ready for shipment.

After samples are in the cooler and before shipment, the cooler will be opened, and empty space will be filled with appropriate packing material. The cooler will be closed and the exterior surveyed with a calibrated exposure rate meter (e.g., Ludlum Measurements Model 19, or equivalent) to verify compliance with federal shipping regulations in 49 CFR 173. It is expected that the samples will comply with exemption criteria in 49 CFR 173.436, which will be verified before shipment. The chain-of-custody form will be signed by the Survey Manager or designee (the signatory). The form will be copied, and the original form will be replaced in the cooler. The cooler will be completely closed, and a custody seal will be applied to the outside of the container. The container will be secured with strong tape or other binding prior to shipment.

A copy of the signed chain-of-custody form will be retained. The cooler will either remain in the custody of the signatory, or it may be consigned to a courier or delivery service, such as Fed Ex or United Parcel Service. A signed copy of the shipping papers will serve as a record of custody between the signatory and the receiving party (such as a laboratory).

Packages containing samples shall be shipped for delivery to one of the following laboratories:

Eberline Analytical Corporation
601 Scarboro Rd # A, Oak Ridge, TN 37830
2016 TNI Std: TN010672025-19
DoD-ELAP: 70747 / L24-611
DOECAP-AP: 70747 / L24-612

-and-

GEL Laboratories, LLC
2040 Savage Road, Charleston, SC 29407
2016 TNI
DoD DOE ELAP: 2567.01

2.6 SAMPLE ANALYSIS

Samples will be sent to Eberline in Oak Ridge, TN or GEL in Charleston, South Carolina, both NELAP accredited radioanalytical laboratories for gamma spectroscopy (EPA 901.1 Modified). Eberline and GEL will generate radioisotope concentrations for each sample sent in pCi/g. Analytical radioisotope concentration data will be correlated to onsite survey/counting data and used to develop the remediation plan.

3.0 MATERIALS AND EQUIPMENT

3.1 RADIOLOGICAL DETECTORS

The borehole logging data will be acquired with a Ludlum Model 44-2 1-inch gamma scintillation probe, or equivalent, paired with a Ludlum Model 2241-2 detector system, or equivalent.

The core gamma scanning will be performed using a Ludlum Model 44-20 3-inch gamma scintillation probe, or equivalent, paired with a Ludlum Model 2221 detector system, or equivalent.

Other radiation survey equipment that will be used at the Site includes beta/gamma detectors (Model 44-9, Ludlum, or equivalent) that will be coupled to survey meters (Ludlum Model 2241-2 or equivalent). The beta/gamma survey instruments will be used to scan workers and equipment for surface radioactive contamination before leaving the work areas of the site.

The GPS equipment used for locating sampling sites for drilling will be a Juniper Systems Geode sub-meter GPS receiver, or equivalent.

3.1.1 Detector QA/QC

All radiological detection instrumentation will have current calibration (within the past 12 months, or more frequently if recommended by the manufacturer). Daily field performance checks (i.e. a background and source check) will be conducted in accordance with individual instrument use procedures. These performance checks will be performed prior to daily field activities and at any time the instrument response appears questionable. The performance check is accomplished by using a radioactive source and obtaining a measurement on each detector/meter combination. Deviations should not exceed $\pm 20\%$. Deviations greater than $\pm 20\%$ will be investigated. If the unit is not performing properly, it will be replaced. Performing the daily source check validates instrument performance. Only data obtained using instruments that satisfy the performance requirements will be accepted for use in the evaluation. Results of the daily field performance checks will be recorded on an instrument quality control check form.

The survey results will be recorded in counts per minute (cpm).

3.1.2 Instrument Calibration and Sensitivity

Instrumentation will have been calibrated at a lab qualified to perform that work and calibration certificates will be stored onsite during the execution of this workplan. Duplicate calibration certificates are maintained by ENTACT.

The Ludlum Model 44-2 1-inch gamma scintillation probe is sensitive to the gamma energies emitted by the isotopes of concern and their progeny to a sufficient degree to perform the downhole logging effectively.

The Ludlum Model 44-20 3-inch gamma scintillation probe is sensitive to the gamma energies emitted by the isotopes of concern and their progeny to a sufficient degree to perform the core scanning effectively.

The Ludlum Model 44-9 alpha/beta probe is sensitive to the alpha, beta, and to a lesser degree gamma radiation energies emitted by the isotopes of concern and their progeny and is an appropriate radiation detector to use contamination screening.

3.2 EXAMPLE RADIOANALYTICAL EQUIPMENT

Eberline and GEL use High Purity Germanium (HPGe) gamma spectroscopic systems capable of detecting minute amounts of gamma-emitting radioisotopes in various media. While their specific arrangement of equipment is proprietary, Eberline and GEL have demonstrated their systems perform well for the detection of radium and uranium in the quantities expected at the Site.

3.2.1 Radioanalytical Result QA/QC (Validation)

While ENTACT does not directly calibrate or perform QA/QC checks on the gamma spectroscopic systems employed by the lab, the data those systems generate will be evaluated to confirm their proper operation.

The isotopes of interest at the Site and their surrogates, are in a certain equilibrium in nature and, with the proper hold time as discussed above, the data generated by a gamma spectroscopic investigation should show activity concentration values at a reasonable approximation of that equilibrium. Any imbalance in the radioisotope proportions may require additional investigation steps including but not limited to contacting that lab for a recount of that sample and asking the lab for documentation of the proper operation of the detector system used on that sample.

3.2.2 Lab Sensitivities for Radium and Uranium

Typical minimum detectable concentrations (MDCs) on HPGe detector systems like those used by Eberline and GEL for gamma spectroscopic analysis for the isotopes of concern at the Site are shown in Table 2 below and demonstrate the systems are capable of meeting or exceeding the expected 5/15 remediation goals for this project.⁷

Radionuclide ⁸	Background Soil	Reference Std.
Ra-226 (Pb-214)	0.1-0.25 pCi/g	0.2-0.3 pCi/g
U-238 (Th-234)	0.8-1.4 pCi/g	1.2-2.4 pCi/g

Table 2 - Typical HPGe MDCs for the Radioisotopes of Concern

4.0 RECORDS

4.1 FIELD DATA

The field data (soil screening data, survey data, etc.) will be recorded in bound logbooks with numbered pages and/or in electronic formats, such as Microsoft Word or Excel applications. Field data will document the date, location, sampler's full name and initials, sample IDs, and any anomalies related to this Plan. Pictures are recommended at each location. Paper records will be maintained for future reference. Electronic files will be maintained on a company-based cloud server for security and back-up/redundancy.

4.2 LABORATORY ANALYTICAL RESULTS

Analytical results will be transmitted from the laboratories to ENTACT in an Excel® spreadsheet or an equivalent, compatible format such as a comma-delimited file. Once received, results will be stored electronically. A report of the analytical results will include a pdf-type file with full reporting contents and case narrative.

4.3 LABORATORY QA/QC DOCUMENTATION

Laboratory reports will include documentation of the analytical process, quality assurance/quality control data and analytical instrument performance will be sent in electronic format from the laboratories to the team. These analytical reports shall include:

- Copies of completed chain-of-custody forms,
- Analytical results for samples listed in the chain-of-custody forms,
- Instrument calibration and/or instrument quality control records,
- Results for blanks and spikes associated with the reported results,
- Results for duplicates,
- Sufficient documentation to reproduce calculated results from instrument responses, and
- A case narrative describing the analytical process used to produce the published results.

4.4 DATA VALIDATION

Laboratory data will be validated as described in Section 3.2.1. The laboratory reports and validation packets will be maintained on the ENTACT cloud-based system and will be made available to NMED upon request.

⁷ (Energy, Minerals & Natural Resources Department Mining and Minerals Division and New Mexico Environment Department, 2016)

⁸ Daughters of these radionuclides, shown in parentheses, produce stronger gamma signatures than their parents and as such are easier to detect by gamma spectroscopy. The radionuclides of interest (radium-226 and uranium-238) presented outside the parentheses are the parents.

5.0 ANTICIPATED PROJECT SCHEDULE

As illustrated on the project schedule, the field remedial investigation activities are anticipated to begin in late October 2025 and be completed in December 2025, weather-permitting. The proposed schedule is also dependent on confirmation of landowner access agreements/approvals of whose land sampling activities will take place, where applicable. The start date of the field investigation activities will depend upon NMED's permit approval. The remedial investigation summary report is anticipated to be complete and ready for submittal to the NMED no more than 30 days after receipt of the final analytical results from Eberline and/or GEL.

5.1 BOREHOLE DRILLING SCHEDULE

There are more than 500 boreholes planned. The driller estimates they can direct push 30 sample cores an average of seven (7) feet per day. Given the initial priority of closing the Roundy site within the current New Mexico state fiscal year, ENTACT proposes to begin the sampling with the biased samples on the Roundy and Piedra Trieste regions of the property; then complete the Roundy, and Piedra Trieste Class 2 areas and collocated Class 3 sample points before proceeding to the Class 1 and 2 areas of the Unknown Strip Mine region of the property; complete all Class 3 samples for all regions except for Red Bluff No. 1; and then enter and complete the Schmidt property side of Red Bluff No. 1. The State Land portion of Red Bluff No. 1 is currently planned for January 2026 assuming access and sampling approvals are in place at that time. Given the delay in accessing the State Land portion of Red Bluff No. 1 and the priority given to closing the Roundy regions of the property, the private land portion of Red Bluff No. 1 will be completed last as those sample points are the lowest priority in determining a remedial action plan and the higher priority data should be acquired first.

Eberline and GEL will analyze the samples in the order they are received, which will mean the Class 1 and 2 sampling data for the Roundy property will be available first, enabling a remedial design. Given the similar geology of this property, it is likely the remainder of the Unknown Strip Mine site will end up exhibiting similar sampling data and thus be accommodated by the same remedial design. Red Bluff No. 1 includes the mesa and appears to feature bedrock close to the surface. As such, sampling data is required before conclusions can be made regarding whether the remedial design for the Roundy, and Unknown Strip Mine regions of the property could apply.

The planned sampling schedule is as follows in Table 3 and assumes minimal difficulty in locating the sample sites, traveling between sampling sites, 100% drill rig uptime, and no weather delays:

Property Region	# of Biased Samples	# of Class 2 samples	# of Class 3 samples	Expected days to complete
Red Bluff No. 1	10	66	13	~3 for Biased and Class 2 / ~0.5 for Class 3
Roundy	29	122	16	~6 for Biased and Class 2 / ~0.5 for Class 3
Piedra Trieste	1	21	13	~1 for Biased and Class 2 / ~0.5 for Class 3
Unknown	47	155	16	~7 for Biased and Class 2 / ~0.5 for Class 3

Table 3 – 2025 Planned Sampling Schedule by Site Region

REFERENCES

49 C.F.R. pt. 173 (2025)

Energy, Minerals & Natural Resources Department Mining and Minerals Division and New Mexico Environment Department. (2016). Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico.

ENTACT, LLC. (2025). SITE RADIOLOGICAL SURVEY PLAN.

ENTACT, LLC. (2025). Site Radiological Survey Report: Red Bluff No. 1 and Roundy Site.

USEPA. (2001). Multi-Agency Radiation Survey and Site Investigation Manual, Revision 1.

U.S.EPA. (2000). Multi-Agency Radiation Survey and Site Investigation Manual, Revision 1. June 2001.

ATTACHMENTS

Attachment 1 - Hierarchy of Sampling Decision Logic and Sampling Process

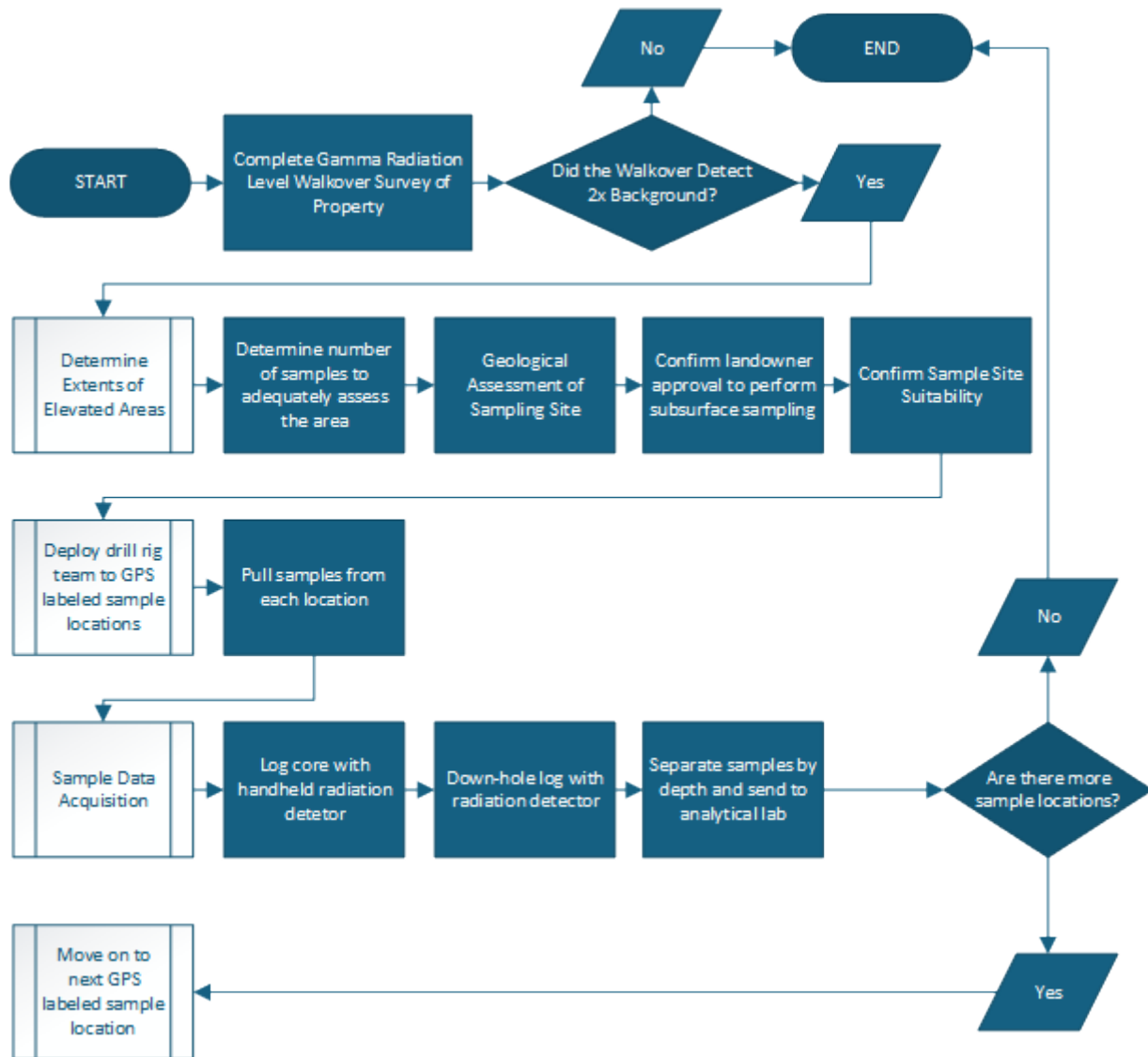
Attachment 2 - MARSSIM Class 1, 2 and 3 Areas

Attachment 3 - Proposed Sampling Locations

ATTACHMENT 1

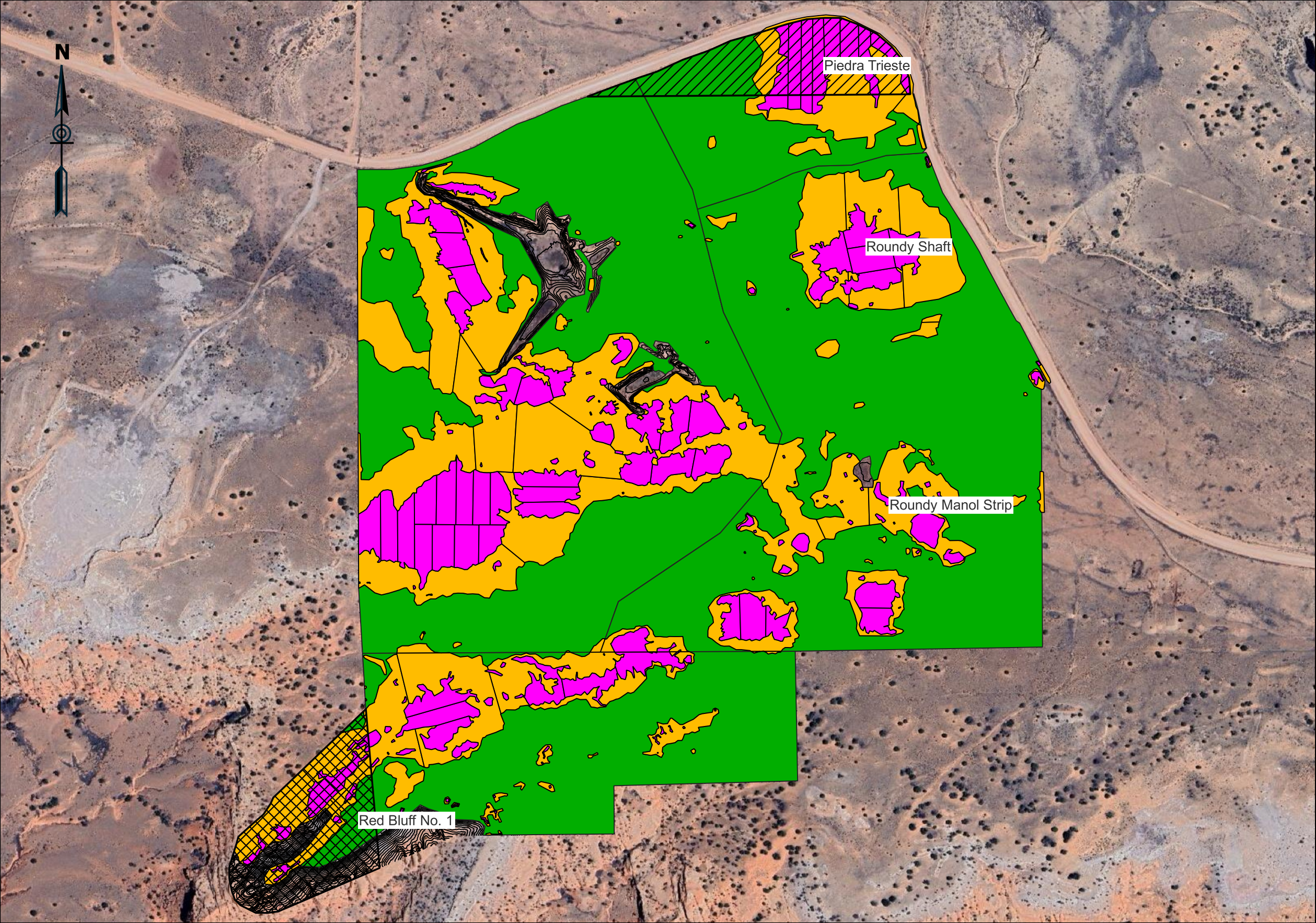
Hierarchy of Sampling Decision Logic and Sampling Process

ATTACHMENT 1 - Hierarchy of Sampling Decision Logic and Sampling Process



ATTACHMENT 2

MARSSIM Class 1, 2 and 3 Areas



LEGEND

AREA DESIGNATIONS

NM State Land



BLM land



MARSSIM AREAS

MARSSIM Class 1 areas



MARSSIM Class 2 areas



MARSSIM Class 3 areas



area labels



Elevation

USGS - 1 meter interval



Google Earth

SOURCES:

Google Earth Aerial Imagery
USGS Elevation (FEMA R6 Lidar 2016)
ENTACT 2025 Gamma Walkover Survey

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

Signature

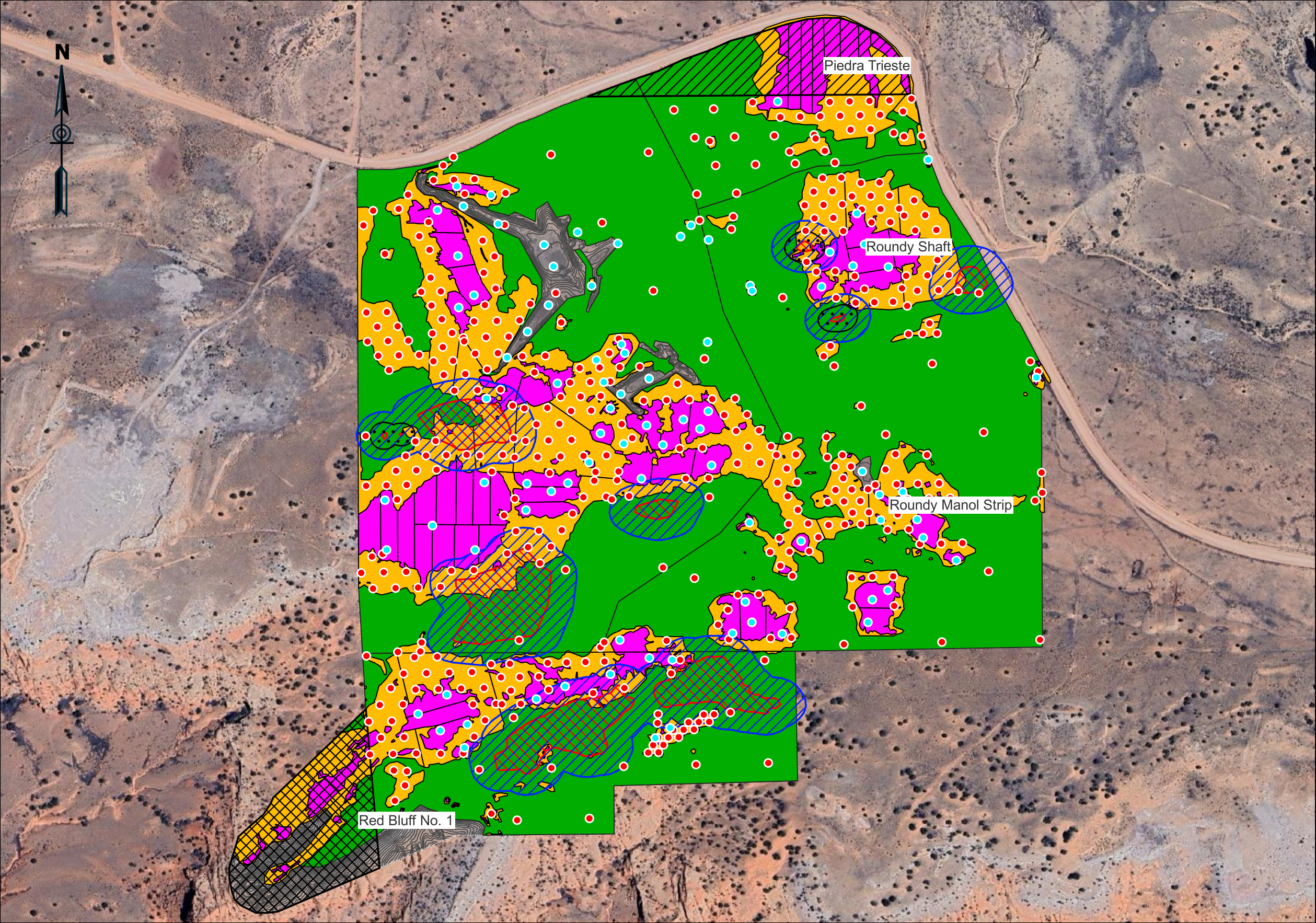
PREPARED FOR:



DRAWING NAME MARSSIM Class 1, 2, and 3 areas at the Site					
PROJECT NAME & LOCATION Red Bluff No.1 & Roundy McKinley County, NM					
DRAWN BY	E. Fruchtnicht	APPROVED BY		DRAWING NO.	
DATE	11/10/2025	DATE		PROJECT NO.	E9462

ATTACHMENT 3

Proposed Sampling Locations



LEGEND

Sampling

- Biased Samples (cyan dot)
- 2025Mob Random Start Triangular Grid - modified (red dot)

Cultural Resources

- 15m Avoidance per AML Comments (black dashed line)
- CR Avoidance Buffer modified - RESI (blue diagonal lines)
- CR Avoidance RESI & AML Comments11-10-2025 (red diagonal lines)

AREA DESIGNATIONS

- NM State Land (black cross-hatch pattern)
- BLM land (black diagonal lines)

MARSSIM AREAS

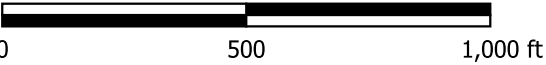
- MARSSIM Class 1 areas (magenta solid fill)
- MARSSIM Class 2 areas (yellow solid fill)
- MARSSIM Class 3 areas (green solid fill)
- area labels (black dot)
- Area of Potential Effect - NMED (grey solid fill)

Elevation

- USGS - 1 meter interval (black line)

SOURCES:

Google Earth Aerial Imagery
USGS Elevation (FEMA R6 Lidar 2016)
RESI 2025-149-01 Cultural Survey
ENTACT 2025 Gamma Walkover Survey



REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

Signature

PREPARED FOR:



DRAWING NAME Proposed Sampling Locations					
PROJECT NAME & LOCATION Red Bluff No.1 & Roundy McKinley County, NM					
DRAWN BY	E. Fruchtnicht	APPROVED BY		DRAWING NO.	
DATE	11/12/2025	DATE		PROJECT NO.	E9462



RADIOACTIVE MATERIALS LICENSE

Pursuant to the *Colorado Radiation Control Act*, Title 25, Article 11, *Colorado Revised Statutes*, and the *State of Colorado Rules and Regulations Pertaining to Radiation Control* (the Regulations) and in reliance on statements and representations heretofore made by the licensee designated below; a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material(s) designated below; and to use such radioactive material(s) for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders now or hereafter in effect of the Colorado Department of Public Health and Environment and to any conditions specified below.

1. Licensee: Clean Harbors Deer Trail, LLC
2. Mailing Address: 108555 East U.S. Highway 36, Deer Trail, Colorado 80105-9611
3. License Number: Colo. 1102-01, Amendment Number 14
4. Expiration date: December 31, 2023
5. Authorized Storage/Use Location: 108555 East U.S. Highway 36, Deer Trail, Colorado 80105-9611
6. Designated Radiation Safety Officer(s): Clyde E. Christman, RRPT
Designated Alternate Radiation Safety Officers: John Kehoe, M.S. and Jim Langsted, CHP
7. Radiation Safety Officer Contact Number: (970) 386-2293
8. Fee Category: 4.A
9. Reference Number:

CONDITIONS

10. Authorized Radioactive Material and Uses:

- A. The licensee is authorized to receive, possess, analyze, store, process, and dispose of waste materials containing naturally occurring radioactive material (NORM), technologically enhanced naturally occurring radioactive material (TENORM), and radium contamination resulting from activities involving purposefully concentrated Radium-226. The specific radionuclides are limited to K-40 and all of the radionuclides in the decay series for U-238, U-235, and Th-232. The physical form of the material includes but is not limited to soils, sludges, process residues, resins, and filters that are compatible with the design and operational criteria required by the CHWA permit.



- i. Oil and gas field wastes: the total radium activity of Ra-226 and Ra-228 per gram shall not exceed 12,200 pCi (451.4 Bq) in pipe scale, or 6,000 pCi (222 Bq) in other waste forms. Additionally, the Pb-210 activity per gram shall not exceed 10,000 pCi (370 Bq). Total oil and gas field wastes received for disposal per year shall not exceed 50,000 tons.
 - ii. Other wastes: the summed activity of all radionuclides per gram contained in the waste materials other than oil and gas field wastes shall not exceed 2000 pCi (74 Bq). Additionally, the Ra-226 activity per gram shall not exceed 222 pCi (8.214 Bq). The Pb-210 activity per gram shall not exceed 666 pCi (24.6 Bq).
- B. In addition to the limits established in Item 10.A, the total uranium and thorium content shall be less than 0.05% by weight (500 µg per gram) of the materials received for disposal.
- C. In addition to the limits established in items 10.A and 10.B the licensee shall limit the total of all waste materials containing radioactive material to a total volume not to exceed 487,514 cubic yards.
- D. The licensee is prohibited from receiving low-level wastes, as defined by the Rocky Mountain Low-Level Radioactive Waste Compact (Compact) administered by Rocky Mountain Low-Level Radioactive Waste Board (Board), from outside the Compact Region without written authorization from the Board.
- E. For the purposes of this license and as used in the application, regulated waste refers to any waste received, handled, processed or disposed of at the site containing radioactive material including: a) NORM/TENORM radionuclides in solid waste; b) NORM/TENORM radionuclides in material licensed by CDPHE; c) NORM/TENORM radionuclides mixed with Colorado Hazardous Waste Act (CHWA) hazardous wastes; d) radium processing wastes; and e) radium contamination resulting from activities involving purposely concentrated Radium-226.
- F. Pursuant to its authority over all radioactive materials at the facility, the Department may at any time impose additional requirements and/or license conditions regarding the receipt, processing, analysis, storage or disposal of these materials as may be necessary to ensure health and safety of workers, protection of the environment and compliance with any applicable rules, regulations and statutes.
- G. Should the licensee become aware of radioactive materials that were not identified in any waste characterization or manifest that are present in waste materials received or buried at the site, the licensee shall maintain a record of these and shall provide immediate notification to the Department for any materials that are not specifically authorized on the license.

11. Authorized Radioactive Material Users:

- A. Radioactive material authorized in License Conditions 10.A through 10.C shall only be received, stored, handled, analyzed, processed or disposed by or under the supervision of the Radiation Safety Officer, the Alternate Radiation Safety Officer, or the individuals who have completed the training course as described in the application correspondence dated June 13, 2016 and have been designated as users by the Radiation Safety Officer.
- B. One or more authorized users shall be physically present at the facility at all times when radioactive materials are being received, stored, handled, analyzed, processed or disposed. The number of authorized users present on site at any one time shall be sufficient to ensure adequate supervision of all persons within the restricted area.
- C. The Radiation Safety Officer shall be on-site sufficient to ensure protection of workers and compliance with this license and the Rules and Regulations.
- D. Temporary contract laborers and members of the public shall be escorted throughout the restricted area under the direct supervision and in the physical presence of an authorized user. Temporary contract laborers shall sign in and out of the facility each day. The sign-in, sign-out logs for the facility shall be maintained in the Operating Record.
- E. Contract laborers and consultants who have successfully completed the radiation safety training as described in the Radiation Protection Program in the application correspondence dated June 13, 2016 may work throughout the restricted area without continuous direct supervision by Clean Harbors personnel.
- F. The Radiation Safety Officer, Alternate Radiation Safety Officer, or authorized users shall physically observe the day-to-day activities of contract laborers and consultants who work without constant supervision. The extent of these observations shall be sufficient to ensure that contract laborers and consultants are complying with established procedures and the requirements of this license.
- G. The Radiation Safety Officer shall maintain written records indicating the date and basis of approval of authorized users including each authorized user's training and experience. The Radiation Safety Officer shall maintain a list of authorized users.

12. General Requirements:

- A. The licensee shall comply with the provisions of the State of Colorado *Rules and Regulations Pertaining to Radiation Control*: Part 1, "General Provisions"; Part 3, "Licensing of Radioactive Material"; Part 4, "Standards for Protection Against Radiation"; Part 10, "Notices, Instructions and Reports to Workers: Inspections"; Part 11, "Special Land Ownership Requirements"; Part 14,

“Licensing Requirements for Land Disposal of Low Level Radioactive Wastes”; Part 15, “Colorado Low-Level Radioactive Waste Rate Regulations”; and Part 17, “Transportation of Radioactive Material.”

- B. The licensee shall not transfer possession and/or control of radioactive materials or items contaminated with radioactive material except: by transfer of waste to an authorized recipient; by transfer to a specifically licensed recipient; or, as provided otherwise by specific condition of this license pursuant to the requirements of Part 3, Section 3.22 of the Regulations.
- C. Radioactive material authorized by Condition 10 of this license shall be stored and used in a manner that will preclude use by unauthorized personnel.
- D. The licensee shall ensure that information listed in this license is correct and accurate. The licensee shall notify the Department in writing within ten (10) days whenever the information contained in Items 1 through 7 above is no longer current or determined to be incorrect.
- E. The licensee may transport radioactive material or deliver radioactive material to a carrier for transport in accordance with the provisions of Part 17 of the Regulations and the requirements of U.S. Department of Transportation (49 CFR).
- F. The licensee shall not make any false statement, representation, or certification in any application, record, report, plan, or other document regarding radiation levels, tests performed or radiation safety conditions or practices.

13. Occupational Dose Monitoring:

- A. All users of radioactive material must be equipped with personnel monitoring devices capable of detecting both beta and gamma radiation.
- B. Each person receiving an occupational dose at the facility is deemed to require monitoring pursuant to Part 4, Section 4.18 of the Regulations.
- C. The Radiation Safety Officer shall maintain training and dose monitoring records for each worker at the site who receives an occupational dose. These records shall show the initial hire date, the specific training received, the date training was successfully completed, the date when dose monitoring was initiated, the date when employment terminated, and a copy of the annual total dose assessment for each year the individual works at the site.
- D. The licensee shall determine occupational doses (total effective dose equivalent (TEDE), committed effective dose equivalent (CEDE), and deep dose equivalent (DDE)) annually and summarized the final determination in the annual report.

14. Specific Radiation Safety Requirements:

- A. The licensee shall not make any substantial modification to the facility, equipment, process, or procedures used in the receipt, storage, handling, processing or disposal of waste containing radioactive materials without first evaluating and documenting the impact of such changes to workers, the environment, and members of the public. The licensee shall obtain written authorization from the Department, including a license amendment, if deemed necessary by the Department prior implementing the proposed changes. The Radiation Safety Officer shall maintain documentation of all such evaluations for review by the Department.
- B. Characterization and approval of regulated waste streams shall be performed in accordance with the most current revisions of Radioactive Materials Acceptance SOP 15.WAC.01, 15.WAC.03, or 15.WAC.04. All records of characterization and approval of regulated waste streams shall be maintained by the licensee for review by the department.
- C. The licensee shall implement and maintain Department-approved controls for limiting the release of radon and radioactive particulates from all waste repositories and processing facilities.
- D. The licensee shall conduct an air sampling program sufficient to demonstrate compliance with the public and occupational dose limits specified in Part 4 of the Regulations.
- E. Samples collected for the assessment of doses to members of the public, occupational doses, and samples collected for verification of characterization of wastes or environmental contamination levels shall be analyzed by radiochemistry laboratory that is appropriately licensed for the type of analysis being performed.
- F. For all waste streams following the Radioactive Materials Acceptance SOP 15.WAC.01, the licensee shall collect a random sample from 1 shipment out of every 20 shipments from each waste stream from each generator as described in the most current revision of SOP 15.WAC.01. The random sample shall be sent to an off-site laboratory for analysis including: Gamma Spectrum, Total Uranium Mass/g, Total Thorium Mass/g and Total Radium Activity/g. Isotopic Uranium, Isotopic Thorium, and Isotopic Radium analyses (reported in activity/g) may be used in lieu of Total Uranium, Total Thorium, and Total Radium. The results of this analysis shall be compared to the initial characterization data for the waste stream. If the results differ significantly from the profile, the RSO, general manager, compliance manager, or their designee shall contact the waste generator and attempt to resolve the discrepancy. If the results cannot be reconciled, the waste stream shall be deactivated until it can be resolved. All records from the random sampling program shall be maintained for review by the Department. Specific waste streams may be exempted from this requirement by the Department on a case-by-case basis.

- G. For all waste streams following the Radioactive Materials Acceptance SOP 15.WAC.03 and 15.WAC.04, the licensee shall collect 20 confirmatory samples per year, or an alternative number of samples approved by the Department. The samples shall be sent to an off-site laboratory for analysis including but not limited to: Ra-226 Activity/g, Ra-228 Activity/g, Pb-210 Activity/g, and Po-210 Activity/g. The samples shall cover a variety of waste streams. The samples shall be analyzed by the methods approved by the Department.
- H. The licensee shall conduct sufficient radiation surveys on materials and equipment to ensure that contamination levels do not exceed Department-approved criteria prior to release to unrestricted areas or for unrestricted use. The results of each survey shall be recorded and maintained on file for review by the Department for three (3) years after the record is made in accordance with Part 4, Section 4.42 of the Regulations.

15. Special License Requirements:

- A. The licensee shall maintain in effect a financial warranty acceptable to the Department in the amount of \$5,712,428 for closure cost and \$5,910,802 for post-closure cost in 2017 dollars in accordance with the requirements of Part 3, Section 3.9.5 of the Regulations.
- B. The licensee shall provide in writing to the Department, no later than June 30th of each calendar year, an annual report demonstrating proof of the value of existing financial warranties and any proposed changes to the financial assurance warranties, including updated decommissioning fund plans.
- C. The licensee shall maintain all equipment and facilities, essential to operations governed by this license, in good working condition. This includes but is not limited to process equipment, process tanks, dust suppression equipment, air sampling equipment, water monitoring wells, radiation detection equipment, survey instruments, gates, fences, waste impoundments, security systems, safety equipment, and emergency systems and equipment.
- D. The licensee's management and radiation safety officer shall take prompt and appropriate action to correct known deficiencies in the facility's procedures, processes, equipment, and site conditions. These deficiencies and the corrective actions shall be documented and records maintained for review by the Department for three (3) years.
- E. The licensee shall document and implement a system of routine preventive maintenance so that safety equipment is checked for proper working order according to a regular schedule.
- F. The license shall post individual areas of the facility and the entrances to each building or room that contains radioactive materials, with a conspicuous sign bearing the radiation symbol and the words, "Caution - Radioactive Materials".

- G. Prior to closure of each landfill cell, the licensee shall submit an analysis of the adequacy of the cap design to the Department for approval. The cap design must provide reasonable assurance of control of radiological hazards to be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years. Additionally, the cap design must be sufficient such that the release of Radon-222 does not exceed 20 pCi per square meter per second averaged over the surface area of the cell. This analysis shall include radon flux measurements and an analysis of the amount and concentration of radon producing materials disposed in the cell.
- H. Upon closure of each landfill cell containing radioactive material, the licensee shall record with the Adams County clerk and recorder a deed annotation as required in Part 11, Section 11.3.5 of the Regulations.
- I. Following the construction of a new landfill liner system or a landfill final cover system, the licensee shall provide the Department with “as-built” drawings of the landfill liner system or final cover system.
- J. The licensee shall provide the Department with an annual report by May 1 of each calendar year. That report shall contain the following items:
- i. specification of each quantity of radioactive contaminants released to unrestricted areas in liquid and in airborne effluents;
 - ii. the results of the environmental monitoring program;
 - iii. a summary of licensee disposal unit radiation survey and maintenance activities;
 - iv. a summary of activities and quantities of radionuclides disposed of;
 - v. any instances in which the observed site characteristics were significantly different from those described in the application for a license;
 - vi. estimated doses to members of the public from the licensee’s activities. This includes TEDE (total effective dose equivalent) and TODE (total organ dose equivalent) for both the nearest resident and the maximally exposed member of the public (if they are not the same person). The calculation of public doses shall be in accordance with Department approved methods, sampling frequencies, and dose modeling assumptions. Dose estimates shall be accompanied by appropriate supporting data including an electronic copy of the lab results, spreadsheets, computer model inputs, and modeling results/outputs;
 - vii. a summary of Occupational Doses (total effective dose equivalent (TEDE), committed effective dose equivalent (CEDE), and deep dose equivalent (DDE));
 - viii. a copy of the annual ALARA program audit;
 - ix. a summary of anticipated activities for coming year;
 - x. an evaluation of the existing decommissioning warranty to ensure that the available funds are sufficient to account for inflation, current site conditions, and projected activities for the coming year;
 - xi. an evaluation of the existing decommissioning funding plan to ensure that the licensee will have sufficient funds for the licensee to complete site decommissioning activities; and

- xii. a summary of the confirmatory sample results required in License Condition 14.G, an evaluation on how well the sample results validate the exposure rate acceptance methods in the Radioactive Materials Acceptance SOP 15.WAC.03 and 15.WAC.04, and an updated Pb-210 average activity concentration from gas field wastes.
- K. The licensee shall maintain security measures to prevent unauthorized access to the site's facilities and radioactive materials.
- L. Records of waste disposal shall be maintained in accordance with Part 4, Section 4.48 of the Regulations.
- M. The licensee's facility management and the radiation safety officer shall thoroughly review the content and requirements of this license. The licensee shall promptly notify the Department whenever it identifies an error in license authorizations or it has identified a specific license condition or technical requirement established in this license that is not achievable given the current state of technology or site conditions.
- N. If statements in referenced documents conflict, the most recent document listed below shall prevail unless otherwise specified in this license.
- O. For wastes under the jurisdiction of the Rocky Mountain Low-Level Radioactive Waste Board, the licensee shall provide rate review documentation to the Department pursuant to Part 15, Sections 15.16, 15.17, 15.18 and 15.19 of the Regulations.
 - i. Semiannual reports shall be submitted by July 31st and January 31st of each year.
 - ii. Annual reports shall be submitted by April 1st of each year.

16. Licensee Commitments and Reference Documents:

The State of Colorado *Rules and Regulations Pertaining to Radiation Control* shall govern unless the licensee's statements, representations, and procedures contained in the application and correspondence are more restrictive than the Regulations. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Condition 10 of this license in accordance with the statements, representations, and procedures contained in:

- A. the application and attachments dated May 31, 2010 and March 31, 2015; and
- B. the CHWA Subtitle C Permit dated December 2005, and as renewed; and
- C. financial assurance arrangements for decommissioning and long term care (Indian Harbor Insurance Policy Number PEC004202304 - Closure Cost: \$5,712,428, Post Closure Cost: \$5,910,802, effective on September 6, 2017); and

- D. the decommissioning funding plan dated December 20, 2005; and
- E. the Rocky Mountain Low-Level Radioactive Waste Board Designation as a Limited Regional Disposal Facility, as amended; and
- F. the Standard Operating Procedures as follows:
 - i. Standard Operating Procedure 15.RPP.01, Radiation Protection Plan, Revision 5;
 - ii. Standard Operating Procedure 15.RPP.02, Radiation Safety Training, Revision 3;
 - iii. Standard Operating Procedure 15.RPP.03, Worker Protection Records, Revision 3;
 - iv. Standard Operating Procedure 15.RPP.04, Individual and Area Dosimetry, Revision 5;
 - v. Standard Operating Procedure 15.RPP.05, Estimating Inhalation Doses, Revision 4;
 - vi. Standard Operating Procedure 15.RPP.06, Emergency Response, Revision 1;
 - vii. Standard Operating Procedure 15.RPP.07, ALARA, Revision 4;
 - viii. Standard Operating Procedure 15.RPP.08, Radiation Work Permits, Revision 2;
 - ix. Standard Operating Procedure 15.RPP.09, Personal Protective Equipment, Revision 1;
 - x. Standard Operating Procedure 15.RPP.10, Determination of Prior Occupational Dose, Revision 3;
 - xi. Standard Operating Procedure 15.WAC.01, Radioactive Materials Acceptance, Revision 9;
 - xii. Standard Operating Procedure 15.WAC.02, Waste Tracking, Revision 3;
 - xiii. Standard Operating Procedure 15.WAC.03, Waste Acceptance of Oil Production Pipe, Revision 7;
 - xiv. Standard Operating Procedure 15.WAC.04, Oil and Gas E&P NORM Waste Acceptance, Revision 3;
 - xv. Standard Operating Procedure 15.OPS.01, Landfill Operations, Revision 1;
 - xvi. Standard Operating Procedure 15.OPS.02, Contamination Control During Waste Treatment Operations, Revision 2;
 - xvii. Standard Operating Procedure 15.OPS.03, Operation of Portable Gamma Spectroscopy Unit, Revision 3;
 - xviii. Standard Operating Procedure 15.OPS.04, Operation of Alpha-Beta Smear Counter, Revision 4;
 - xix. Standard Operating Procedure 15.OPS.05, Operation of Gate Monitor Detectors, Revision 3;
 - xx. Standard Operating Procedure 15.OPS.06, Operation of Digital Waste Monitor, Revision 3;
 - xxi. Standard Operating Procedure 15.OPS.07, Operation of Exposure Rate/Dose Rate Meters, Revision 2;
 - xxii. Standard Operating Procedure 15.OPS.08, Operation of Alpha-Beta Scintillation Detector, Revision 2;

- xxiii. Standard Operating Procedure 15.OPS.09, Operation of GM Pancake Probe, Revision 1;
- xxiv. Standard Operating Procedure 15.OPS.10, Operation of Gamma Scintillation Detectors, Revision 2;
- xxv. Standard Operating Procedure 15.OPS.11, Routine Contamination Surveys, Revision 3;
- xxvi. Standard Operating Procedure 15.OPS.12, Personnel Contamination Surveys, Revision 3;
- xxvii. Standard Operating Procedure 15.OPS.13, Equipment and Vehicle Release Surveys, Revision 3;
- xxviii. Standard Operating Procedure 15.OPS.14, Spill Surveys, Revision 2;
- xxix. Standard Operating Procedure 15.OPS.15, Air Monitoring for Radioactive Materials, Revision 4;
- xxx. Groundwater Sampling Standard Operating Procedure 15.Env.2 dated September 1, 2006;
- xxxi. Standard Operating Procedure 15.OPS.17, Volumetric and Material Sampling; Revision 1;
- xxxii. Standard Operating Procedure 15.OPS.18, Decontamination of Surfaces and Equipment, Revision 2;
- xxxiii. Standard Operating Procedure 15.OPS.19, Decontamination of Personnel, Revision 1;
- xxxiv. Standard Operating Procedure 15.OPS.20, Handling of Liquids, Revision 2;
- xxxv. Standard Operating Procedure 15.OPS.21, Package Receipt Surveys, Revision 2; and

- G. the Decommissioning Plan dated December 21, 2005; and
- H. the Environmental Covenant granted by the licensee to the Colorado Department of Public Health and Environment on January 5, 2006 and as may be amended from time to time; and
- I. the correspondence and attachments dated February 12, 2016 (email), June 13, 2016, June 21, 2017, May 17, 2018, and July 17, 2018.

FOR THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Date: 08/21/2018 By: _____



Digitally signed by
James Grice
Date: 2018.08.21
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