

Sampling and Analysis Plan

La Jara Mesa Underground Uranium Mine

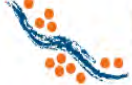
Cibola County, New Mexico

Prepared for
New Mexico Energy, Mining and Natural Resources Department, Mining
and Minerals Division

Prepared by
Laramide Resources LTD.

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(V.0)



 **LARAMIDE**
RESOURCES LTD.

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Appendices

Appendix A	Quality Assurance Project Plan
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Acronyms and Abbreviations

AMSL	above mean sea level
APE	area of potential affect
Barr	Barr Engineering Co.
BDR	baseline data report
BLM	Bureau of Land Management
CNF	Cibola National Forest
DBDR	draft baseline data report
DEM	digital elevation model
DQO	data quality objective
DTM	digital terrain model
EMNRD	Energy Minerals and Natural Resources Department
EPA	Environmental Protection Agency
ERG	Environmental Restoration Group Inc.
FSH	Forest Service Handbook
GIS	geographic information system
GPS	global positioning system
HPIC	high-pressure ionization chamber
IMBCR	Integrated Monitoring in Bird Conservation Regions
IOs	isolated occurrences
IPaC	Information for Planning and Consultation
LJMP	La Jara Mesa Project
LPC	Lidar point cloud
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MFPA	Main Facilities Permit Area
MMD	Mining and Minerals Division
MPO	mine plan of operations
m/s	meter per second
NAGPRA	Native American Graves Protection and Repatriation Act
NaI	sodium Iodide
NHD	National Hydrography Dataset
NIST	National Institute of Standards and Technology
NM 605	New Mexico Highway 605
NMAC	New Mexico Administrative Code
NMCRIS	New Mexico Cultural Resource Information System
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environmental Department
NMERT	New Mexico Environmental Review Tool
NRCS	Natural Resources Conservation Service
NUREG	Nuclear Regulatory Commission publication series
OAS	Office of Archaeological Studies
PCOC	primary constituent(s) of concern
PDAA	Potential Downstream Affected Area
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control

SAP	Sample and Analysis Plan
SDAM	Stream Flow Duration Assessment
SGCN	Species of Greatest Conservation Need
SOP	scope of work
TCS	Tribal Cultural Specialist
TDS	total dissolved solids
THPO	Tribal Historic Preservation Officer
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1 INTRODUCTION

Laramide Resources Ltd. (Laramide) proposes to develop an underground uranium mine in central New Mexico. The proposed mine is in the Ambrosia Lake Mining District, approximately 10 miles northwest of Grants, New Mexico (Map 1-1 and Map 1-2). This Sampling and Analysis Plan (SAP) was prepared to describe the proposed baseline data collection/sampling and analysis methods for presentation in a baseline data report (BDR) to support New Mexico Mining and Minerals Division (MMD) permitting requirements. The proposed mine is on the western flank of the La Jara Mesa in Cibola County, New Mexico, primarily on U.S. Forest Service (USFS)-managed lands in the Cibola National Forest (CNF), Mount Taylor Ranger District.

As part of the New Mexico Mining Act permit application process (Subsection D.12 of 19.10.6.602), the New Mexico MMD requires the development of a sampling and analysis plan (SAP) detailing the sampling objectives, data to be collected, collection and analysis methods, parameters, sampling locations and frequency, quality assurance plans, and a brief justification for the proposed approach for each relevant resource specified in Subsection D.13 of 19.10.6.602. Laramide retained multiple contractors to support the development of this SAP (Table 1-1). This document, a revision to the previously submitted SAP, addresses current conditions and agency comments compiled by the state dated January 15, 2025.

1.1 Overview of Proposed Mine Operations

Laramide revised a Mine Plan of Operations (MPO) during 2025 for the proposed La Jara Mesa Uranium Mine. The plan will provide a detailed description of the proposed mine operations and reclamation plan. A summary is provided below.

The La Jara Mesa Project (LJMP) is a proposed underground uranium mine. Ore would be accessed through two low-angle inclines (about 5,000 feet each) originating at a portal on the southern edge of La Jara Mesa. Excavated, unmineralized “development rock” would be used to build a waste rock pad at the portal, which would also host most surface facilities.

An 8-foot-diameter Escape Raise would be located on top of the mesa above the uranium deposits, serving as ventilation and an emergency exit. Waste rock from boring the raise would fall into the mine, then be hauled out through the inclines to the pad. No waste rock would remain on top of the mesa.

1.1.1 Surface Facilities

The surface facilities would be constructed on or near the pad. These include:

- Shops, offices, and administration building
- Maintenance facility
- Ore storage facility (on a compacted clay liner)
- Miner change houses (dry)
- Substation
- Fuel and explosives storage
- Parking

- Salvaged topsoil stockpile

No milling would occur onsite. Ore would be transported to a licensed third-party mill.

1.1.2 Surface Disturbance and Access

Approximately 50 acres of surface disturbance is expected within the 97-acre Permit Area for the mine portal and pad, stormwater ponds, administrative facilities, escape raise, haul road improvement, and utility corridor development (Map 1-2 and 1-3). An existing unimproved road that crosses private and CNF-managed lands would be improved and partially re-aligned to provide access from the New Mexico Highway 605 (NM 605) to the mine. The existing driveway access to NM 605 would be modified to accommodate the geometry of the improved road. Water and electric power utility lines would parallel the existing mine access road in the Permit Area on Forest Service lands. Because the ore would be hauled to a licensed mill, no ore processing (milling) or mill tailing disposal areas are associated with this project.

1.1.3 Mine Development

Topsoil would be salvaged from the development area and preserved in a protected stockpile. The barren (un-mineralized) rock produced during construction of the inclines, escape raise, and mine development would be placed in the waste rock stockpile just west of the portal. Approximately 452,000 tons of waste rock are expected on the waste rock stockpile. A flat pad area constructed from waste rock would be used as a foundation for the mine buildings and facilities. Stormwater diversions and collection ponds would be constructed to control and contain surface water. A compacted clay-lined area with internal drainage controls would be constructed for temporary ore storage.

Mine development would take place in two phases. During Phase One of mining, an estimated 40,000 to 50,000 tons of ore would be removed for bulk mill testing. If Phase One is successful, full production would take place in Phase Two. Under full production, the mine is expected to yield an average of 500 tons per day. Approximately 1,800,000 tons of ore are expected to be mined. Ore would be mined using a room-and-pillar method.

The ore would be transported to the surface in underground mine trucks and placed on a compacted clay liner to prevent mixing of the waste rock and ore. The ore would be regularly loaded and transported in 40-ton highway trucks to a licensed mill for processing via a haul road with access to NM 605. The transport route to the mill has not been finalized.

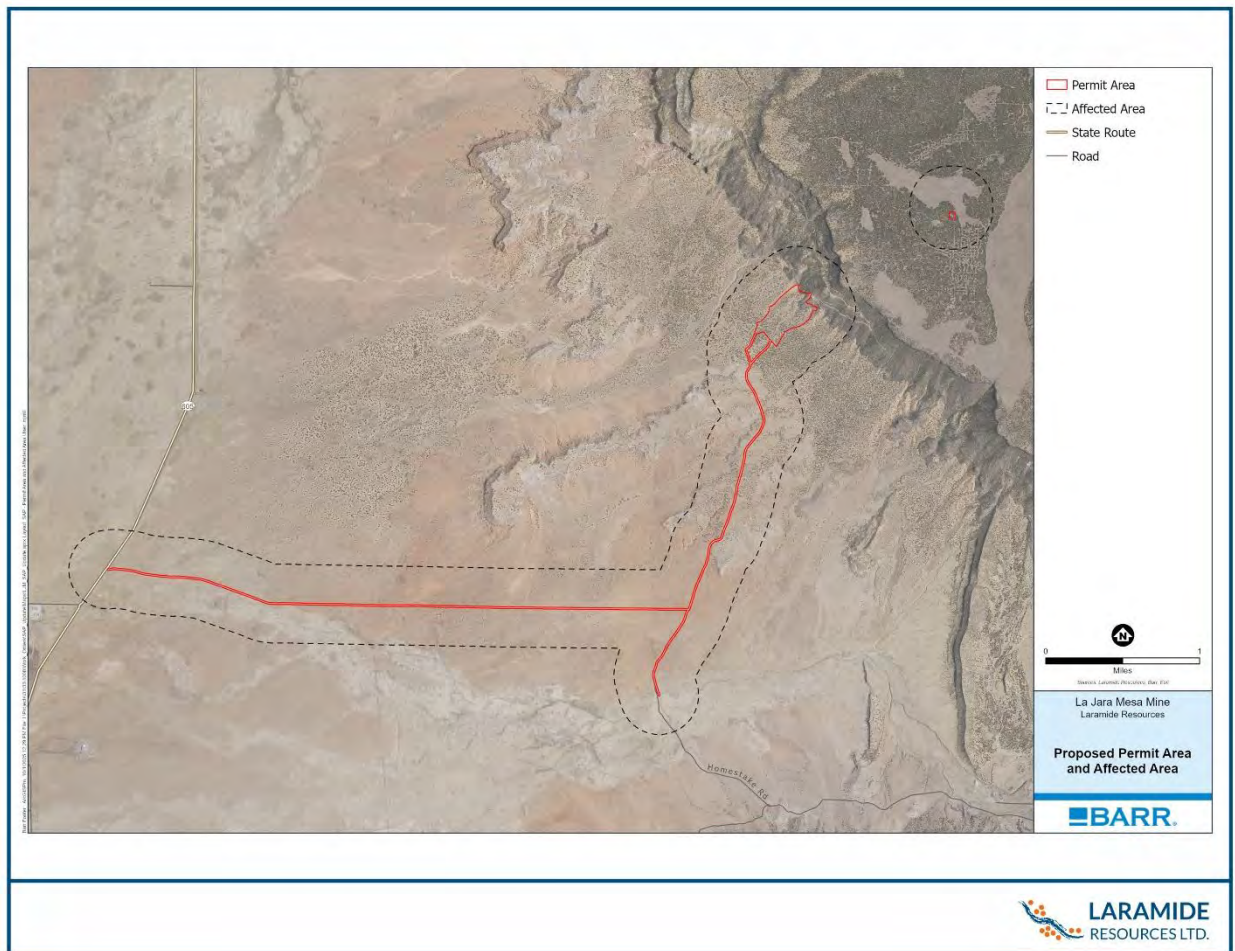
1.1.4 Closure

Upon closure, Laramide would reclaim the site to meet the requirements of New Mexico Administrative Code (NMAC) 19.10.6.603. The major components of the reclamation involve permanently closing the mine workings (inclines) and escape raise, demolishing and removing the buildings, recontouring the waste rock pad, reestablishing the hydrologic connection of the surface waters, and covering and revegetating the waste rock piles. The haul road would be decommissioned and revegetated on CNF-managed lands. The purpose of the reclamation is to return disturbed areas to a stabilized and self-sustaining condition consistent with post-mining land use and the surrounding ecosystem.

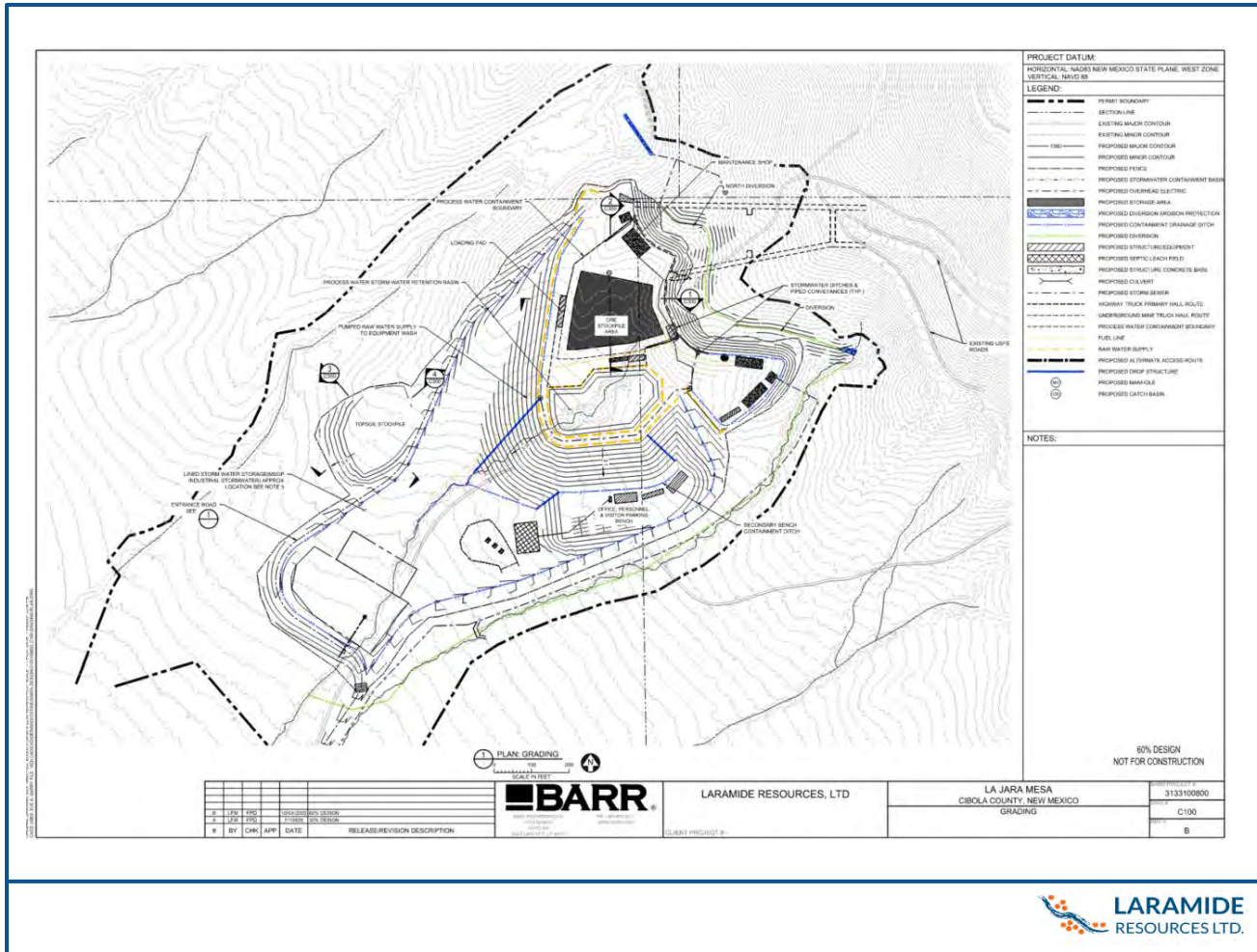
1.2 Proposed Permit Area

The proposed Permit Area is about 97 acres. It includes a 1-acre escape rise, a 48-acre mine area, and a 48-acre haul road and utility corridor. Operational water will be required, but no well location has been





Map 1-2 La Jara Mesa Mine Location Detail Showing Permit Area and Affected Area



Map 1-3 Preliminary Mine Area Layout

1.3 SAP Organization, Objectives, and Contributors

The objective for assembling the baseline data is to describe the existing Permit Area and Affected Area conditions to the extent practicable. The requirements for collecting baseline data are broadly defined under 19.10.6.602.D.13 NMAC, with the level of detail determined by the location, size, scope, and type of mining operation at the discretion of the MMD Director. The SAP presents proposed methods for obtaining and evaluating baseline conditions outlined in the MMD Part 6 New Mine Guidance (MMD 2010), as well as specific requirements identified through the MMD multi-agency review and comment process. The plan is structured in sections that address sampling and analysis proposed for the following parameters: climate (Section 2), topography (Section 3), vegetation (Section 4), wildlife (Section 5), soils (Section 6), ore body and geology (Section 7), surface water (Section 8), groundwater (Section 9), background radiation (Section 10), prior mining operations (Section 11), historic and cultural properties (Section 12), and land use (Section 13).

Individual sections were prepared by multiple Laramide contractors and Laramide (Table 1-1). Sections identify the sampling objectives, relevant data/information to be collected/obtained including methods and parameters, the affected area applicable to the resource or topic, sampling locations (if known), and the number and frequency of sampling/collection efforts. Quality assurance protocols for data collection and

management are provided in the attached Quality Assurance Project Plan (QAPP) in Appendix A. All sampling and analytical activities described in this SAP will be conducted in accordance with the approved QAPP. The QAPP defines the project quality objectives, QA/QC requirements, and data validation procedures.

Table 1-1 SAP Contributors

Section/Role	Provider(s)
1. Introduction	Laramide Resources Ltd. (Laramide)
2. Climate	Barr Engineering Co. (Barr)
3. Topography	Barr Laramide
4. Vegetation	Cedar Creek Associates Inc.(Cedar Creek)
5. Wildlife	Cedar Creek Barr (gray vireo)
6. Soils	Cedar Creek
7. Orebody and Geology	Laramide
8. Surface Water	Laramide Barr (digital arroyo profiles, approved jurisdictional determination)
9. Groundwater	Barr
10. Radiological Testing	Environmental Restoration Group (ERG)
11. Prior Mining Activity	Laramide
12. Historic and Cultural Properties	Office of Archaeological Studies (OAS)
13. Land Use	Laramide Barr
14. References	All
15. QAPP	Laramide Barr ERG Cedar Creek
16. Mapping	Barr ERG Cedar Creek OAS
17. Compiling, formatting, and technical editing	Barr

*Primary contributor listed first

2 CLIMATE

Climate is an important determinant of site ecological potential and a major consideration in operational and reclamation engineering designs. The climate of the La Jara Permit Area is broadly categorized as cool and dry. Mean annual temperature is near 50°F, and precipitation averages about 17 inches per year

in the portal area. Because of the elevation difference, the climate conditions at the escape raise are likely to be somewhat cooler and wetter than the lower elevation mine facilities.

2.1 Objective

The objective for collecting baseline climatic data is to provide a representation of the conditions that may occur in the Permit Area. The data would include assessments of the normal and extreme conditions, which are important for assessing reclamation and engineering designs.

2.2 Sampling Design and Methods

In the southwestern United States, weather conditions are highly variable from year to year. Because of the wide range of seasonal and annual conditions in this region, collecting site-specific data during the baseline period (e.g., 12 months) is expected to be of limited value. Therefore, Laramide proposes to compile historical data from six stations to describe the site's climate.

The Grants remote weather station (Grants RAWS), Grants Airport, San Mateo, Rice Park, and McGaffey stations were selected to represent the project site from a geographic and elevation perspective (Map 2-1). The Grants RAWS is about 5 miles east of the Project, has west-facing topography, and is on the same mountain feature as the Project and thus likely to capture the same storm cells as the Project location. The LJMP is about 10 miles from the Grants Airport and San Mateo stations and occurs at a similar elevation. The McGaffey station is about 40 miles northwest of the LJMP but was selected because it is similar in elevation (8,000 feet) to the escape raise portion of the Permit Area. Similarly, the Rice Park station is about 28 miles west of the Project and provides an overlapping period of record with McGaffey to aid in synthesizing a combined period of record. The Homestake Mill station is included for regional characterization but is not anticipated to provide direct correlation for the Project site. Table 2-1 lists summary information about the proposed stations. Historic records from the stations are expected to be a mixture of daily, monthly, and annual data, depending on station and year of record. If available, daily records would be compiled for the baseline period. Data from these stations would be compiled and summarized to provide an understanding of the distribution, probable ranges, prevailing winds, and extremes in precipitation and temperature that might be expected in the mine area. Data relevant for engineering purposes (e.g., 100-year, 24-hour distributions) would also be compiled.

Table 2-1 Permit Area Climate Station Summaries

Weather Station	Distance/direction from Portal (mi)	Elev. (ft)	Period of Record		Mean Annual Temperature (°F)	Mean Annual Precipitation (inches)
Grants RAWS	5 ESE	8,250	1/17/1986	Present	46.5	13.87
Grants Airport	10 SW	6,530	5/1/1953	Present	49.8	10.28
San Mateo	10 NE	7,300	4/1/1918	2/29/1988 ⁽¹⁾	48.1	8.66
McGaffey 5SE	40 NW	8,000	1/1/1949	1/31/2014	43.3	17.65
Rice Park	28 W	8,480	10/1/1998	Present	44.5	19.72
Homestake Mill	4 W	6,600	1997	Present	TBD	TBD

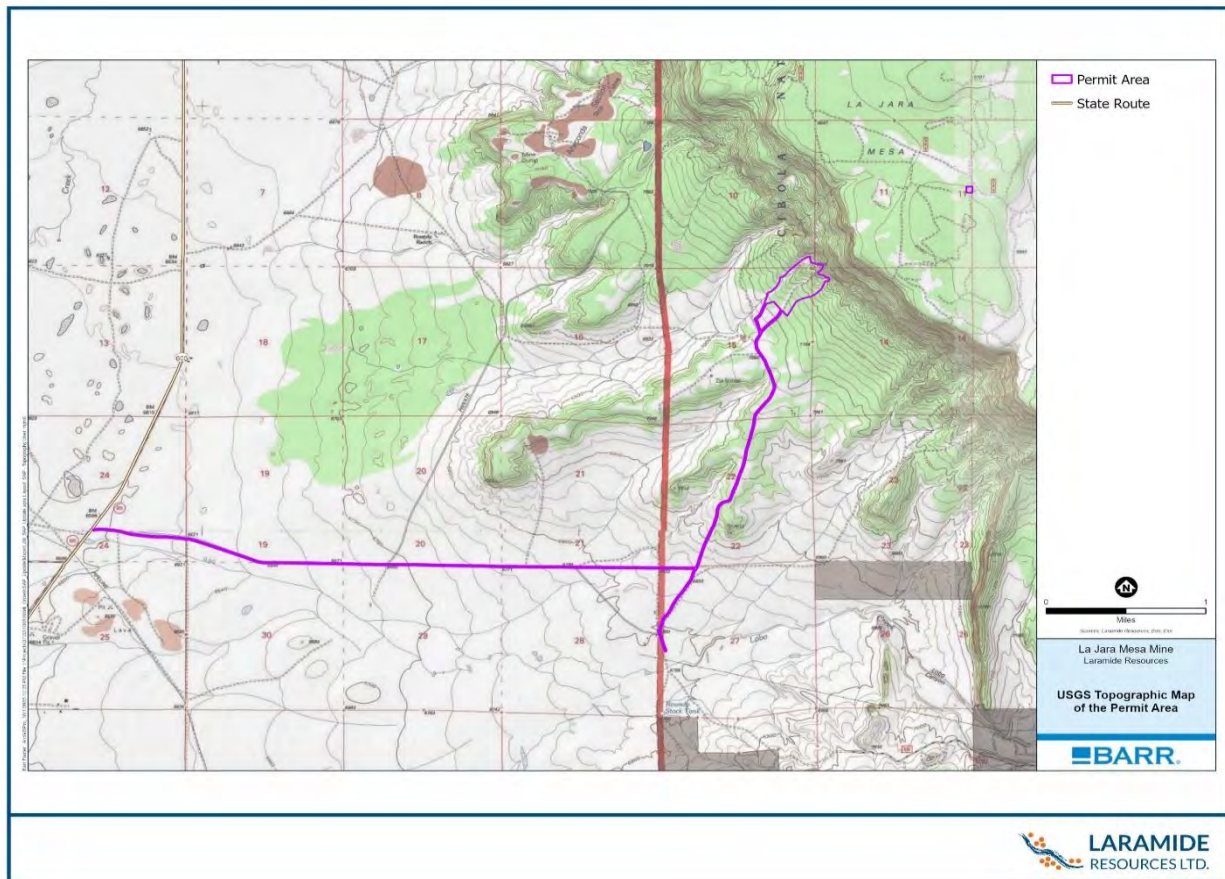
⁽¹⁾ San Mateo monitoring by New Mexico State University may have resumed in spring 2025; future data availability TBD.



Map 2-1 Climate Stations near the Permit Area

3 TOPOGRAPHY

Topographic considerations are important in mine planning to assess engineering and drainage-related issues. Map 3-1 provides an overview of the Permit Area and surrounding topography. The Permit Area is near the La Jara Mesa escarpment, a gently to steeply sloping dissected pediment that ranges in elevation from about 6,800 to 8,000 feet above mean sea level (AMSL). The Permit Area ranges in elevation from about 6,600 feet AMSL, where the haul road leaves NM Highway 605, to about 8,080 feet AMSL at the escape raise on the mesa top. The mine portal and main facilities occur at the base of the escarpment from about 7,100 to 7,500 feet AMSL. An access road would extend south from the portal to the Forest Service boundary, then west across private land to NM 605. The access road crosses gently sloping dissected pediment and alluvial fan surfaces extending southwest from the escarpment. A utility corridor would follow the access road from the portal and extend farther southward through similar topography. The escape raise and associated generator housing would be sited on the nearly level mesa top surface.



Map 3-1 U.S. Geological Survey (USGS) Topographic Map of the Permit Area

3.1 Objective

The objective for collecting topographic data is to provide a basis for establishing mine engineering baselines, stability considerations, surface water runoff calculations and permitting parameters, permitting boundaries, and facilities siting and layout. Topographic considerations also inform the development of operations and reclamation plans and associated costs.

3.2 Sampling Design and Methods

To characterize topography, Laramide has acquired publicly available digital elevation models (DEMs) at both 1-meter and 10-meter resolutions, as well as lidar point cloud (LPC) data, from the U.S. Geological Survey (USGS). The 1-meter DEM would be used to derive detailed topographic information such as contours, slope, and aspect, and would likely be appropriate for most applications. The 10-meter DEM would be used for applications where a more generalized model of topography is adequate or more appropriate, such as determining slope on a landscape scale. Where appropriate, the LPC data can be used to generate sub-meter DEMs that would enable finer detailed topographic analysis, such as generating 2-foot contours, calculating drainage volumes, or generating realistic 3D visualizations of topography. All topographic analysis would be conducted using ESRI's ArcGIS Pro software package.

4 VEGETATION

Characterizing baseline vegetation in the Permit Area prior to mining will establish expectations for revegetation success for post-mining land uses. In addition, it is necessary to determine whether protected or other target species are present and evaluate any potential for effects. Plant species that are likely to occur in the Permit Area are listed in Table B-1.

The distribution of vegetation in the Permit Area reflects the combined influences of area land use, environmental gradients (soils and climate), disturbance history (mineral development, fire, grazing), management practices, and climate. The Permit Area contains saltbush shrubland, desert grassland, and open piñon-juniper woodland. The site has gently to moderately sloped topography interrupted by sheer rock faces, mesas, and arroyos. Elevations range from approximately 6,600 to 8,100 feet.

4.1 Objective

Baseline vegetation data is intended to support analyses of revegetation success and to determine whether sensitive or threatened and endangered plants are present within the disturbance area.

4.2 Community Mapping

Initial vegetation community mapping was completed using high-quality aerial imagery (Map 4-1). Vegetation community types will be ground-verified and mapped within the Permit Area by a meandering pedestrian survey and/or driving survey. Photo data, vegetation cover, and a list of plant species observed in each community type will be obtained during the field surveys.

4.3 Surveys for Sensitive Plants, Host Plants, and Noxious Weeds

A desktop assessment will be completed to identify state- and federally listed species with a likelihood of occurrence within the Permit Area based on elevational and general habitat requirements compared to the preliminary mapped vegetation communities. Species identified with a moderate-to-high likelihood of

occurrence will be further researched to gather detailed habitat association information and flowering/blooming timeframes to develop a survey schedule and targeted areas for the searches. The initial Information for Planning and Consultation (IPaC) query (Appendix B) indicates that the threatened species Pecos sunflower (*Helianthus paradoxus*) may occur in the Permit Area. The state endangered plants in Cibola County are Parish's alkali grass (*Puccinellia parishii*) and American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*).

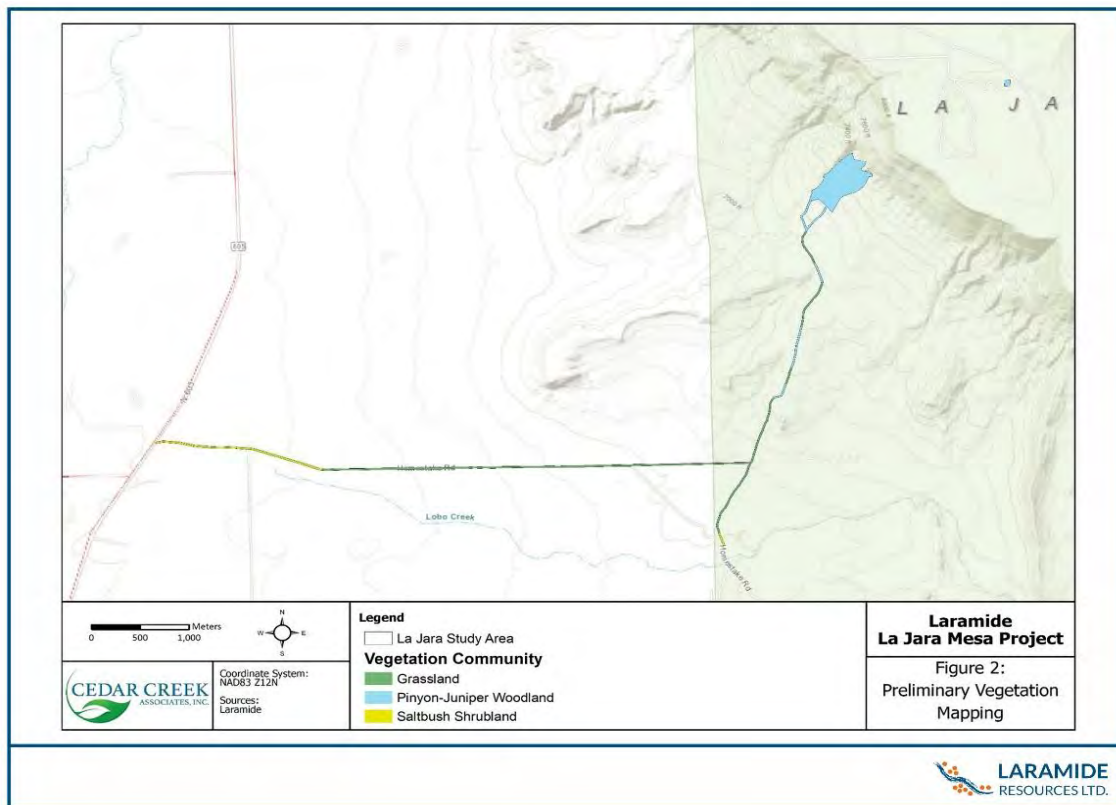
Surveys will be conducted based on plant phenology and timing as identified by the desktop assessment and special status screening process. Special-status species surveys will occur throughout the Permit Area. Based on the survey windows for species with a moderate-to-high likelihood of occurrence, special-status species surveys began during late summer (2025) and are expected to continue during spring (2026). The field effort will consist of surveying the Permit Area and a suitable surrounding buffer area (Affected Area), shown in Map 4-1. Pedestrian surveys will be conducted during the appropriate season for the target species to confirm identification. Qualified biologists will use the intuitive controlled pedestrian (walking) survey method, which is suitable for large areas. Specialists will traverse the study area, covering representative habitats, topographic features, and visiting known occurrence locations. Survey tracks will be recorded. If a target plant species is found, photographs, Universal Transverse Mercator (UTM) coordinates, population size, and associated species will be recorded on the appropriate form(s).

Cedar Creek personnel will also record all species encountered within each vegetation community. This species inventory is useful for 1) developing floristic information for the region, 2) assembling additional habitat characterization information for any associated threatened or endangered plant species, and 3) refining knowledge about the distribution and frequency of plant species in the region.

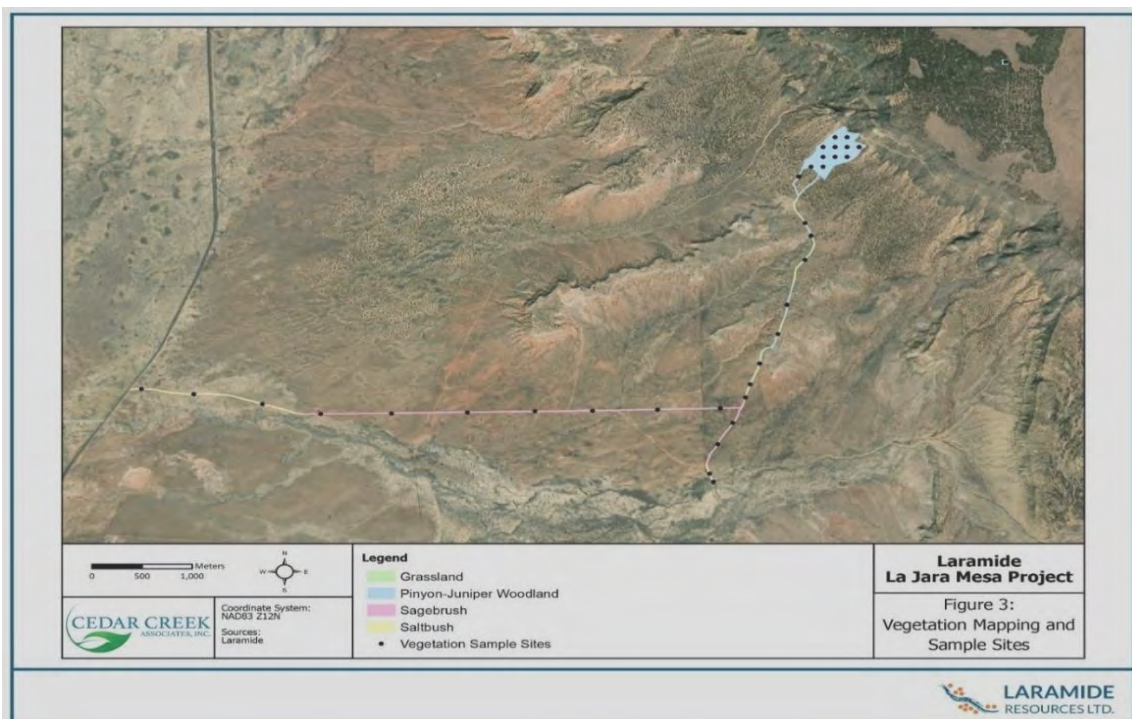
During habitat assessment and plant species surveys, Cedar Creek personnel will also incidentally record any instances of milkweeds (host plants for Monarch butterflies, a currently proposed threatened species) and noxious weed species observed. Specific noxious weed surveys will be implemented throughout the Permit Area, with special attention to areas with known noxious weed vector pathways, such as roads. The survey will include all weeds identified by the New Mexico Department of Agriculture (2020). Noxious weed findings will include photographs, mapping, and abundance estimates.

4.4 Quantitative Vegetation Characterization

Quantitative vegetation characterization will occur in vegetation communities within the Permit Area. In each of these communities, sample sites will be evaluated for vegetation cover, productivity, and woody plant density, in accordance with the methodology presented below. In accordance with MMD guidelines, each vegetation community (and reference areas) will be evaluated with randomly located sample sites. Proposed reference area locations are provided in Map 4-1. In addition, sample adequacy for dominant communities and associated reference areas will be demonstrated using the Cochran formula for vegetation cover, woody plant density, and productivity. Quantitative vegetation sampling will occur in September, during the peak production period following the monsoon season. All vegetation sampling will be completed within 1 week.



Map 4-1 Preliminary Vegetation Community Map



Map 4-2 Proposed Vegetation Sampling Locations

4.4.1 Map Vegetation Cover Methodology

Ground cover at each sampling site will be determined using the point-intercept methodology (Bonham 1989). This methodology has been used for range studies for over 80 years. The sampling technique is implemented as follows: First, a 10-meter-long transect is extended from the starting point of each sample site in a random direction. Then, at each 1-meter interval along the transect, a laser point bar or optical point bar will be situated vertically above the ground surface, and a set of 10 readings will be recorded for hits on vegetation (by species), litter, rock, or bare soil. Hits will be determined at each meter interval by activating a battery of 10 specialized lasers situated along the bar at 10-centimeter intervals and recording the variable intercepted by each narrow-focused (0.02 inch) beam (Maps 4-1 and 4-2). In this manner, a total of 100 intercepts per transect will be recorded, resulting in 1 percent cover per intercept.

4.4.2 Production Methodology

At each sample site, current annual production is collected from a 1/2 m² quadrat frame at each sampling location. Utilization and development will be estimated from on-the-ground observations of herbivory within each quadrat frame. The quadrat is placed 1 meter and 90° to the right (clockwise) of the ground cover transect to avoid vegetation trampled by investigators during sample site location. From within each quadrat, all above-ground current annual vegetation within the vertical boundaries of the frame is clipped and bagged separately by life form as follows:

Native Perennial Cool Season Grass	Shrub
Native Perennial Warm Season Grass	Sub-Shrub
Introduced Perennial Grass	Native Perennial Forb
Annual Grass	Introduced Perennial Forb
Noxious Weed	Native/Introduced Annual/Biennial Forb

All production samples are returned to the lab for drying and weighing. Drying will occur at 105°C until a stable weight is achieved (24 hours). Samples will then be weighed to the nearest 0.1 gram. Utilization and growth stage adjustments will be incorporated into the presentation of results.

4.4.3 Shrub / Tree Density Methodology

Shrub and tree density at each sampling site will be determined using fixed-length/width belt transects oriented parallel to, and co-located with, each ground cover transect. Each belt is 2 meters in width and extends from the beginning of the sample point to 50 meters. All shrubs, sub-shrubs, succulents, and trees rooted within the boundaries of these belts will be counted and classified according to species.

4.5 Reporting

Following completion of fieldwork, a baseline biological report for vegetation will be prepared, describing the findings of desktop analysis and field surveys. The report will include methodology, sample locations, summary findings, raw data, and any agency correspondence, determinations, or agreements obtained during the assessment surveys that are relevant to the reporting and permit application. Maps and the associated geographic information system (GIS) shapefiles containing applicable information, such as

field-verified vegetation communities, points/areas of interest, and photographs, will also be included in the baseline report.

5 WILDLIFE

The Permit Area is within the Arizona-New Mexico Mountains Ecoregion (Griffith 2006). It is broadly classified as a Pinyon-Juniper woodland. No permanent water sources or riparian ecosystems are present. Wildlife surveys will occur based on habitat types, as characterized by a wildlife biologist. In general, the major habitats correspond to identified vegetation types, though some physical habitats will be extensive enough to warrant wildlife sampling. In general, the proposed wildlife surveys will be implemented in the affected area, including the Permit Area (all mine facilities, including the escape raise and utility corridor) and a suitable buffer based on wildlife type.

5.1 Habitat Assessment for Special Status Species

A desktop assessment will be conducted to identify state- and federally listed species with a likelihood of occurrence within the Permit Area based on elevational and general habitat requirements of each species. For each species potentially occurring in the Permit Area, a qualified wildlife biologist will determine whether suitable habitat is present. If suitable habitat is likely to be present within the Permit Area, species-specific surveys will be conducted. Detailed survey methods will be developed in consultation with the U.S. Fish and Wildlife Service (USFWS) for any threatened or endangered species that may occur within the Permit Area or its immediate vicinity. A preliminary USFWS IPaC webtool query (USFWS 2026) indicates that the following species may occur in the Permit Area:

- Mexican Wolf (*Canis lupus baileyi*)—Endangered
- Mexican Spotted Owl (*Strix occidentalis lucida*)—Threatened
- Southwestern Willow Flycatcher (*Empidonax traillii extimus*)—Endangered
- Yellow-Billed Cuckoo (*Coccyzus americanus*)—Threatened
- Monarch Butterfly (*Danaus Plexippus*)—Proposed Endangered
- Suckley's Cuckoo Bumble Bee (*Bombus suckleyi*)—Proposed Endangered

The New Mexico Environmental Review Tool (NMERT), attached in Appendix B, was used to identify the potential for New Mexico Species of Greatest Conservation Need (SGCN) and Species of Economic and Recreational Importance in the Permit Area. The NMERT report listed 36 wildlife species to consider (Appendix B). The NMERT report also indicated that the burrowing owl (*Athene cunicularia*) may occur in the Permit Area. Burrowing owls are protected from *take* by the Migratory Bird Treaty Act and under New Mexico state statute. Black-tailed prairie dogs (*Cynomys ludovicianus*) are designated as New Mexico SGCN. Any burrows in the Permit Area will be surveyed by a qualified biologist to determine whether they are active or inactive and whether burrowing owls may be using the site. All agency species lists will be updated prior to the completion of baseline data reporting.

5.2 Migratory Bird Surveys

Migratory birds will be surveyed in representative habitats throughout the Permit Area by a point-count transect survey using the Integrated Monitoring in Bird Conservation Regions (IMBCR) protocol (McLaren et al, 2025). The surveys will be implemented in favorable weather conditions for bird activity. They will

characterize the general presence of bird species that use the Permit Area and relative activity in different habitats. The surveyor walks from point to point, stopping to listen and observe birds at each point for 5 minutes. The 14 sample points are located at least 300 m apart to avoid double-counting. A qualified surveyor will use auditory and visual identification methods to identify all the species present. Initial surveys began during the winter months of 2025/2026 and are expected to continue through May to early June 2026 for peak breeding season.

5.3 Raptor Nesting Surveys

Ground-based raptor surveys will be conducted within 1 mile of the basalt cliff line habitat and ½ mile of the Permit Area by a qualified wildlife biologist who is familiar with nesting habits and territorial behavior. Nest searches will concentrate in likely habitats depending on the species potentially present. The wildlife biologist will carefully observe cliff and rimrock faces, bluffs, outcrops, knolls, trees, snags, cavities, and other likely habitats or features using high-quality optics. They will pay particular attention to substrate, aspect or exposure, height, and other characteristics of sites typically selected for nesting and look for nests, telltale “whitewash” streaks, returning or circling birds, and defensive behavior. The survey will also visit known nests identified through a data request with New Mexico Natural Heritage and the New Mexico Department of Game and Fish (NMDGF). If nests are found, the surveyor will determine the status and success (unoccupied, occupied active, incubating, fledglings present, etc.) from the greatest distance possible, using existing terrain and vegetation as a screen where feasible. Follow-up visits may be necessary to collect data on nest success and production. The raptor surveys will occur in Began in December 2025/January 2026 and will continue into late May or early June 2026, concurrent with the migratory bird surveys. Grey vireo (*Vireo vicinior*) surveys have already been completed (see below).

5.4 Herpetofauna and Small Mammal Surveys

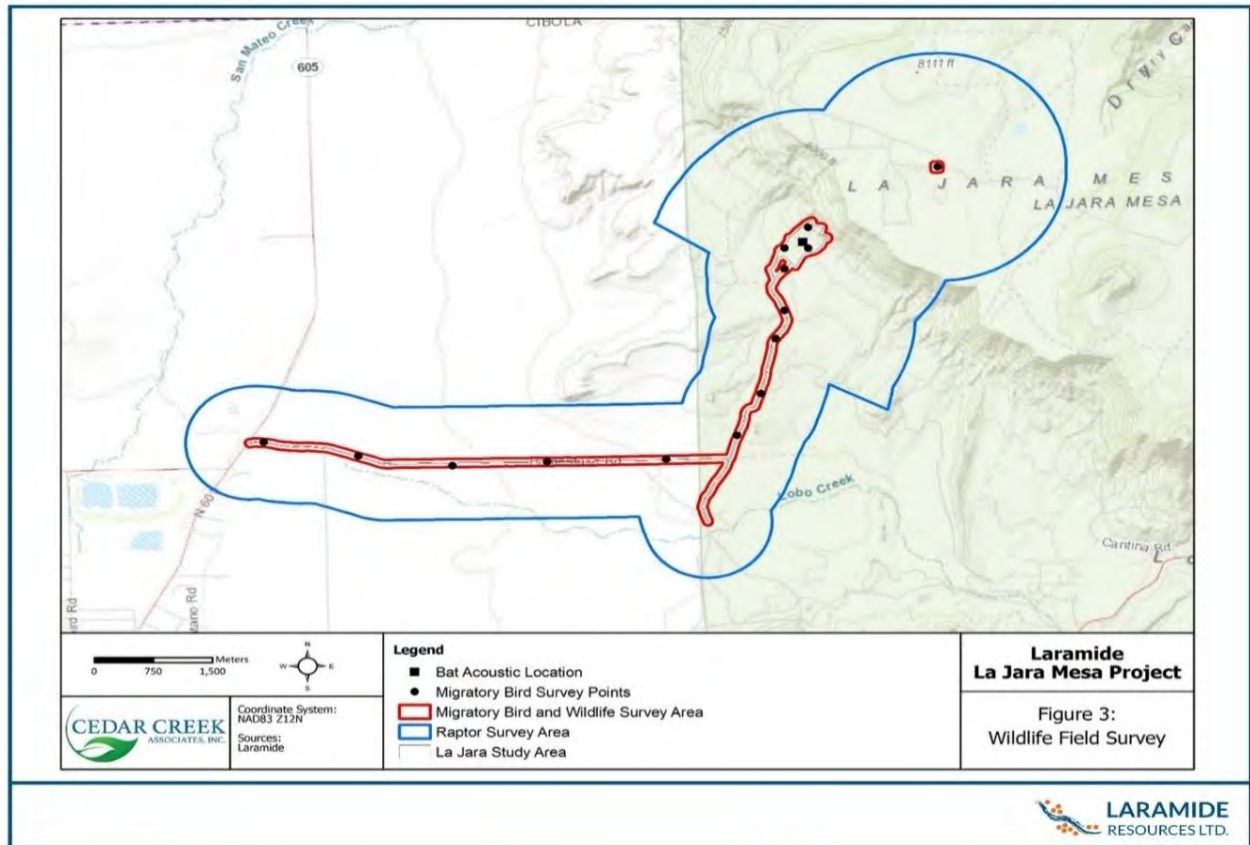
A qualified biologist conducted herpetofauna and small-mammal surveys using visual and auditory encounter methods, implemented systematically throughout the Permit Area in late summer (2025) and is expected to continue into spring (2026). Species occurrence will be determined by observing species or signs (such as scat) and identifying calls.

5.5 Acoustic Bat Survey

An acoustic bat recorder, which is suitable for detecting the spotted bat, was deployed for 5 days during September 2025 within the main proposed disturbance area in the Permit Area. A second deployment will be made in the Spring of 2026 for at least 3 days. A qualified bat biologist will interpret the collected acoustic data to provide a list of bat species in the Permit Area.

5.6 General Wildlife Surveys -

Wildlife biologists will establish and walk broad transects through the different habitats of the Permit Area to record wildlife presence within the wildlife survey areas (Map 5-1). Along the transects and in special habitats, biologists will note the number, size, and type of burrows; nests observed; other signs of wildlife (e.g., scat, feathers); and any wildlife observations. Pellet counts for big game will be completed during the woody plant density assessment (within the same belts). General wildlife surveys were initiated in the late summer (2025) and will continue through spring (2026).



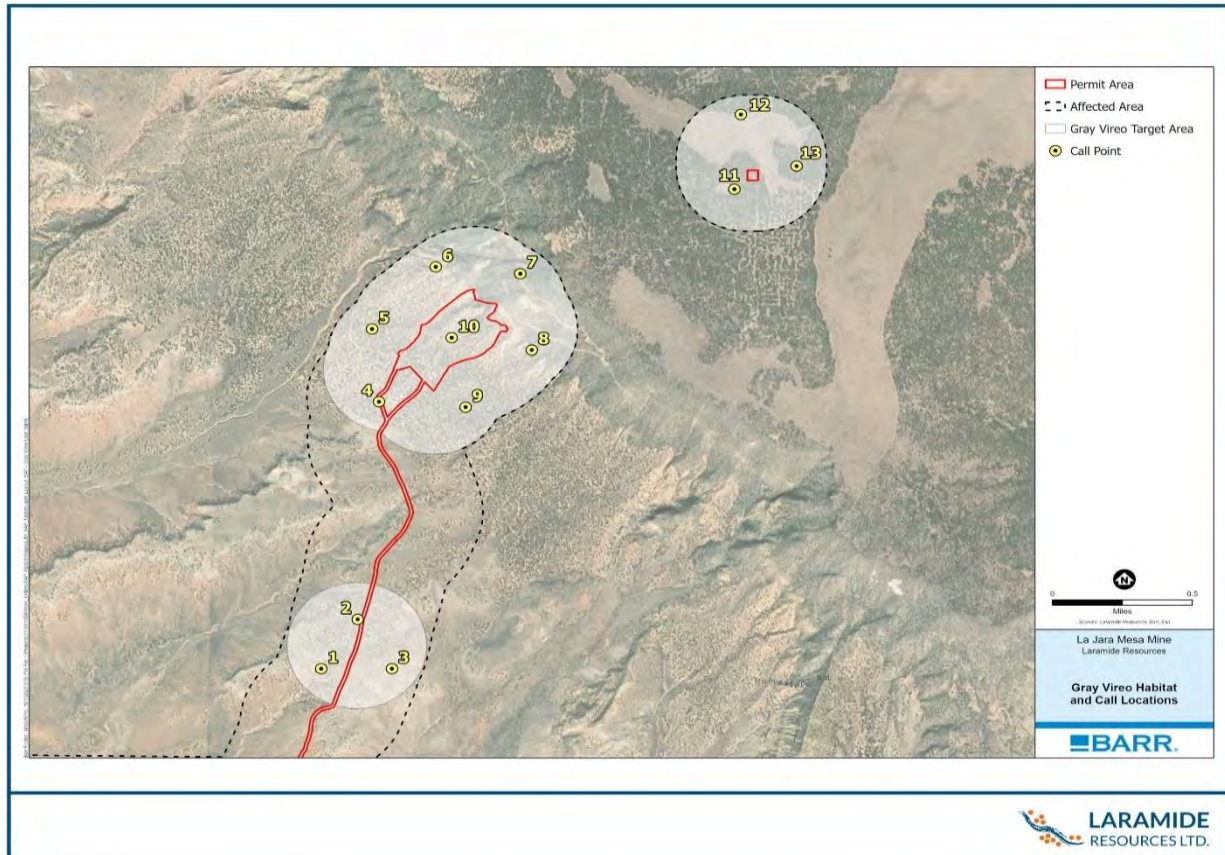
Map 5-1 Wildlife Survey Areas

5.7 Reporting

Following completion of fieldwork, a baseline biological report for wildlife will be prepared, describing the findings of desktop analysis and field surveys. The report will include methodology, sample locations, summary findings, considerations of habitat fragmentation, and raw data. Any agency correspondence, determinations, or agreements obtained during the surveys relevant to the reporting and permit application will be included. Maps and shapefiles containing applicable information, such as field-verified vegetation communities, habitat surveyed, points/areas of interest, and photographs, will also be included.

5.8 Gray Vireo

The NMDGF requested species-specific surveys for the state-threatened gray vireo (*Vireo vicinior*) based on habitat suitability in the Permit Area. Barr conducted this survey during the 2025 nesting season. Suitable gray vireo target habitats within the Permit Area and Affected Area were identified through a review of mapped vegetation communities, aerial imagery, and previous survey findings. Surveys were conducted in three focus areas, shown as Gray Vireo Target Areas on Map 5-2. Thirteen call points were generated using GIS tools to fix points at approximately 250–300 meter intervals within focus areas. The field protocol involved a call playback method (Adapted DeLong and Williams 2006 protocol; NMDGF Gray Vireo Symposium, 2008). A memorandum of findings was prepared and will be incorporated into the next version of the BDR, referred to as BDR V.0. No follow-up surveys are currently planned.



Map 5-2 Gray Vireo Habitat and Call Locations

6 SOILS

Reclamation of the waste rock pile and disturbed areas would be completed once the facilities are no longer needed or following the closure of the mine. Laramide proposes to salvage and stockpile soils that would ultimately be used as a soil cover to reclaim the waste rock pile.

6.1 Objective

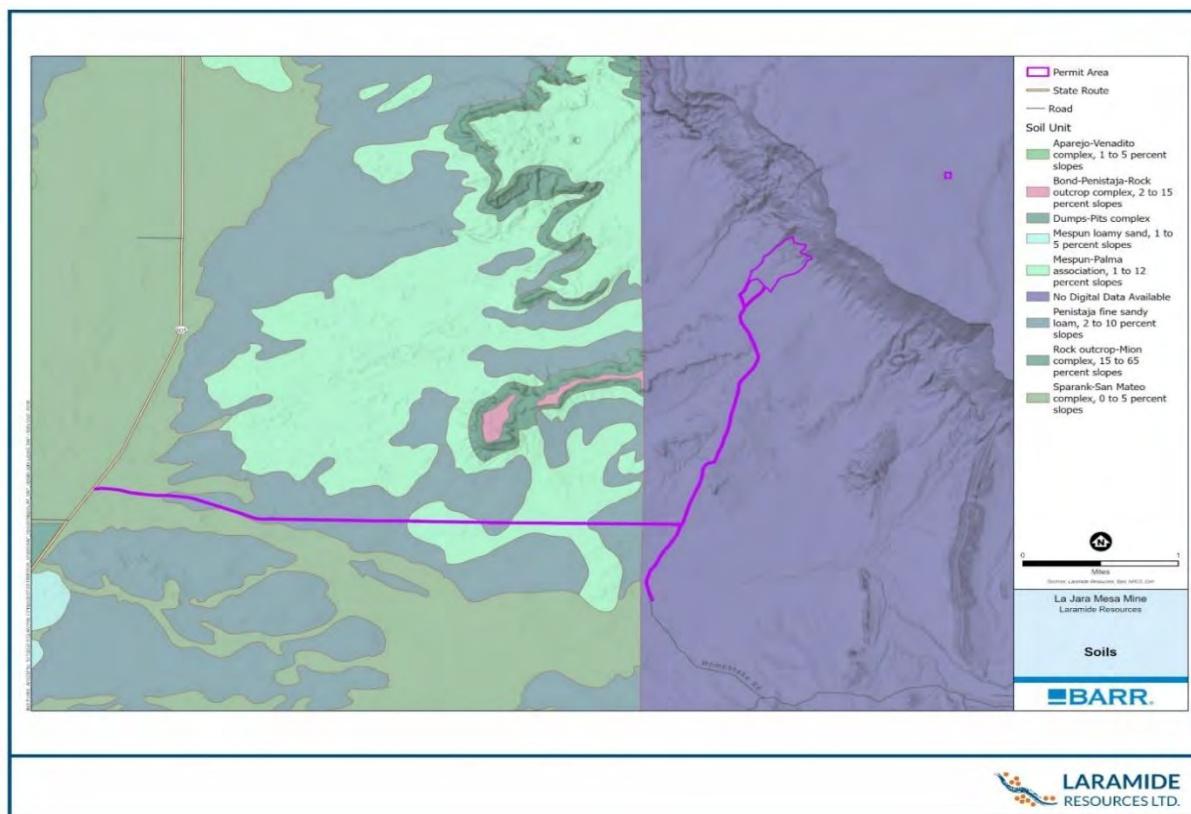
The objective for collecting baseline soils data is to provide a basis for determining the suitability of the materials as reclamation substrates. This information would be used to develop salvaging strategies to determine if sufficient volumes of suitable material would be available at closure. Mapped soil units in the Permit Area are provided in Table 6-1.

The MMD's reclamation performance standards require that native soils and other soil resources be characterized to determine their suitability for vegetation establishment. Mine operators are also required to salvage, store, and redistribute suitable soil materials for the revegetation of mine-related disturbances. The soils investigation would document and quantify soil resources to support mine permitting and reclamation planning in accordance with the MMD guidelines.

6.2 Soil Description and Delineation

Soil delineations and descriptions will be implemented throughout the Permit Area. Soil assessments were conducted in September 2025. Lands to be affected through mining or related activity were intensively mapped (Order 1-2). Sample locations were established in representative areas for each soil map unit. Sample locations were determined by changes or relative influences in any of the five soil-forming factors: time, climate, parent material, topography and relief, and organisms. The Project area was traversed and observed prior to selecting representative sampling locations (Maps 6-1 and 6-2).

Five locations were selected for soil description and analysis. Several additional locations were chosen for confirmatory observation and description. The analytical suite for soil testing is provided below. At each sample point, a soil profile (pit) was excavated using a hand auger or shovel to refusal or a maximum depth of 48 inches. The soil profile's morphological features, such as horizon and depth, structure, texture, color, presence of redoximorphic features, effervescence, roots, and visible salts, were described. Landscape information, including slope, aspect, topographic position, and landform, was collected at each sample site. Methodologies for soil evaluations and descriptions followed general US Department of Agriculture Natural Resources Conservation Service (NRCS) guidance, provided within The Field Book for Describing and Sampling Soils, version 3.0 (2012), Soil Survey Field and Laboratory Methods Manual, version 2 (2014), and the Soil Survey Manual (2017). At least one soil description will be implemented in each map unit. Additional excavations may occur for observation purposes.

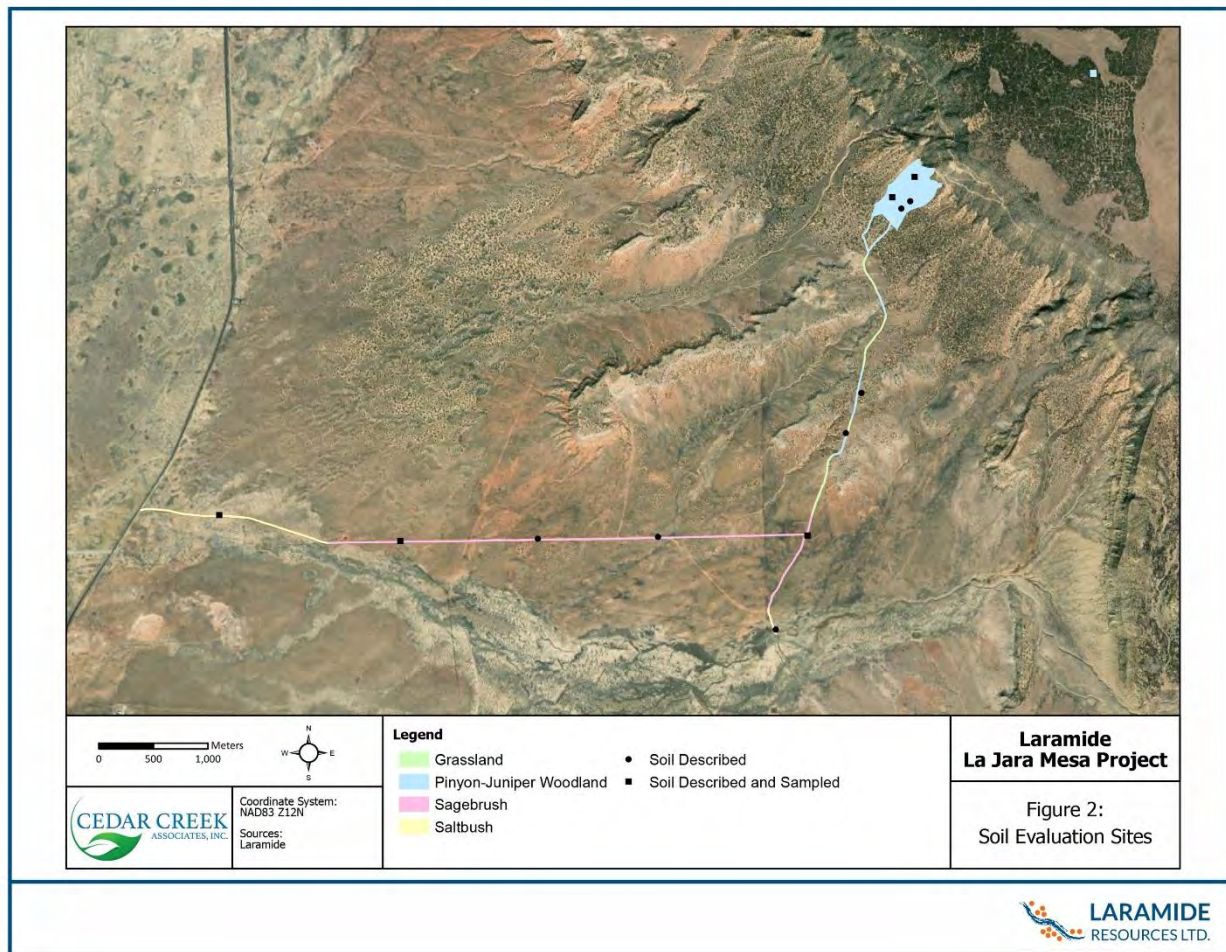


Map 6-1 Mapped Soil Units in the Permit Area

Table 6-1 Mapped Soils Units in the Permit Area

Soil Unit	Acres	Percent of Permit Area
No digital data available	70.8	73%
Penistaja fine sandy loam, 2 to 10 percent slopes	12.5	13%
Mespin-Palma association, 1 to 12 percent slopes	7.0	7%
Sparank-San Mateo complex, 0 to 5 percent slopes	3.7	4%
Penistaja fine sandy loam, 2 to 10 percent slopes	2.6	3%
Total	96.6	100%

Source: SSURGO Dataset



Map 6-2 Soil Sampling Locations

6.3 Agronomic Testing of Growth Media

In accordance with the 2022 MMD Soil Guidance for Soil and Cover Material Handling and Suitability for Part 5 Existing Mines, laboratory analyses will consist of numerous tests to inform the physical and

chemical suitability of materials for use as a reclamation growth media. Routine agronomic tests to be implemented by Colorado State Soil and Plant Testing Laboratory are identified in Table 6-2.

Table 6-2 Soil Testing Parameters and Detection Limits

Parameter	Method	Detection Limit
Metals Analysis		
Arsenic, total (3050)	EPA 6020B	0.1 mg/Kg
Boron, total (3050)	EPA 6010D	3 mg/Kg
Cadmium, total (3050)	EPA 6020B	0.025 mg/Kg
Calcium, soluble (Sat. Paste)	EPA 6010D	0.1 mEq/L
Chromium, total (3050)	EPA 6010D	2 mg/Kg
Copper, total (3050)	EPA 6010D	1 mg/Kg
Iron, total (3050)	EPA 6010D	6 mg/Kg
Lead, total (3050)	EPA 6020B	0.05 mg/Kg
Magnesium, soluble (Sat. Paste)	EPA 6010D	0.2 mEq/L
Magnesium, total (3050)	EPA 6010D	20 mg/Kg
Manganese, total (3050)	EPA 6010D	1 mg/Kg
Mercury by Direct Combustion AA	EPA 7473	4 ng/g
Molybdenum, total (3050)	EPA 6010D	2 mg/Kg
Nickel, total (3050)	EPA 6010D	0.8 mg/Kg
Phosphorus, total (3050)	EPA 6010D	10 mg/Kg
Potassium, total (3050)	EPA 6010D	50 mg/Kg
Selenium, total (3050)	EPA 6020B	0.05 mg/Kg
Sodium Adsorption Ratio	Calculation	Calculation
Sodium, soluble (Sat. Paste)	EPA 6010D	0.2 mEq/L
Thorium, total (3050)	EPA 6020B	0.5 mg/Kg
Uranium, total (3050)	EPA 6020B	0.05 mg/Kg
Zinc, total (3050)	EPA 6010D	2 mg/Kg
Radiochemistry		
Radium 226 (3050)	EPA 903.1	0.5 pCi/g
Sample Preparation		
Air Dry at 34 Degrees C	USDA No. 1, 1972	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	

Parameter	Method	Detection Limit
Digestion—Hot Plate	EPA 3050B	
Saturated Paste Extraction	USDA No. 60 (2)	
Sieve-2000 um (2.0mm)	ASA No.9 15-4.2.2	
Sieve-250 um (60 mesh)	ASA No.9 15-4.2.2	
Water Extraction	ASA No. 9 10-2.3.2	
Soil Analysis		
Acid Generation Potential (calc on Sulfur total)	EPA 600/2-78-054 3.2.4	Calculation
Acid Neutralization Potential (calc)	EPA 600/2-78-054 1.3	Calculation
Acid-Base Potential (calculation)	EPA 600/2-78-054 1.3	Calculation
Conductivity @25C	SM 2510 B-2011	0.001 mmhos/cm
Net Neutralization Potential	EPA 600/2-78-054 1.3	Calculation
Neutralization Potential as CaCO ₃	EPA 600/2-78-054 3.2.3	0.1%
pH, Saturated Paste	EPA 600/2-78-054 3.2.2	0.1 units
Sample Weight	Rad Disposal Compliance	G
Solids, Percent	D2216-80	0.1%
Sulfur Forms	EPA 600/2-78-054 3.2.4 Modified	0.01%
Texture by Hydrometer	ASA No. 9 15-5	0.1%
Wet Chemistry		
Nitrate as N, soluble (Water)	Calculation (NO ₃ NO ₂ -NO ₂)	Calculation
Nitrate/Nitrite as N, soluble (Water)	EPA 353.2	0.1 mg/Kg
Nitrite as N, soluble (Water)	EPA 353.2	0.05 mg/Kg

6.3.1 Radiological Testing of Growth Media

Bulk soil samples will be collected and sent to ACZ Laboratories for analysis of uranium, radium 226, and thorium.

7 OREBODY AND GEOLOGY

The geochemical nature and reactivity of the overburden, waste rock, and ore are important considerations for reclamation planning. Understanding the rocks' structure and character and the configuration of the mine workings relative to groundwater is important for assessing mining activities and potential environmental impacts.

The Permit Area is in the Ambrosia Lake mining district, which has been extensively described (Rautman, 1980; Kelley, 1963). The geologic units of interest range in age from Permian to Quaternary and are dominated by Jurassic and Cretaceous rocks exposed on the Mesa's slopes. The mesa is capped by Tertiary volcanic rocks.

The uranium mineralization is restricted to unnamed sandstone units in the Poison Canyon tongue of the Brushy Basin Member of the Morrison Formation (Laramide, 2008). The uranium-enriched zone is similar to many other sandstone-hosted uranium deposits in the Grants area. The average depth to the uranium mineralized sandstone zone is about 650 to 700 feet below the surface of the mesa.

7.1 Objective

The objective of the Orebody and Geology investigation is to describe the ore body in the proposed Permit Area, including geologic plans and cross-sections depicting the nature and depth of overburden, mineralized zone or ore body, aquifers, and springs. Detailed analyses may be required if the substrata are suspected to contain substances that are likely to cause acid drainage or might degrade surface water or groundwater, or hinder reclamation. Laramide, through a consultant, prepared a BDR in 2013 (La Jara Mesa Project Draft Baseline Data Report [DBDR]), which was resubmitted and received state and federal agency comments in 2025. In response to these comments, Laramide amended the information with detailed maps and cross-sections, including a depiction of the orebody in relation to the shallowest underlying aquifer. Supporting geologic data will include exploration drill logs, a map of exploration drill logs showing the location of the cross-section(s), and data collected during field validation studies. The nature, elevation, and distance of the nearest springs to the proposed Permit Area will be described, including the potential effect of mining at La Jara Mesa on those springs (additional details provided in Section 9).

7.2 Sampling Design and Methods

For the 2013 DBDR, representative samples of the geologic units were collected from existing drill core and outcrop to represent the range of materials that will be associated with the waste rock piles at the mine. The number of samples of each unit is proportional to the expected volumes in the waste rock piles. Until excavation of the mine workings begins, there are no more waste rock samples available, as all core samples have been consumed. No additional rock sampling and geochemical characterization is proposed. Previously reported waste rock sample geochemical and reactivity characteristics will be presented in the 2026 BDR V.0.

7.3 Geology and Stratigraphy

The geology and stratigraphy of La Jara Mesa were described in the 2013 DBDR relative to the ore body and groundwater. Descriptions of the geologic units were developed from published sources, complemented by data from the exploration activities and ground surveys within the Permit Area.

Updated maps and cross-sections will be developed as per state agency requirements. These will be based on historical project files that detail exploration and resource-evaluation activities conducted by Homestake Mining Company and its predecessors. They will illustrate the vertical and horizontal dimensions of the mine workings and ore body relative to stratigraphy and the known hydrology of the proposed Permit Area.

8 SURFACE WATER

The Permit Area occurs in the San Mateo Creek (1302020703) 10-digit and Lobo Creek (130202070305) 12-digit Hydrologic Unit Code (HUC) watersheds. The HUC 12 watersheds are shown in the surficial hydrology map (Map 8-1). Surface water features within and adjacent to the Permit Area convey stream flows classified as both ephemeral and intermittent on the National Hydrography Dataset (NHD) layer

(2023). No springs or other perennial water sources are present in the Permit Area or Affected Area. Surface water features in the Permit Area are ephemeral drainages (flow episodically during storm events—typically late-spring and summer monsoon rainfall). These drainages ultimately terminate as sheet flow without conveying flows to receiving waters (San Mateo Creek). Other surface water features in the vicinity of the Permit Area include stock watering tanks associated with private ranch land.

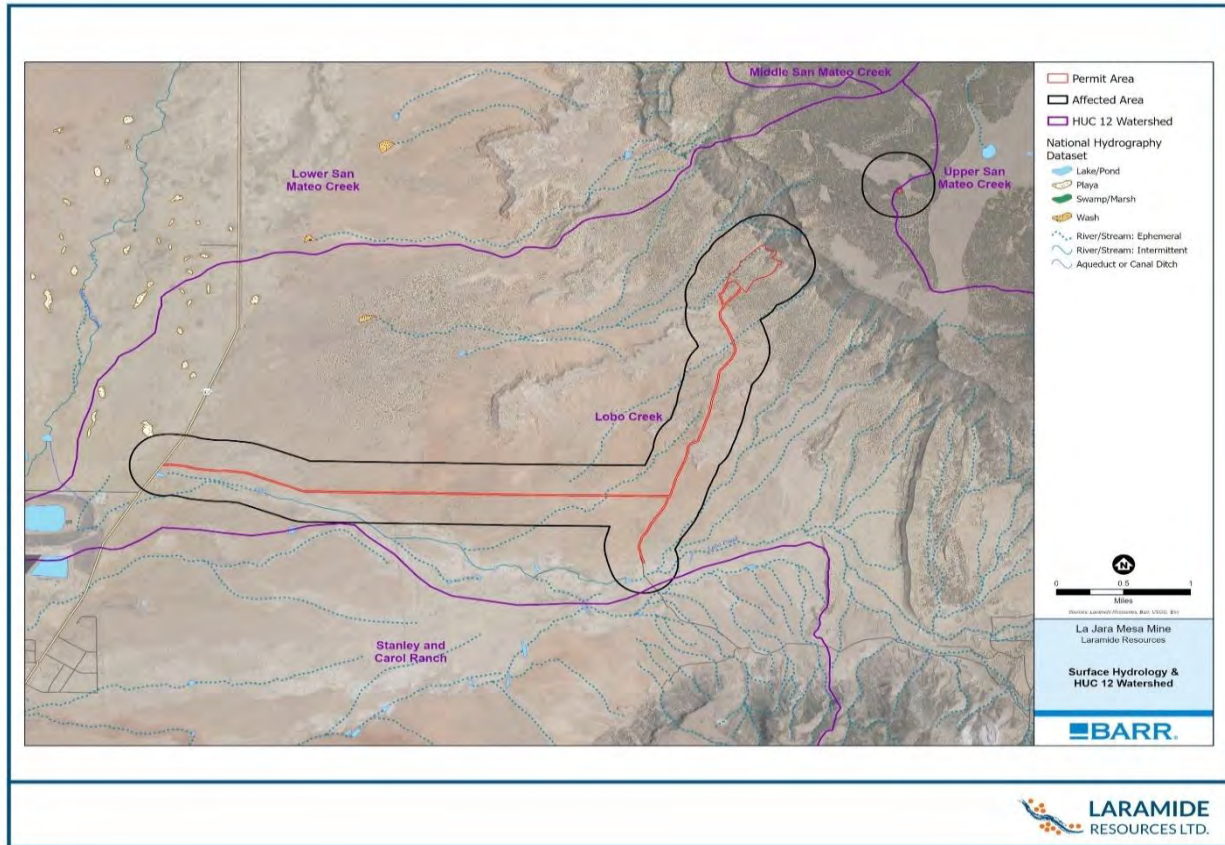
The receiving water for Permit Area flows is San Mateo Creek. Though classified as intermittent on NHD mapping, the creek is now ephemeral through much of its course. San Mateo Creek is a tributary of the Rio San Jose, which discharges into the Rio Puerco, and ultimately the Rio Grande.

8.1 Objectives

The objectives of the surface water sampling and analyses are to delineate the Permit Area watershed, adjacent watersheds, and interior catchments; characterize surface drainages downgradient of the proposed operations; identify the location, channel characteristics, and flow frequency of surface waters; and assess the surface water quality within the identified drainages. The primary requirements for characterizing drainages in the proposed Permit Area are identified in NMAC 19.10.6.602, which describes the requirements for sampling and analysis plans and baseline data requirements. Water quality information will also be used to establish the existing conditions relative to NMAC 20.6.2 and NMAC 20.6.4, which establish water quality standards for the state's surface waters and an anti-degradation policy for these waters. Baseline data collected as outlined in this SAP will be combined with data presented in the previous DBDR.

8.2 Watersheds

Mapping of permit and affected area waterways and other surface water features, as applicable, will be developed using USGS 7.5-minute topographic maps (Dos Lomas and San Mateo Quadrangles) and publicly available watershed datasets. Field investigations will confirm waterway streamflow durations and arroyo condition, as well as arroyo depth, width, and bank conditions. Watershed maps will include watershed boundaries, watershed area, surface water mapping, surface water/sediment sampling locations, as required by 19.10.6.602.D.13.g.i NMAC, and will be included in the BDR V.0.



Map 8-1 Surface Hydrology and HUC 12 Watershed in the Affected Area

8.3 Channel Characteristics, Channel Extent, and Frequency of Flows within Surface Drainages

A description of the channel characteristics for drainages within and adjacent to the proposed Permit Area will be developed based on a review of watershed maps and field observations. This assessment will include documentation at selected points of channel dimensions, gradient, substrate composition, and evidence of erosion or deposition. The U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's Statistical Software Package (HEC-SSP) v 2.3 would be used to model the 2-year, 10-year, and 100-year storm events. The Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) v 4.13 would be used to estimate flows at select points based on the HEC-SSP results. Barr developed a synthetic precipitation for the site that generally matches precipitation data from the National Oceanic and Atmospheric Administration's Atlas 14. By integrating topographic, surface characteristics, soil, and precipitation data, the model will simulate runoff generation and routing throughout the watershed, allowing for estimated flow volumes at select locations.

The extent and frequency of flows will be determined by monitoring weather via available weather services and trail cameras installed on select drainages, followed by visits to surface water collection points to determine if samples have been successfully collected. Downstream portions of drainages will be visited to observe the extent of flow, based on the observation of deposited sediments or recent scour features. Confirming the termination point(s) of the ephemeral drainages will help to define the extent of potentially affected surface water or channel sediments downgradient of the proposed mining area.

An evaluation of streamflow duration, documentation of arroyo channel conditions, and the preparation of digital channel profiles will be conducted as part of a jurisdictional determination. This effort will include describing Permit Area waterways and field-verifying arroyo conditions. Quantitative and qualitative descriptions will be obtained (e.g., bank height, channel width, stability/condition observations, frequency of flow indicators, and evidence of lateral migration and bank stability).

Barr will complete a Stream Flow Duration Assessment (SDAM) for the Arid West Region (USACE and U.S. Environmental Protection Agency [USEPA] 2024) and associated data sheets within Permit Area arroyos to document indicators of flow frequency. Pursuant to the 2025 agency coordination meeting outcomes, the full Arid West SDAM method will be applied to the Permit Area during 2026. No ordinary high-water mark delineation would occur, pending the determination of jurisdiction. Photo and observational documentation will be developed for up to two additional crossings, which are shown on the NHD mapping layer but do not appear to support bed and bank features in the field. An approved jurisdictional determination will be requested through the USACE Albuquerque District Office. To inform future State of New Mexico stormwater and dredge/fill permits for the project, hydrologic modelling will be done to identify the storm event that would discharge into San Mateo Creek, the downstream receiving Waters of the United States for the Permit Area.

Digital profiles of Permit Area arroyos will be prepared to provide more information regarding their condition. Barr will acquire raw lidar point clouds (LAS files) from the USGS National Map to generate high-resolution digital terrain models (DTMs) using ArcGIS Pro's lidar processing tools. A DTM represents bare-earth topography, excluding above-ground features such as vegetation. The resolution will depend on the point cloud's density and quality, but a 1–2 foot resolution is likely feasible. If this resolution introduces excessive detail (e.g., rocks or minor surface variations) that hinders analysis, a lower-resolution DTM will be used. Using ArcGIS Pro's 3D mapping capabilities, the DTM will be visualized in a virtual 3D space, and analysis tools will be applied to measure arroyo characteristics such as width, volume, and slope. Figures will be created to visually communicate the results.

8.3.1 Springs

The potential presence of springs in the vicinity of the Permit Area is addressed in Section 9: Groundwater. If springs are identified and are accessible, baseline data, including flow rates and water quality, will be collected to establish pre-operational conditions.

8.3.2 Baseline Surface Water Quality

The primary objective of the surface water sampling and analysis program is to establish baseline water quality data for ephemeral channels located within, adjacent to, and downstream of the proposed Permit Area. Given that channels within the study area are ephemeral, four opportunistic sampling events will be targeted over the course of the monitoring period. The timing of these events will depend on precipitation that generates surface flow. While efforts will be made to identify seasonal variability in surface water conditions, this will be contingent on the occurrence and timing of flow events. Sediment samples may be collected at each designated surface water sampling location at least once during the monitoring period as an alternative to water sampling (Figure 8-1).

Surface water samples will be collected using ditch-mounted Nalgene Storm Water Samplers, each with a 1-liter capacity. The sampling system includes a mounting kit composed of a reusable protective mounting tube and a metal stake, which is installed in a hole, approximately 1 foot wide and 1.5 feet deep, in the bottom of an arroyo or drainage ditch. A metal stake is driven into the ground adjacent to the

hole, and the collector housing is secured to the stake at the desired depth. The hole is then backfilled with sediment to stabilize the assembly. Once the mounting kit is properly installed, a 1-liter Nalgene sample collection bottle is placed into the mounting tube and secured with a grated cover.

The protective mounting tube is designed to shed falling rain while allowing surface runoff to be collected once the flow reaches a critical level during a storm event. The bottle is equipped with a floating ball valve that seals the sample chamber once the bottle is full, preventing dilution or contamination from additional runoff. It also includes a dome-shaped cap that deflects debris passing through the mounting tube.

After a storm event, the full sample bottle is retrieved, replaced with a new one, and the collected sample is transferred into containers supplied by a certified analytical laboratory for further analysis.

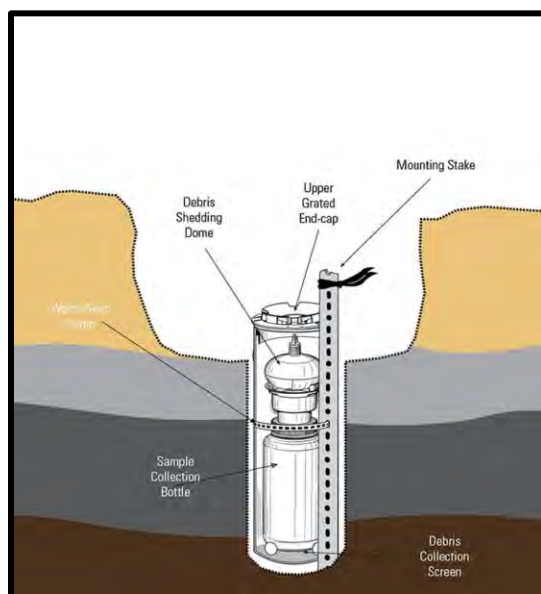


Figure 8-1 Typical Installation of a Ditch-Mount Stormwater Sampler

Field measurements will be taken when sample collection coincides with active surface water flow and sampling conditions are deemed safe. These field parameters will include temperature, specific conductance, pH, and turbidity.

Water quality samples will be collected using containers provided by a certified analytical laboratory. Sample collection and preservation will follow protocols consistent with the analytical methods to be used. All samples will be placed on ice immediately after collection and maintained at or below 4°C during transport to the laboratory, with proper chain-of-custody documentation and protocols strictly followed.

Sediment samples may be collected at each designated surface water sampling location at least once in lieu of water sampling. Additional sediment samples may be collected if observations suggest recent sediment deposition, recognizing that even when flow is evident, surface water sample collection is not always successful. At each location, surface sediments (0–2.5 inches in depth) will be collected using a clean trowel or spatula and stored in labeled containers for laboratory analysis. Laboratory analyses will include the analytes listed in Tables 8-1 and 8-2.

Table 8-1 Analytical Methods for Chemical Analyses of Water Samples

Metals/Radiochemistry	Method	Mdl	Units
Aluminum, total	EPA 200.7	0.35	mg/L
Antimony, total	EPA 200.8	0.0008	mg/L
Arsenic, total	EPA 200.8	0.0004	mg/L
Barium, total	EPA 200.7	0.045	mg/L
Beryllium, total	EPA 200.8	0.0002	mg/L
Boron, total	EPA 200.7	0.15	mg/L
Cadmium, total	EPA 200.8	0.0001	mg/L
Calcium, total	EPA 200.7	0.5	mg/L
Chromium, total	EPA 200.7	0.1	mg/L
Cobalt, total	EPA 200.7	0.1	mg/L
Copper, total	EPA 200.7	0.05	mg/L
Iron, total	EPA 200.7	0.3	mg/L
Lead, total	EPA 200.8	0.0002	mg/L
Magnesium, total	EPA 200.7	1	mg/L
Manganese, total	EPA 200.7	0.05	mg/L
Mercury, total	EPA 245.1	0.0002	mg/L
Molybdenum, total	EPA 200.7	0.1	mg/L
Nickel, total	EPA 200.7	0.04	mg/L
Potassium, total	EPA 200.7	2.5	mg/L
Selenium, total	EPA 200.8	0.0002	mg/L
Silver, total	EPA 200.8	0.0002	mg/L
Sodium, total	EPA 200.7	1	mg/L
Thallium, total	EPA 200.8	0.0002	mg/L
Thorium, total	EPA 200.8	0.002	mg/L
Uranium, total	EPA 200.8	0.0002	mg/L
Zinc, total	EPA 200.7	0.1	mg/L
Combined Radium, total	RA226 + RA228		pCi/L

Metals/Radiochemistry	Method	Mdl	Units
Gross Alpha	EPA 900.0	8.5	pCi/L
Gross Beta	EPA 900.0	24	pCi/L
Radium 226, total	EPA 903.1	2.1	pCi/L
Radium 228, total	EPA 904.0	19	pCi/L
Radon-222	ASTM D5072-92	100	pCi/L
Wet Chemistry	Method	Mdl	Units
Bicarbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Carbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Chloride	SM 4500-Cl E-2011	1	mg/L
Cyanide, total	EPA 335.4	0.003	mg/L
Fluoride	SM 4500-F C-2011	0.3	mg/L
Hydroxide as CaCO ₃	SM 2320 B-2011	2	mg/L
Nitrate as N	NO ₃ NO ₂ -NO ₂	0.02	mg/L
Nitrate/Nitrite as N	EPA 353.2	0.02	mg/L
Nitrite as N	EPA 353.2	0.01	mg/L
Residue, Filterable (TDS) @180C	SM 2540 C-2011	200	mg/L
Sulfate	ASTM D516-07/-11/-16	1	mg/L
Total Alkalinity	SM 2320 B-2011	2	mg/L
Turbidity	EPA 180.1	0.5	NTU

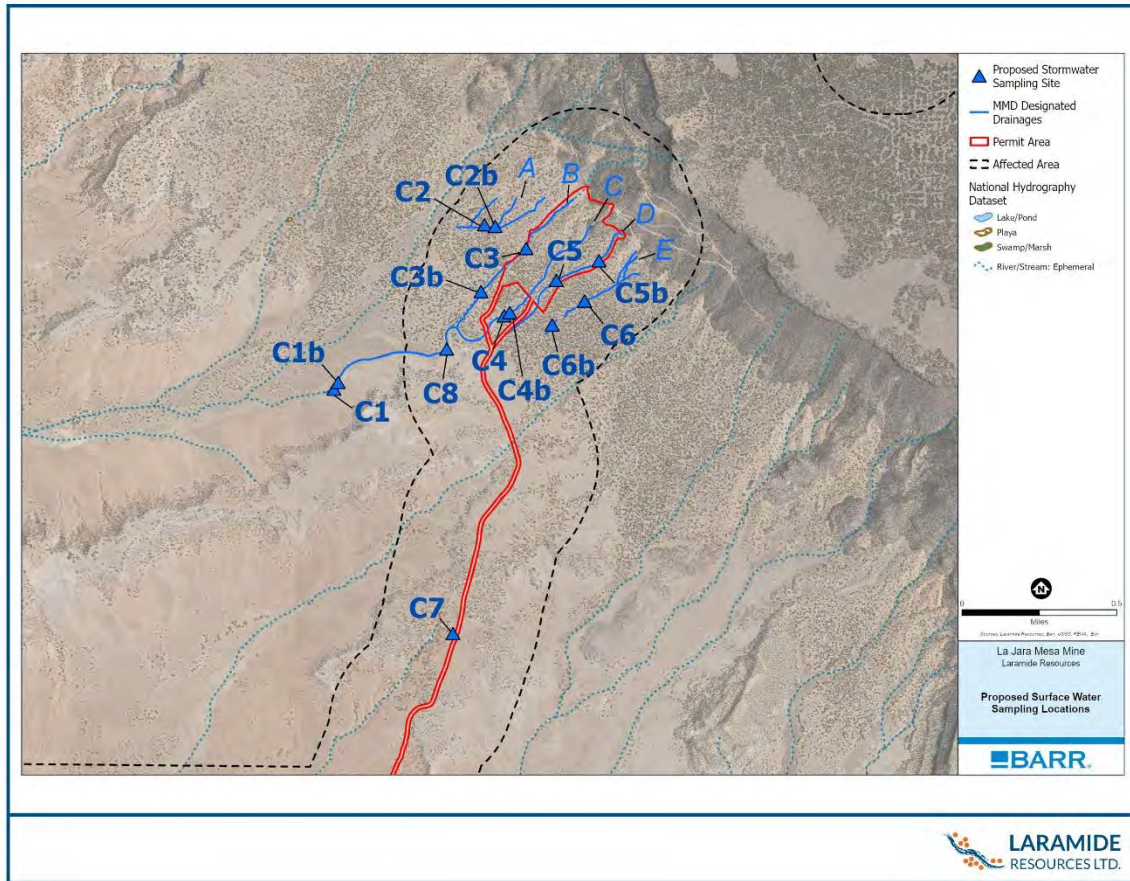
Table 8-2 Analytical Methods for Chemical Analyses of Sediment Samples

Metals	Method	Mdl	Units
Arsenic	EPA 6020B	0.1	mg/Kg
Barium	EPA 6020B	0.1	mg/Kg
Cadmium	EPA 6020B	0.025	mg/Kg
Chromium	EPA 6020B	0.25	mg/Kg
Cobalt	EPA 6020B	0.025	mg/Kg
Copper	EPA 6010D	1	mg/Kg

Metals	Method	Mdl	Units
Lead	EPA 6020B	0.05	mg/Kg
Manganese	EPA 6010D	1	mg/Kg
Mercury	EPA 7473	4	ng/g
Molybdenum	EPA 6010D	2	mg/Kg
Nickel	EPA 6010D	0.8	mg/Kg
Selenium	EPA 6010D	0.005	mg/Kg
Silver	EPA 6010D	0.1	mg/Kg
Zinc	EPA 6010D	0.01	mg/Kg
Thorium	EPA 6020B	0.5	mg/Kg
Uranium	EPA 6020B	0.05	mg/Kg
Radiochemistry	Method	Mdl	Units
Gross Alpha and Beta	EPA 9310	1 to 2	pCi/g
Radium 226	EPA 903.1	0.5	pCi/g
Radium 228	EPA 9320	3	pCi/g
Additional Analyses	Method	Mdl	Units
pH, Saturated Paste	EPA 600/2-78-054 3.2.2	0.1	
Conductivity @25C	SM 2510 B-2011	0.001	mmhos/cm
Saturation Percentage	SLS, 1954-Method 27a		
Particle-Size Distribution	ASA No.9 15-4.2.2		
Rock Fragment			

8.3.3 Surface Water and Sediment Sampling Locations

Surface water and sediment sampling points are strategically located in ephemeral drainages within and surrounding the proposed Permit Area. These drainages either flow through, originate from, or border the permit boundary. Drainages that may be impacted by historic mine sites or intersect or lie adjacent to the proposed haul road are also targeted. Sampling locations were selected to characterize baseline surface water and sediment quality, assess potential impacts from historical and proposed activities, and capture both spatial and seasonal variability. Eight sampling locations are selected based on a review of watershed maps and field observations of channel features such as sediment deposition or channel scour that indicate a reasonable likelihood of successful water sample collection. The selection of sampling point locations follows recommendations from the MMD in response to previous submittals. The sample locations are identified on Map 8-2, and coordinates are provided in Table 8-3.



Map 8-2 Surface Water and Sediment Sampling Location Map

Table 8-3 Surface Water and Sediment Sampling Universal Transverse Mercator (UTM) Points

Location ID	UTM Northing	UTM Easting
C1	3906259	247017
C1b	3906293	247040
C2	3907080	247824
C2b	3907070	247879
C3	3906952	248036
C3b	3906738	247796
C4	3906611	247913
C4b	3906626	247942
C5	3906784	248189
C5b	3906878	248414
C6	3906674	248333
C6b	3906556	248161
C7	3904987	247600
C8	3906448	247609

9 GROUNDWATER

Understanding groundwater conditions in relation to the mining operation is important for determining the probable hydrologic consequences of the mining activity in the Permit Area and potentially affected area.

The stormwater runoff holding pond for the ore stockpile area will be lined to prevent infiltration of ore stockpile runoff water. Water supply for the mine will preferably be obtained from an off-site source. If that becomes impossible, a water supply well will be developed. The use of water at the mine will be restricted to cooling and lubricating downhole tools during drilling, underground and surface dust control, and sanitary uses by the mine workers. Potable water will be obtained for the on-site drinking water supply. Water for other on-site uses may have a somewhat higher total dissolved solids (TDS) content than potable water.

9.1 Background

Shoemaker (2009) notes that the alluvium in the vicinity of La Jara Mesa is unsaturated and that the shallowest (i.e., youngest) bedrock aquifer is the stock-watering well nearest to the proposed mine site, comprising Jurassic-age Entrada Sandstone (T12N, R9E, Section 28). This well is in the lowlands of the Lobo Creek drainage. However, the Entrada Sandstone is uplifted across a fault between that well and

the proposed mine site and outcrops on the sides of uplifted terraces nearest to the mine site. Given the very limited possibility of recharge on the flanks of La Jara Mesa, where the uplifted Entrada Sandstone outcrops, it is unlikely that the Entrada is saturated beneath the proposed mine site.

The shallowest saturated aquifers beneath the proposed mine site could potentially be sand beds in the Triassic-age Chinle Formation or the Permian-age San Andreas-Glorietta aquifer. In the vicinity of the proposed La Jara Mesa mining operations, these aquifers are vertically separated from the ore pad stormwater pond and waste rock stockpile by confining units of the Summerville Formation and the Chinle Formation. The target ore body in the Brushy Basin Member of the Morrison Formation is separated from the shallowest potential aquifers by confining members of the Chinle Formation, Summerville Formation, Recapture Member, and shale units of the lower Brushy Basin Member of the Morrison Formation (e.g., Cather, 2011). Baldwin and Rankin (1995) note that the Summerville Formation is a confining unit, as are the Recapture Member and the lower Brushy Basin Member.

The proposed La Jara Mesa mine would be in unsaturated rocks. Near the proposed underground mine, the host Poison Canyon sands of the Brushy Basin Member are overlain by a thick layer of Cretaceous Mancos Shale, which would block percolation of meteoric water from the surface of La Jara Mesa. As noted above, the Summerville Formation and Recapture Member confining units lie between the Brushy Basin Member and the Entrada Sandstone aquifer. In essence, the stratigraphic layers that will be accessed by the mine are bracketed by confining layers above and below.

The mining operation is not expected to have any water quality impacts on aquifers in the Permit Area for the following reasons:

- 1) The mine workings will be entirely in unsaturated rocks, situated more than 600 feet above the shallowest regional aquifer in the area. The portal and waste rock pile will be more than 400 feet above the shallowest potential saturated zones. Confining layers exist above and below the stratigraphic intervals that will be accessed by the mine.
- 2) No processing solutions will be used on the site.
- 3) The ore will be segregated and contained on-site before being hauled off-site to a licensed mill for processing. The ore stockpile facility will be lined to prevent precipitation from infiltrating into the waste rock stockpile.

9.2 Objectives

The objectives of the groundwater SAP include the following:

- 1) Describe the plan for determining the groundwater regime in the Permit Area and the potential affected area, with emphasis on identifying the character and location of water-bearing units and the direction of groundwater flow
- 2) Describe the plan for developing a baseline inventory of wells, springs, and groundwater uses within a one-mile radius of the mine facilities' portion of the Permit Area
- 3) Describe the plan for assessing water supply options
- 4) Develop a plan for sampling groundwater parameters once a source has been identified

9.3 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model of the Permit Area and a 1-mile buffer around the Permit Area will be developed based on data collected during exploratory drilling, well data from the New Mexico State Engineer Office, and published sources from the U.S. Geological Survey, the State of New Mexico, and other publicly available information that can be identified. Development of the hydrogeologic conceptual model will rely, to the extent possible, on the most current information available from the various sources.

The hydrogeologic conceptual model will identify the lithology and thickness of each geologic unit below the site. Water-bearing units will be identified along with their hydraulic properties. An assessment of hydraulic connections between geologic units will also be included.

The preferred option for water supply for the mining operation is an off-site well or wells. If water from an off-site well or wells cannot be obtained, then a well or wells will be installed at the site to provide water for the mining operation. If a well or wells are installed to supply water for the mining operation, the BDR will assess the potential impacts of well operation on water resources and local hydrology. In addition, the BDR will assess the probable hydrologic consequences of water discharged from an on- or off-site source during mine development and operations. This investigation will evaluate both short- and long-term effects under predicted pumping scenarios, with a focus on changes in groundwater flow patterns, drawdown extents, and potential impacts to nearby wells or surface waters. The assessment will consider the characteristics of the completed well(s), including location, depth, target aquifer, screened intervals, and anticipated withdrawal rates.

9.4 Aquifer Characteristics

Hydraulic characteristics of the aquifers in the vicinity of the Permit Area include hydraulic conductivity, transmissivity, storability, groundwater piezometric elevations, and groundwater flow directions. Publicly available information, such as well data from the New Mexico State Engineer Office, published sources from the U.S. Geological Survey, the State of New Mexico, and other publicly available information, will be used to determine and describe these characteristics to the extent possible. If additional data are required to assess the hydraulic characteristics of the aquifers, aquifer testing would be performed in the well or wells identified to supply water to the project. Aquifer testing may consist of slug tests, pumping tests, and/or borehole flow logging. Testing would be performed using industry-standard methods. Aquifer testing data would be analyzed using industry-standard software platforms (e.g., AQTESOLV [Duffield, 2007] and FLASH [Day-Lewis et al., 2011]).

9.5 Groundwater Quality

Sampling will be performed to characterize the quality of groundwater to be supplied to the mining operation. The sampling procedures will generally conform to USEPA guidance (e.g., USEPA, 1999). Groundwater samples will be collected from the well or wells (whether offsite or onsite) identified to supply water to the project. Sampling technicians will wear disposable surgical gloves during sample container handling and sample collection. The sampling will be performed semi-annually for 1 year.

If an existing well or wells with a dedicated pump installed is/are sampled, groundwater will be obtained using the installed pump(s). If an existing well or wells are sampled and no pump is installed, or if a new well or wells are sampled, a temporary sampling pump or no-purge sampling device, such as a Hydro Sleeve, will be used. If possible, the depth to water in the well and the total well depth will be measured prior to purging and sampling the well. Alternatively, total well depth may be determined from the well

record (if available). The field parameters shown in Table 9-1 will be measured prior to sample collection using a YSI ProDSS or similar water-quality meter. Groundwater samples will be analyzed for the parameters shown in Table 9-2. Sampling using a temporary or permanent pump will be performed in conformance with the standard operating procedures (SOPs) presented in the Quality Assurance Project Plan (QAPP) (Appendix A).

If a no-purge sampling device is used, it will be lowered into the open interval of the well and immediately retrieved. Collected groundwater will be decanted into the sample bottles provided by the laboratory. The collection procedure will be repeated until the water volume needed for the analyses has been collected. New no-purge sampling devices will be used in each well and for each sampling event. Groundwater samples will be analyzed for the parameters shown in Table 9-2.

Table 9-1 Field Parameters Measured during Well Purging and Groundwater Sampling

Parameter	Method	Units	Stabilization Criteria
Conductivity	Standard Method 2510B	µmhos/cm	±5%
Dissolved Oxygen	ASTM Method D888-09 (C)	mg/L	±10% (>0.5 mg/L; three consecutive readings below 0.5 mg/L will be considered stabilized even if the change between readings is more than +/-10%)
Oxidation-Reduction Potential	Standard Method 2580A	mV	±10 mV
pH	Standard Method 4500-H ⁺ B	Standard Units	±0.1 standard units
Temperature	Standard Method 2550B	°C	±0.5°C
Turbidity	Standard Method 2130B or ISO7027	NTU or FNU	±10% (>5 NTU or FNU; three consecutive readings below 5 NTU/FNU will be considered stabilized even if the change between readings is more than +/-10%)

Table 9-2 Analytical Methods for Chemical Analyses of Groundwater Samples

Metals	Method	Mdl	Units
Aluminum, dissolved	EPA 200.7	0.08	mg/L
Antimony, dissolved	EPA 200.8	0.0004	mg/L
Arsenic, dissolved	EPA 200.8	0.0002	mg/L
Barium, dissolved	EPA 200.7	0.009	mg/L
Beryllium, dissolved	EPA 200.8	0.0001	mg/L
Boron, dissolved	EPA 200.7	0.03	mg/L
Cadmium, dissolved	EPA 200.8	0.00005	mg/L

Metals	Method	Mdl	Units
Calcium, dissolved	EPA 200.7	0.2	mg/L
Chromium, dissolved	EPA 200.8	0.0005	mg/L
Cobalt, dissolved	EPA 200.8	0.00005	mg/L
Copper, dissolved	EPA 200.8	0.0008	mg/L
Iron, dissolved	EPA 200.7	0.09	mg/L
Lead, dissolved	EPA 200.8	0.0001	mg/L
Magnesium, dissolved	EPA 200.7	0.2	mg/L
Manganese, dissolved	EPA 200.7	0.02	mg/L
Mercury, total	EPA 245.1	0.0002	mg/L
Molybdenum, dissolved	EPA 200.7	0.02	mg/L
Nickel, dissolved	EPA 200.7	0.008	mg/L
Potassium, dissolved	EPA 200.7	0.5	mg/L
Selenium, dissolved	EPA 200.8	0.0001	mg/L
Silver, dissolved	EPA 200.8	0.0001	mg/L
Sodium, dissolved	EPA 200.7	0.2	mg/L
Thallium, dissolved	EPA 200.8	0.0001	mg/L
Thorium, dissolved	EPA 200.8	0.001	mg/L
Uranium, dissolved	EPA 200.8	0.0001	mg/L
Zinc, dissolved	EPA 200.7	0.02	mg/L
Radiochemistry	Method	Mdl	Units
Combined Radium (dissolved)	RA226 + RA228		pCi/L
Gross Alpha, dissolved	EPA 900.0	2 - 4	pCi/L
Gross Beta, dissolved	EPA 900.0	2 - 4	pCi/L
Radium 226, dissolved	EPA 903.1	0.4	pCi/L
Radium 228, dissolved	EPA 904.0	1.5	pCi/L
Radon-222, dissolved	ASTM D5072-92	100	pCi/L
Wet chemistry	Method	Mdl	Units
Bicarbonate as CaCO ₃	SM 2320 B-2011	2	mg/L

Metals	Method	Mdl	Units
Carbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Chloride	SM 4500-Cl E-2011	1	mg/L
Cyanide, total	EPA 335.4	0.003	mg/L
Fluoride	SM 4500-F C-2011	0.15	mg/L
Hydroxide as CaCO ₃	SM 2320 B-2011	2	mg/L
Nitrate as N	NO ₃ NO ₂ -NO ₂	0.02	mg/L
Nitrate/Nitrite as N	EPA 353.2	0.02	mg/L
Nitrite as N	EPA 353.2	0.01	mg/L
Residue, Filterable (TDS) @180C	SM 2540 C-2011	20	mg/L
Sulfate	ASTM D516-07/-11/-16	1	mg/L
Total Alkalinity	SM 2320 B-2011	2	mg/L
Turbidity	EPA 180.1	0.1	NTU

9.6 Springs

Baldwin and Rankin (1995) note that springs emanating from the basalts along the mesa margins are present in the vicinity of Grants. Therefore, publicly available information and field verification of findings, to the extent that limitations such as land access allow, will be used to determine whether there are any springs within 1 mile of the Permit Area boundary. This is consistent with the model's 1 mile buffer.

9.7 Existing Wells

A well search will be conducted to identify wells within 1 mile of the Permit Area boundary. Information from the New Mexico Office of the State Engineer will be used to complete the well search.

10 RADIOLOGICAL SURVEY

10.1 Site Description and History

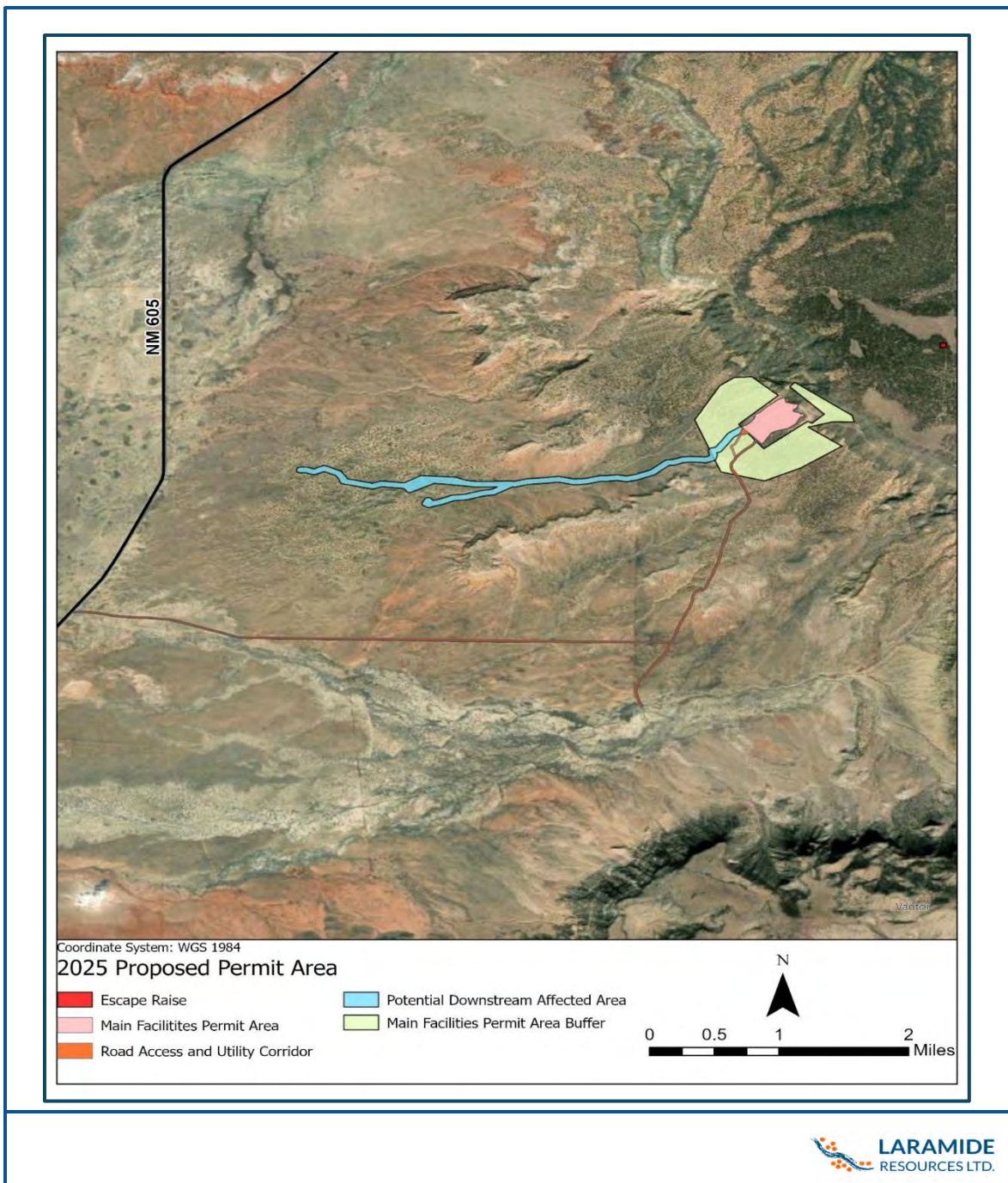
A baseline radiological survey was performed in 2011. This data was reported in a draft BDR in 2012. This included gamma radiation surveys, a high-pressure ionization chamber (HPIC)-based exposure rate cross-calibration, and soil sampling across the project areas. At the time the baseline work was performed, the LJMP consisted of three general areas, listed below and shown in Map 10-1.

- Main Facilities Permit Area (MFPA) and buffer area
- Road Access and Utility Corridor (RUC)
- Potential Downstream Affected Area (PDAA).

The MFPA is located on the western base of the La Jara Mesa and includes an escape raise to the northeast of the main area. The RUC consists of an unimproved road that links the MFPA to NM 605 and crosses private and federal lands managed by the Bureau of Land Management (BLM) and the Forest Service. The PDAA extends due west from the MFPA as a bifurcated arroyo until termination. There will be no ore processing (milling) or mill tailings disposal areas associated with this site.

Since 2012, reclamation and remedial activities have been performed at nearby mine sites on USFS land. Areas with observed elevated gamma count rates in 2011 are likely to have a reduced radiological signature following these activities. While these areas are not directly applicable to the LJMP Permit Area, there is interest in recharacterizing them to understand the current radiological conditions and capture any anomalies observed prior to site operations.

MMD has provided technical comments on the DBDR. Applicable comments to this SAP are discussed. Project area boundaries have been updated to be consistent with current plans (Map 10-2), such as the inclusion of a new segment road for site access.



Map 10-2 Proposed Permit Areas, Buffer, and Affected Area

10.2 Objectives

The primary goals of this sampling and analysis effort include addressing agency concerns and comments from previous submittals and completing the following:

1. Repeat the HPIC study from 2011 to develop exposure rate cross-calibration ("correlation") with current gamma survey instruments. This data may be used to justify the use of existing gamma data across the site areas.

2. Resurvey (gamma) portions of the previously surveyed MFPA to support the use of existing gamma data.
3. Resurvey (gamma) areas that may have changed since initial gamma data collection. This includes areas associated with USFS activities (e.g., Taffy, Zia mine sites).
4. Gamma survey the new proposed access road segments that have not been previously surveyed.
5. Gamma survey areas of the proposed permit and/or buffer areas not previously surveyed, including an area around the escape raise location, if applicable.
6. Collect additional surface soil samples across proposed permit and/or buffer areas (including escape raise location) to determine baseline surface soil concentrations of total uranium, total thorium, Ra-226, Ra-228, and gross alpha/beta.

10.2.1 Addressing Draft Baseline Data Report Comments

Comments from MMD on the DBDR are detailed in Table 10-1. Discussion on how the comments are addressed via this SAP is included.

Table 10-1 MMD Comments from The Draft BDR and SAP Responses

#	Comment	Response in SAP
56	MMD will require a new RAD survey to be conducted due to the time since collection and due to USFS/CERCLA activities occurring on and immediately adjacent to the Permit Area. An amended sampling plan must be submitted for MMD review.	Areas reclaimed or remediated since 2012 will be resurveyed. Existing gamma data use will be justified via HPIC cross-calibrations and partial resurveys of areas with existing data. Any areas identified as not previously surveyed will be included in a new gamma survey.
57	As described in the Part 6 guidelines, the radiological survey should comprise the following: a proposed scope of work (SOW) that provides a baseline for radiochemical content and a gamma-survey of the primary permit areas, such as roads, facility locations, and potential downstream affected areas. Bulk soil samples should be proposed for collection to verify field readings for analysis of uranium (total-238), radium 226, radium 228, thorium (total-232), and gross alpha/beta. MMD requests that the amended sampling plan include the above components.	Any areas not captured in previous surveys will be gamma surveyed and included in soil sampling, including an area around the escape raise, as applicable. Additional surface soil samples will be collected within the MFPA and analyzed for the requested analytes to supplement the existing soils dataset.

#	Comment	Response in SAP
58	The RAD survey shall include all affected areas, including the footprint of the expanded road. Due to historical reclamation within and around the immediate Permit Area, it is important to gather complete data from surrounding areas to confirm accurate baseline data. As other pre-act mining activities have historically shown widespread contamination from sources such as wind-blown erosion, MMD believes it is prudent for Laramide to cover a broader landscape for the RAD survey to facilitate accurate pre-disturbance RAD levels.	As described in response to Comment #56, areas that have changed since 2012 will be re-surveyed. Where previous gamma data exists, its use will be justified through HPIC cross-calibrations and partial gamma resurveys to show consistency between detector responses (i.e., 2011 vs. 2026 detectors). If consistency between detector responses is shown, existing and new gamma datasets may be combined to characterize baseline site conditions.
59	As previously mentioned, the footprint of the below-RAD survey doesn't appear to match the proposed road. When conducting the new RAD survey, make sure it covers the proposed road footprint.	The updated site permit boundaries include the new proposed access road segments and an escape raise location. This segment will be characterized by new gamma survey data and will be included in soil sampling.

10.3 Data Quality Objectives

10.3.1 Overview

This section provides data quality objective (DQO) statements for the SAP, as applicable to the gamma surveys and surface soil sampling parameters. These DQO statements have been developed to align with the steps for systematic planning, as described in EPA QA/G-4 guidance (USEPA, 2006) and the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (USEPA, 2000). DQO statements are intended as a systematic planning exercise to facilitate the collection of the appropriate type, quantity, and quality of data to meet Project objectives.

10.3.2 State the Problem

The fundamental problems to be addressed by this SAP are to characterize baseline radiological conditions within the LJMP-proposed Permit and associated areas to support mine permitting.

10.3.3 Identify Goals of the Study

The primary goals of this SAP are to:

1. Repeat the HPIC study from 2011 to develop exposure rate cross-calibration ("correlation") with current gamma survey instruments. This data may be used to justify the use of existing gamma data across the site areas.
2. Resurvey (gamma) portions of the previously surveyed MFPA to support the use of existing gamma data.
3. Resurvey (gamma) areas that may have changed since initial gamma data collection. This includes areas associated with USFS activities (e.g., Taffy, Zia mine sites).
4. Gamma survey the new proposed access road segments that have not been previously surveyed.

5. Gamma survey areas of the proposed Permit and/or buffer areas not previously surveyed, including an area around the escape raise location, if applicable.
6. Collect additional surface soil samples across proposed Permit and/or buffer areas to determine baseline surface soil concentrations of total uranium, total thorium, Ra-226, Ra-228, and gross alpha/beta.

10.3.4 Identify Information Inputs

Gamma surveys and soil sampling will be used to characterize the existing radiation environment across the site areas. The radiological characterization described in this SAP is designed to capture spatial variability in radiation levels across the site and to establish existing baseline gamma levels and radiological soil concentrations prior to site operations.

Additional sources of data and supporting technical information include:

- Digital topographic, geologic, and soils data in GIS format.
- Existing data and technical information from previous relevant studies, regulatory submittals, or other documentation.

Analytical methods to support the Project DQOs are provided in Table 10-2.

Table 10-2 Analytical Parameters and Methods

Parameter	Reporting Limit	Units	Method
Total Uranium	5	mg/kg	USEPA 3050/6010
Total Thorium	5	mg/kg	USEPA 3050/6010
Radium-226	0.2	pCi/g	USEPA 901.1M
Radium-228	0.2	pCi/g	USEPA 901.1M
Gross alpha/beta	10	pCi/g	SM 7110-B

10.3.5 Define Study Boundaries

The horizontal spatial extent of radiological baseline studies at the Site is limited to the Project Area boundary, as shown in **Error! Reference source not found. 1-2**. Vertical bounds on sampling of surface soils will be up to 15 cm below the ground surface.

Gamma surveys of the site and soil sampling will each be one-time events. Temporal boundaries on gamma surveys may be constrained to periods of favorable weather and site conditions. This would include avoidance of surveys during precipitation events or when soils are wet. Diurnal fluctuations in ambient radon levels may limit gamma surveys to late morning and afternoon hours, as commonly higher radon levels in the early morning hours can cause a slight high bias in measured ambient gamma radiation levels (due to the presence of short-lived radon progeny).

10.3.6 Develop the Analytical Approach

Characterization of the terrestrial radiation environment across the site areas will be based on gamma survey data collected with global positioning system (GPS)-based scan systems (e.g., a GPS-receiver and data logger paired with a Ludlum Model 3000 meter and 2" x 2" sodium iodide (NaI) scintillation detector) and walkover scanning with the detector positioned approximately 1 meter above the ground surface.

An HPIC will be used to develop a detector count rate (cpm) to exposure rate ($\mu\text{R/hr}$) cross-calibration (correlation). It will be performed consistently with the previous HPIC study and used to justify the use of existing gamma data. Project Areas with existing gamma data will be partially re-surveyed to support the use of existing data. New or unsurveyed areas identified will be gamma surveyed as described in Section 10.4.1. Any areas with existing data that have been affected or changed (e.g., via reclamation/remediation) or areas with existing gamma data whose use cannot be justified will be resurveyed.

Additional surface soil samples will be collected in the MFPA (including the escape raise location) and within new access road segments to establish an average baseline Ra-226, Ra-228, total uranium, and total thorium soil concentrations (pCi/g or mg/kg).

10.3.7 Performance or Acceptance Criteria

Performance criteria for the collection and characterization of baseline gamma radiation will include requirements for the following:

- 1) Instrument calibrations (within 1 year prior to use on the Project)
- 2) Consistency of instrument response between calibrated instruments (within $\pm 10\%$)
- 3) Daily instrument response checks during fieldwork (within $\pm 20\%$ of the initial mean reference reading among all instruments to be used on the Project)

Daily gamma survey instrument response checks will be performed in the field at a consistent, dedicated location throughout applicable portions of the fieldwork.

For laboratory analysis of surface soil samples, data acceptance criteria will be based on standard quality assurance (QA) and quality control (QC) procedures from a qualified commercial laboratory accredited by the National Environmental Laboratory Accreditation Program (NELAP) for analysis of radiological parameters.

Acceptance criteria for the use of existing gamma data will be justified by the comparison of existing data with new gamma data. Comparisons of HPIC study data and gamma survey data will be performed using simple statistics and visual observations of regression results. Instruments (and the data collected with them) will be considered matched if the average detector responses are within $\pm 10\%$. When instrument responses are matched, data collected by any instrument is directly comparable, and datasets (e.g., existing gamma data and new gamma data) can be combined. For the HPIC studies, the linear regressions should have a similar slope. The regressions will be visually compared, and prediction limits on the regressions may be calculated and compared to show that detector responses are consistent and matched.

10.4 Radiological Characterization Design and Methods

This Section describes the survey and sampling designs and methods to be used for characterization of the baseline radiological environment across the site areas.

Generic Standard Operating Procedures (SOPs) (Appendix A) will be used where applicable for radiological surveys and sampling. A list of these SOPs is provided in Table 10-3.

Table 10-3 Standard Operating Procedures and Titles

SOP Number	SOP Title
ITC.201	Operational Checkout of Single-Channel Detector with Meter
ITC.207	Operational Checkout of Single-Channel Detector with a Ludlum Model 3000
PWT.102	Field Logbook Use
PWT.105	Performing a GPS-Based Gamma Radiation Survey
PWT.106	Making Exposure Rate Measurements Using an HPIC
PWT.108	Soil Sampling for Analytical Purposes

10.4.1 Gamma Radiation Surveys

Spatial bounds on the extent of gamma walkover surveys will initially be based on the boundaries described in DQO 4 (Define Study Boundaries) in Section 10.3.5. These survey boundaries may be subject to modification in the field based on site access, safety, and field observations (e.g., the delineation of a gamma radiation source).

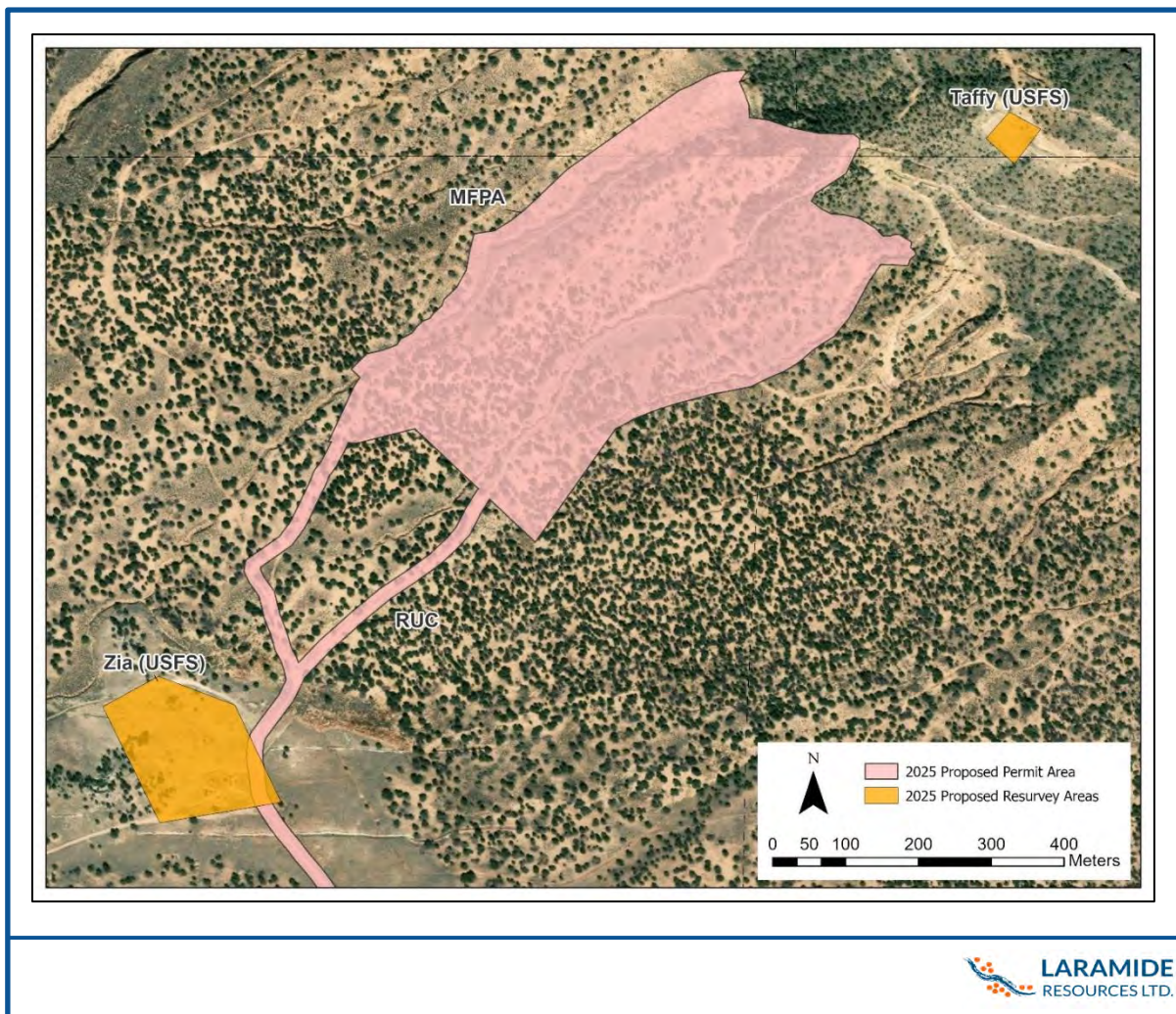
The gamma survey will consist of two primary components:

1. Resurvey a set of areas previously surveyed to assess how detector responses (previously used and current) compare and justify the use of existing gamma data.
2. Gamma surveys of any new areas not previously surveyed or areas previously surveyed that have since been remediated/reclaimed (See Maps 10-3 and 10-4).

Resurveys of areas within the MFPA for the objective of justifying existing gamma data use will be performed in the same manner as originally collected: a GPS-enabled NaI scintillation detector (e.g., Ludlum 44-10 detector coupled with a Ludlum 3000 ratemeter) positioned approximately 1 meter above the ground surface while scanning. Scan speed will be governed by typical walking speeds (e.g., approximately 0.5 to 1.5 meters/second [m/s]), depending on terrain and vegetative cover). Transect spacings will be approximately 3 meters.

For any new gamma surveys or areas deemed necessary for resurvey (Map 10-3), gamma walkover radiation surveys will be performed along approximately 10-meter (~ 32-foot) transects in the Project area. Consistent with previous surveys, scan transects in MFPA buffer areas will be performed on approximately 100-meter transects. The 2-inch by 2-inch NaI scintillation detectors used for gamma surveys will be positioned approximately 1 meter above the ground surface while scanning, and scan speed will be governed by typical walking speeds (e.g., approximately 0.5 to 1.5 m/s, depending on terrain and vegetative cover).

The minimum detectable concentration (MDC) of Ra-226 in surface soil during site scanning (scan MDC) was calculated using the probabilistic method published by Alecksen and Whicker (2016 and 2023). The results (Figure 10-1) show that the proposed gamma survey equipment and scanning method can detect Ra-226 levels for contaminated soil “hotspots” as small as a 3-meter-diameter area at 5 pCi/g Ra-226. Considering the 100-m² spatial dimensions of soil cleanup levels for existing uranium mines, as specified by the MMD and New Mexico Environmental Department (MMD/NMED, 2016), the planned scanning instruments and technique are considered sufficiently sensitive to meet the DQOs described in Section 2.0.



Map 10-3 Proposed Re-Survey Areas for USFS Zia and Taffy Mine Sites

10.4.2 Methods

GPS-based gamma radiation surveys will be performed using Environmental Restoration Group's (ERG's) RadScout survey system in accordance with the methods described in this section. The RadScout system uses a NaI-based Ludlum Model 44-10 gamma detector (scintillometer with 2" x 2" NaI crystal) coupled with a Ludlum Model 3000 scaler/ratemeter (or similar). The detector/scaler pairing will be properly calibrated within 1 year prior to use in the field. The scanning system will also feature a Geode GPS receiver with sub-meter accuracy, and a ruggedized Mesa field tablet with custom data

acquisition software, programmed to record gamma count rate and simultaneous GPS coordinates every 1 second while scanning.

Surveys will be performed with walkover scanning. The gamma detector will be positioned 1 meter above the ground surface. Nominal scan speeds will be approximately 0.5 to 1.5 m/s, depending on terrain, vegetation, obstructions, and safety considerations. Some areas within the project boundaries may be inaccessible due to terrain and safety considerations.

Survey areas, in general, will be surveyed using 10-meter transect spacing. However, areas being re-surveyed to show consistency with existing data will use the existing data transect spacing (e.g., 3-m transect spacing in the MFPA resurvey areas).

10.4.3 Scan Sensitivity

Prospective (a priori) estimates of the Ra-226 in soil MDC while scanning, referred to in MARSSIM as the “scan MDC” (USNRC, 2000), were calculated using the “probabilistic method” published by Alecksen and Whicker (2016 and 2023) and associated online scan MDC calculator (see calculator at <http://www.ergoffice.com>), based on an assumed average scan speed of 1.5 m/s, detector height of 1 m above ground surface, and conservative background count rate of 15,000 counts per minute (cpm). A 5% false positive decision error rate was selected for these calculations. The resulting graph of scan MDC values as a function of area size (diameter) of contaminated surface soil (referred to as a “hotspot”) is shown in Figure 10-1.

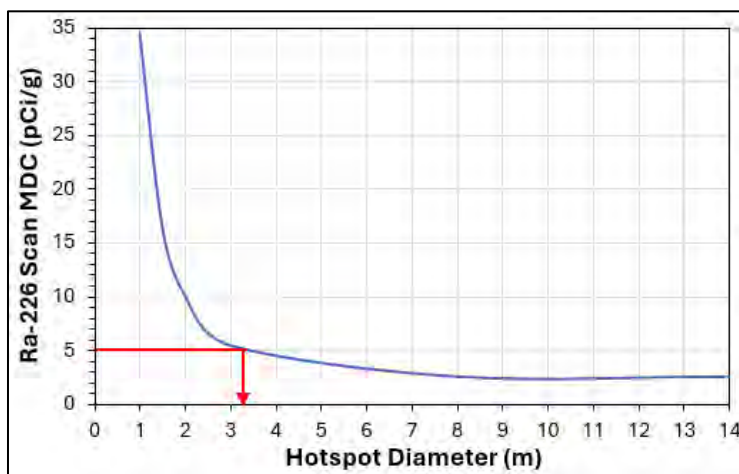


Figure 10-1 Calculated Scan MDC for Ra-226 in Surface Soils

The scan MDC curve in Figure 10-1 indicates that the gamma survey system and scanning parameters specified in this SAP will be able to detect a hotspot of Ra-226 in surface soil (0-15 cm) as small as 3.2 meters in diameter at the 5 pCi/g above-background cleanup criterion for Ra-226 as specified in the 2016 Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico (NMED, 2016). For comparison, the commonly accepted soil release criterion of 5 pCi/g above background (see 10 CFR 40, Appendix A, Criterion 6(6)) is applicable as an average Ra-226 concentration in surface soils across any 100-m² area. Because the gamma survey system, configuration, and scanning parameters specified in this SAP can detect this concentration (above background) across much smaller areas based on the calculated scan MDC, the overall gamma survey method described is easily sensitive enough to meet survey objectives for radiological characterization.

10.4.4 Equipment and Materials

Equipment and materials needed for gamma surveys and related field measurements include:

- Calibrated gamma radiation survey instruments with RS-232 or Bluetooth output—Ludlum Model 3000 ratemeter/scaler paired with a Ludlum Model 44-10 (2-inch by 2-inch NaI) scintillation gamma detector, or equivalents.
- ERG's RadScout GPS-based gamma survey system, including a Juniper Systems Mesa field tablet with custom data logger/controller software and Geode GPS receiver with sub-meter accuracy, or similar GPS/data logging system.
- Shapefiles of target gamma scan transects, loaded onto the field tablet to guide the field survey of the site areas.
- All appropriate scan system cables, as applicable (e.g., if the scan system is not fully Bluetooth capable, the necessary cables may include a GPS antenna cable, RS-232 data output cable, and coax cable from the meter to the detector).
- A radiological check source (e.g., a small, regulatorily exempt, sealed cesium-137 button source) and calibration jig to maintain consistency in measurement geometry for daily instrument function checks. Check sources used for daily function checks are not required to be traceable to the National Institute of Standards and Technology (NIST).
- A backpack for walkover scanning, to hold the meter and mount the detector approximately 1 meter above the ground.
- Spare batteries and chargers for radiation detectors and GPS scan system equipment.
- A field logbook and daily instrument QC function check forms.
- Personal protective equipment (PPE) to protect against environmental and biological hazards (e.g., robust/protective yet comfortable boots for all-day hiking, snake chaps if scanning on foot in the warm season, insect repellent, sunscreen, etc.).
- A First Aid Kit.
- A fire extinguisher (must be carried in any utility terrain vehicle).

10.5 HPIC Cross-Calibration Study

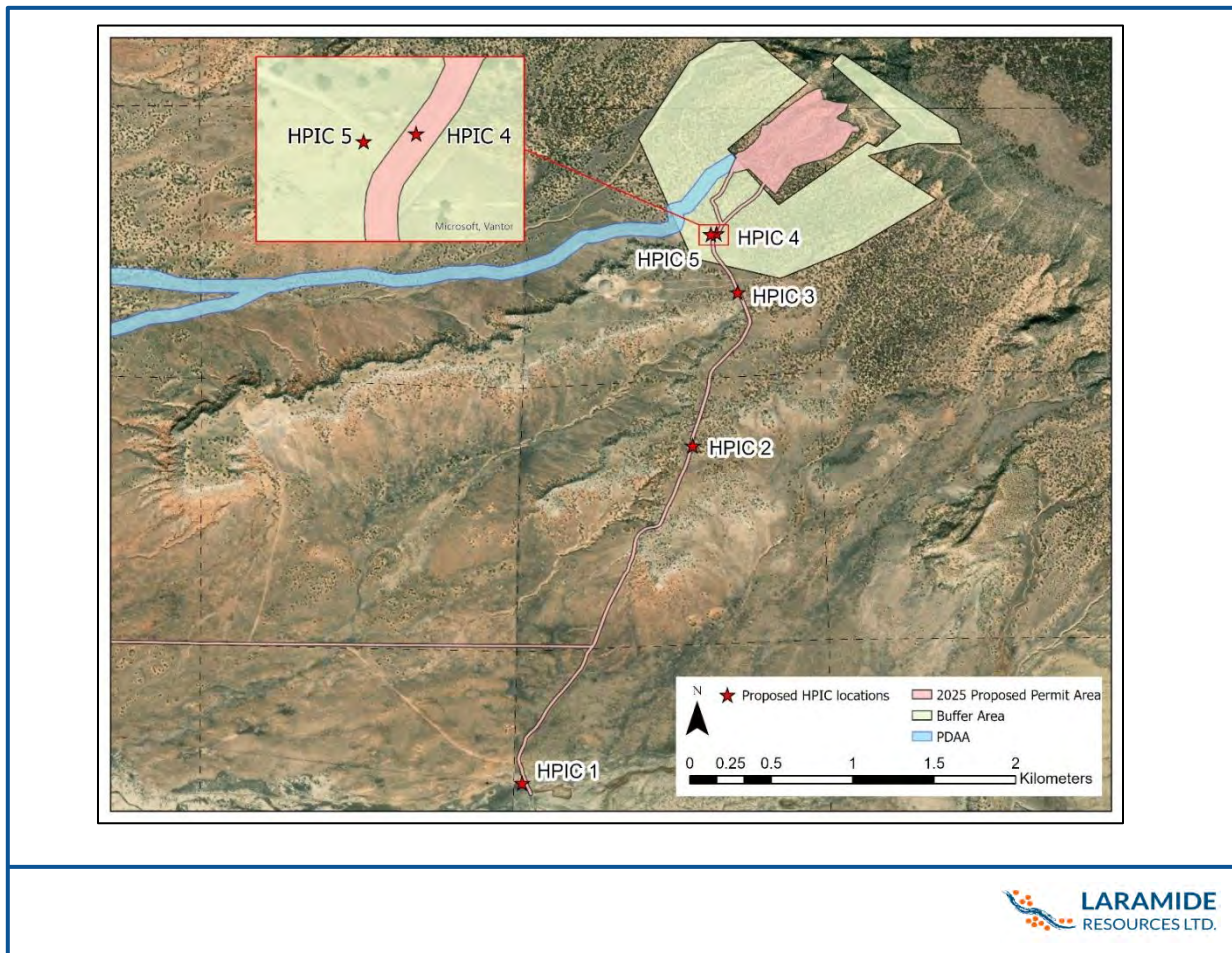
In 2011, a cross-calibration between the walkover gamma survey meters and an HPIC instrument was performed. The HPIC instrument directly measures exposure rates. It is a highly stable, energy-independent measurement and an excellent tool to cross-calibrate other survey equipment (e.g., walkover gamma survey meters) to exposure rate.

The 2011 HPIC study will be repeated using a set of new detectors to collect any new gamma data. A linear regression between detector count rate (cpm) and exposure rate ($\mu\text{R/hr}$) will be calculated. This linear regression will be compared with the 2011 linear regression reported in the DBDR. If the linear regressions are comparable, this provides evidence that the new set of detectors has a response consistent with the previously used detectors; therefore, the data are equivalent and can be directly compared and combined. This will support the use of existing gamma data in an updated BDR.

10.5.1 Methods

The HPIC study locations (“plots”) will be consistent with the original locations from the 2011 HPIC study. If these locations have been modified, remediated, reclaimed, etc., other areas that exhibit similar average count rates and homogeneity may be identified and used to replace any affected locations. A minimum of five locations will be included in the study. The original locations are indicated in Map 10-4, with GPS locations tabulated in Table 10-4.

At each location, a minimum of a 60-second static scaler count will be collected with each instrument pairing used for gamma scanning (Ludlum Model 44-10 NaI detector paired with a Model 3000 scaler) at 1 meter above the ground, followed by at least 10 minutes of static HPIC measurements at the same location and detector height. Results of static NaI count rates at each location (cpm) will be averaged across all NaI detectors used for scanning, and the average HPIC exposure rate ($\mu\text{R/hr}$) at each location will be calculated. Linear regression analysis will be performed on the paired average NaI/HPIC values to determine the statistical relationship between NaI count rate (cpm) and HPIC exposure rate. The resulting cross-calibration equation may be used to convert raw count-rate scan data to units of exposure rate ($\mu\text{R/hr}$), as necessary.



Map 10-4 Proposed HPIC Study Locations

Table 10-4 Proposed HPIC Study Location Coordinates

Location	Coordinates	
	Easting	Northing
1	2,738,091.195	1,542,260.351
2	2,740,897.960	1,548,981.052
3	2,741,637.192	1,552,042.499
4	2,741,287.884	1,553,216.023
5	2,741,193.124	1,553,119.014

Note: Coordinates in US State Plane NAD83 NM West. Units: US feet.

10.5.2 Equipment and Materials

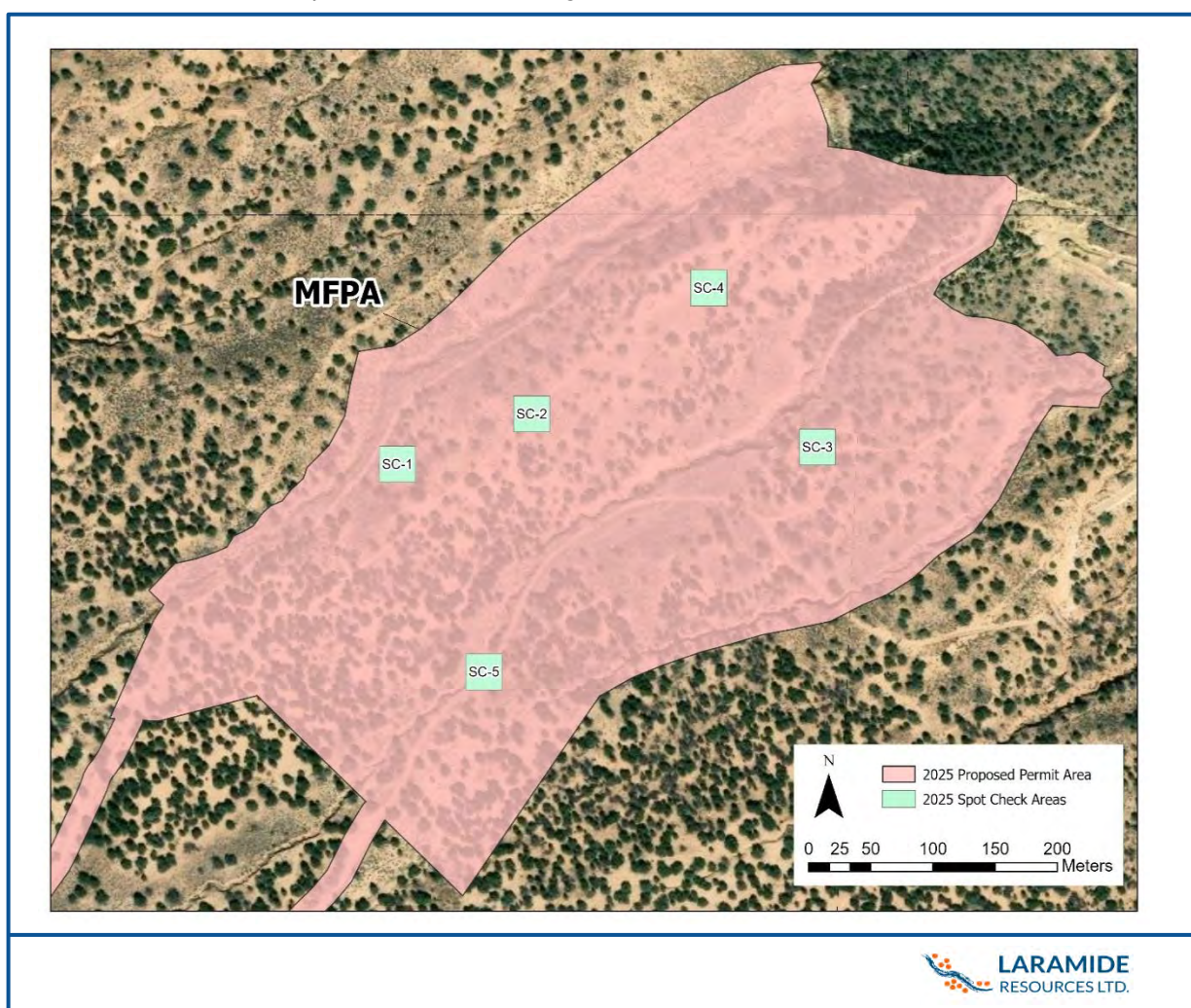
- Calibrated gamma radiation survey instruments with RS-232 or Bluetooth output—Ludlum Model 3000 ratemeter/scaler paired with a Ludlum Model 44-10 (2-inch by 2-inch NaI) scintillation gamma detector, or equivalents
- ERG's RadScout GPS-based gamma survey system, including a Juniper Systems Mesa field tablet with custom data logger/controller software and Geode GPS receiver with sub-meter accuracy, or similar GPS/data-logging system
- Calibrated HPIC-GE Reuter-Stokes RSDetection (or equivalent)
- Tripod stand for HPIC instrument positioning
- Shapefiles of HPIC plot locations, loaded onto the field tablet to guide the field survey of the site areas
- All appropriate scan system cables, as applicable (e.g., if the scan system is not fully Bluetooth capable, the necessary cables may include a GPS antenna cable, RS-232 data output cable, and coax cable from the meter to the detector)
- Radiological check source (e.g., a small, regulatorily exempt, sealed cesium 137 button source) and calibration jig to maintain consistency in measurement geometry for daily instrument function checks; check sources used for daily function checks are not required to be traceable to the NIST
- Spare batteries and chargers for radiation detectors and GPS scan system equipment
- Field logbook and daily instrument QC function check forms
- Appropriate PPE
- First Aid Kit

10.6 Previous Gamma Data Usability

The gamma data previously collected is likely still applicable and may be reported in an updated BDR. MMD has indicated uncertainty in its use due to the time since collection, as well as some adjacent areas associated with USFS sites that have reclamation or remediation work completed. To provide confidence in the existing gamma data and justify its usability, two studies will be performed: 1) an HPIC study, and 2) a resurvey of multiple, randomly chosen areas within existing gamma data areas to compare detector

responses. Map 10-5 depicts areas that have been randomly selected to be re-surveyed. These are approximately 25-m by 25-m areas where gamma data from 2011 exists. A 3-meter transect spacing, consistent with previous gamma surveys, will be used in these areas.

As described in DQO #6 (Performance or Acceptance Criteria), acceptance criteria for the use of existing gamma data will be justified via comparisons of existing gamma data to new gamma data. Comparisons of both the HPIC study data and gamma survey data will be performed using simple statistics and visual observations of regression results. Data and detector responses will be considered matched and consistent between existing data and new data collection if the average detector response between instruments is within $\pm 10\%$. For the HPIC study, the regressions should have a similar slope. The regressions will be visually compared, and prediction limits on the regressions may be calculated and compared to show that detector responses are consistent. If shown, this data will be considered usable and reported in an updated BDR. This data set will be combined with any new data collected (e.g., from USFS remediated site areas) to form the baseline gamma dataset.



Map 10-5 Proposed Gamma Resurvey/Spot Check Areas within the MFPA

10.7 Surface Soil Sampling

Surface soil sampling will be performed within a depth interval of 0 to 15 cm. This is consistent with regulatory guidance, including NMED guidance for establishing cleanup criteria at uranium mining

operations (NMED, 2016), Nuclear Regulatory Commission publication series (NUREG) 1569 (USNRC, 2000), and soil samples previously collected at the site.

In 2011, 58 surface soil samples were collected and screened in the field. Of these 58 samples, 12 were submitted for analysis to ALS Laboratory in Fort Collins, Colorado. Samples and analytical data collected and reported in the DBDR are still applicable. These results, which included samples from the MFPA, Buffer Area, RUC, and within the potentially affected downstream areas, were reported in the DBDR. They showed very consistent levels of Ra-226, Ra-228, total uranium, and total thorium across the areas.

While these results should be sufficient to define baseline concentrations within the project area, additional samples will be collected and analyzed as part of this SAP to supplement and expand the existing soil dataset.

10.7.1 Objectives

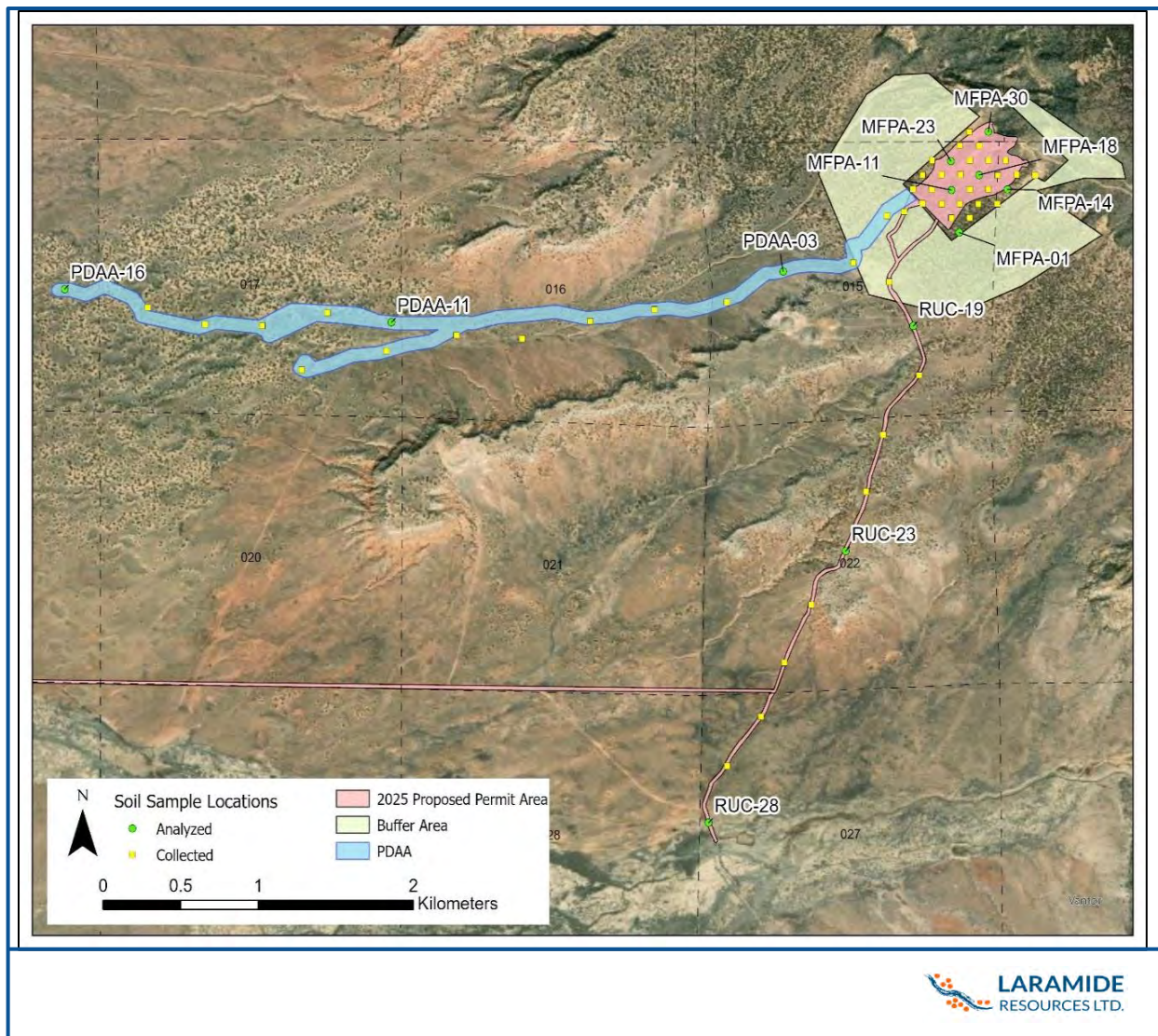
The objectives of surface soil sampling are summarized as follows:

1. Perform surface soil sampling (0–15 cm) across permit areas.
2. Use soil samples to establish average baseline concentrations of the primary constituents of concern (PCOCs), which are total uranium (mg/kg), total thorium (mg/kg), Ra-226 (pCi/g), and Ra-228 (pCi/g).

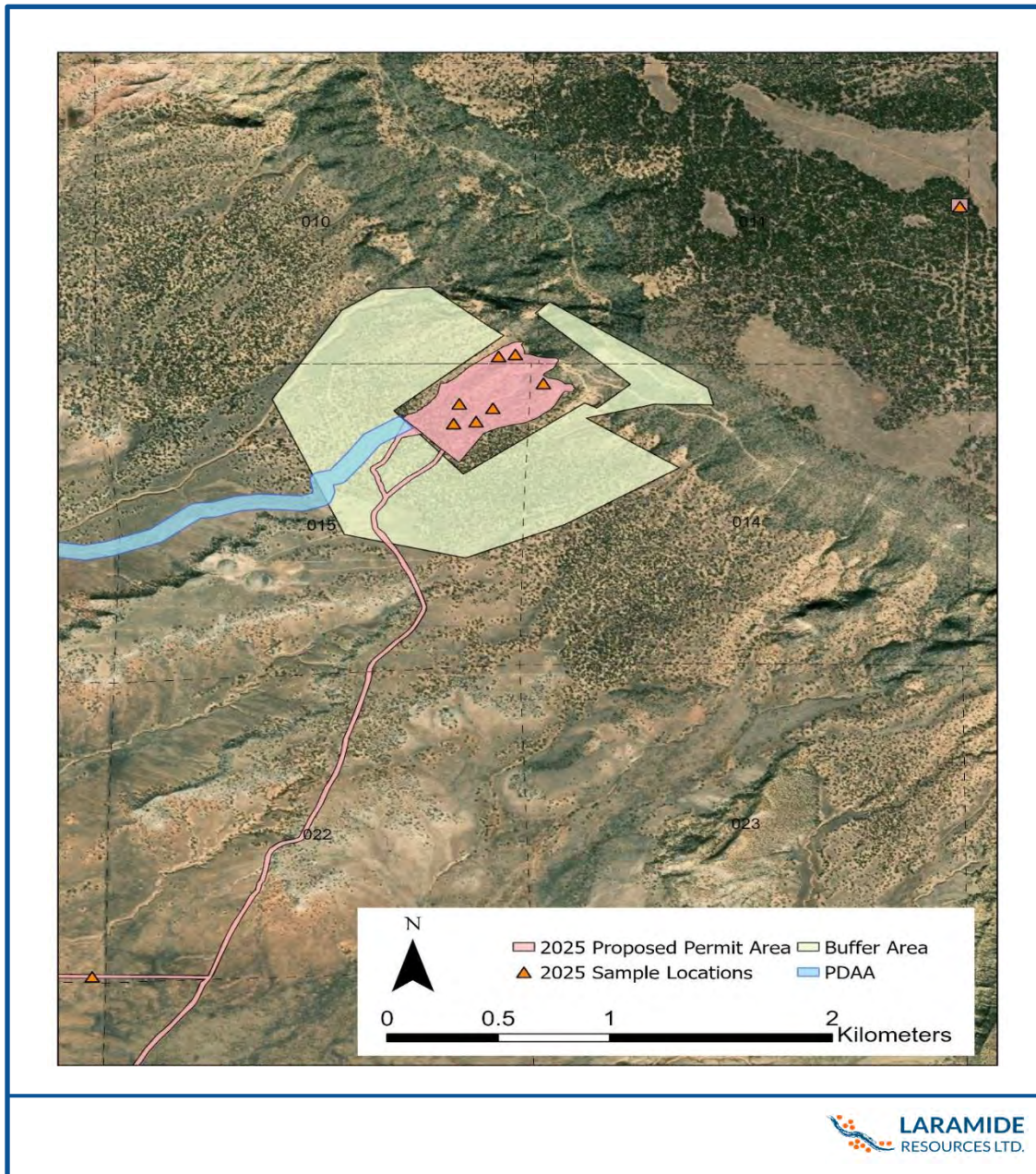
10.7.2 Surface Soil Sampling Design

Visual Sample Plan (VSP, 2026) was used to determine an appropriate number of samples required to estimate the mean concentrations of Ra-226, Ra-228, total uranium, and total thorium in surface soils. The existing Ra-226 soils concentration data were used in the VSP calculations. The VSP calculations were designed to calculate the number of samples necessary to be 95% confident that the estimated mean is within one standard deviation of the true mean (two-sided confidence interval). VSP determined that seven samples were required. Therefore, seven additional samples will be collected from within the MFPA to estimate the mean surface soil concentrations of PCOCs. Additionally, one sample will be collected within the boundaries of the new segments of the site access road.

The previously sampled locations are indicated in Map 10-6. The new sample locations within the MFPA, escape raise location, and the new access road segments are indicated in Map 10-7. The locations within the MFPA were selected according to a random-start, triangular grid algorithm by VSP to ensure sample locations are unbiased. The location at the escape raise was selected to be near the center of the grid. The location within the new primary access road segment was chosen to be at the approximate mid-point of this road segment.



Map 10-6 Surface Soil Sample Locations from 2011



Map 10-7 New Soil Sampling Locations

10.7.3 Surface Soil Sampling and Analysis Methods

Soil samples will be collected as 5-point composite samples from a 10-m by 10-m grid centered on the indicated sample location. The composite sampling scheme is illustrated in Figure 10-2. Samples will be collected with a hand trowel or hand auger sampler to a depth of 15 cm below the ground surface. A sample volume should fill about one-half of a quart-size bag (~ 500 grams). Homogenization of each surface soil sample will be performed in a mixing bowl prior to scooping it into the sample container.

Sampling equipment (e.g., trowels, shovels, mixing bowls, etc.) will be decontaminated between each sample. This can be accomplished by various wet or dry methods. Equipment is considered decontaminated when there is no visible soil material present.

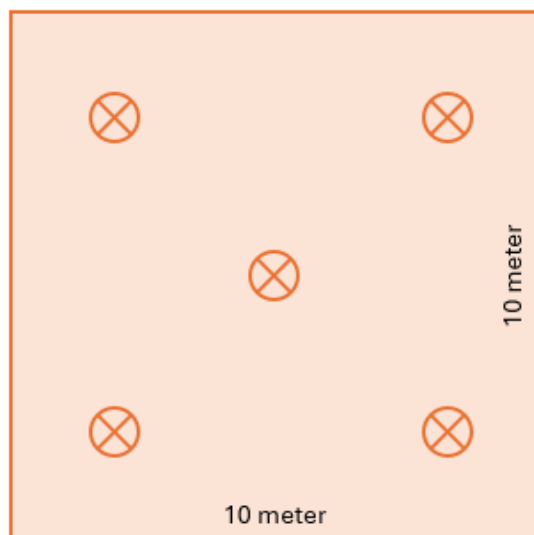


Figure 10-2 Five-Point Composite Sampling Scheme within 10-m by 10-m Grid Centered on Sample Location

11 PRIOR MINING OPERATIONS

11.1 Objective

The Objective of the Prior Mining Operations section of the BDR is to describe and delineate any prior exploration and mining operations that may have affected the Permit Area, including, if known, the type of mining and processing method, and a list of any processing chemicals or reagents used. Golder Associates Inc. largely accomplished that for the LJMP, as documented in their 2013 report “La Jara Mesa Project Draft Baseline Data Report” (2013 DBDR), submitted to the State of New Mexico MMD and other state agencies. Data from the 2013 DBDR will be incorporated in the 2026 BDR.V.0. After the preparation of the 2013 DBDR, the USFS performed remediation operations at the Taffy, La Jara, and Zia Mines adjacent to the La Jara Mesa proposed Permit Area. The 2026 BDR.V.0 will include an account of these operations.

11.2 Sampling Design and Methods

Information from available previous reports, aerial photographs, topographic maps, and ground surveys will be used to delineate prior mining areas in and around the proposed Permit Area. Documentation will include descriptions of the nature of the disturbance and estimates of the amount of area involved. Photographs and descriptions of representative features will be provided. The 2026 BDR V.0 will rely on remediation project reports prepared by and for the USFS, which document the characterization, remediation, and ongoing revegetation activities at the La Jara, Zia, and Taffy Mines, as well as the potential impacts on the proposed Permit Area.

12 HISTORICAL AND CULTURAL PROPERTIES

12.1 Objective

The objective is to update previous survey and reporting efforts (Harris et al. 2011, Miller 2015, Railey 2012) to meet current requirements, identify existing conditions/baselines, and incorporate input from expanded tribal collaboration.

12.2 Methods and Technical Approach

Under the guidance of the lead agency (USFS), OAS will reach out to the seven participating tribal representatives and/or Tribal Historic Preservation Officer (THPO) offices to finalize field study protocols, data gathering for the visual and noise areas of potential affects (APEs), post-field data analysis, reporting, and schedule. Initial contact with tribal representatives and THPOs will include both emails and physical letters sent by certified mail (USFS CNF will be copied on all correspondence). Tribes will have 30 calendar days from the date of receipt to respond to the emails or letters. Follow-up phone calls will be made by OAS to confirm receipt and begin the kick-off coordination and scheduling process in consultation with the parties.

Kick-off meetings will be scheduled prior to commencing fieldwork with the field team—OAS field personnel, Tribal Cultural Specialists (TCSs) and representatives, and the project team, including Laramide and the USFS CNF representatives. The meetings will serve to introduce the TCSs and staff to the project research plan and objectives, review previous work in the area, provide an overview of field methods and USFS Region 3 (R3) standards, and outline safety protocols and best practices. Tribal representatives will have the opportunity to share any specific concerns or items important to the group. Once established, OAS will meet with the Cibola to review and approve approaches developed in collaboration with tribal representatives.

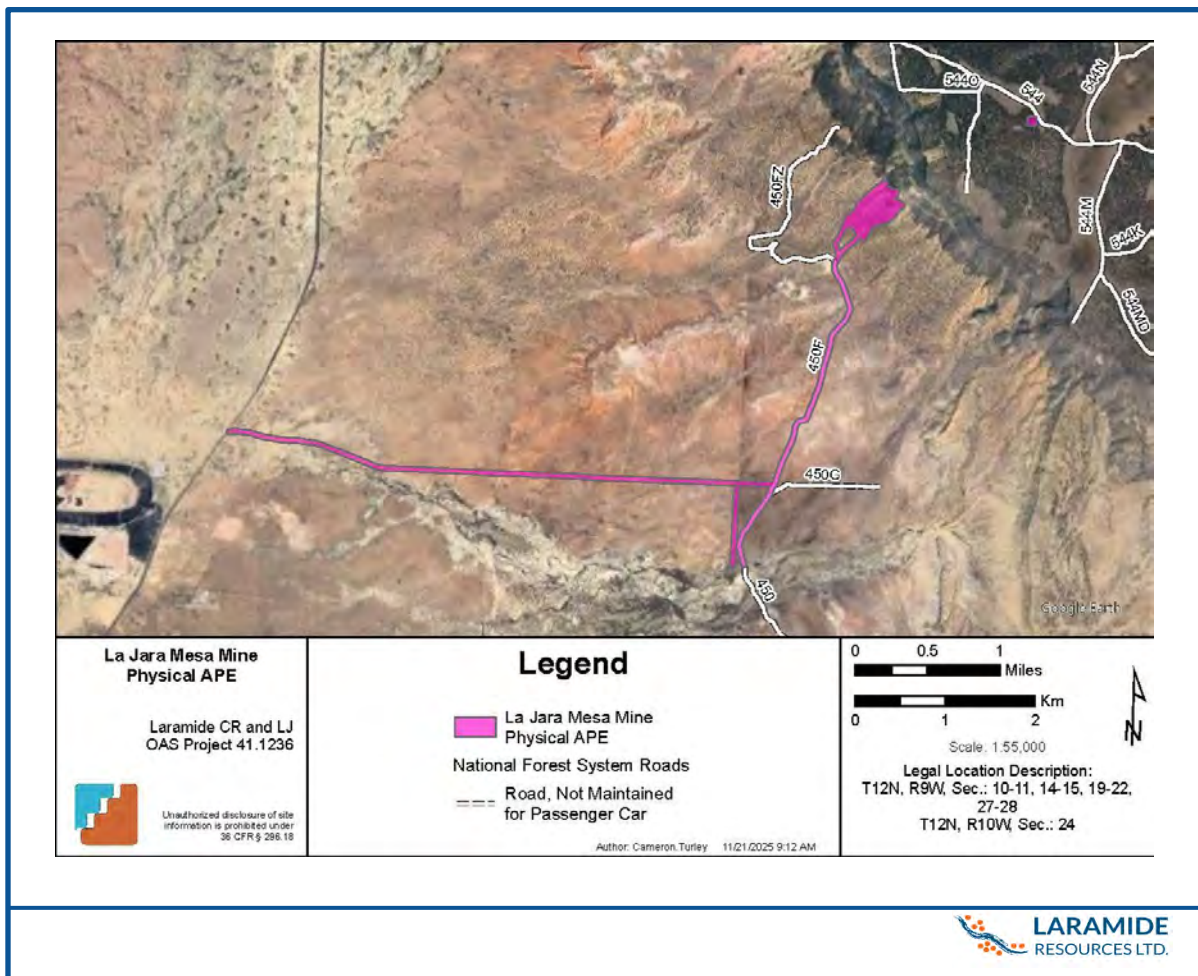
All tribes are encouraged to attend the kick-off meetings; however, we will do our best to collaborate with Tribes if there is a timing conflict or other issues, including the possibility of a hybrid in-person/virtual meeting format. Multiple meetings will occur if scheduling conflicts cannot be resolved.

12.2.1 Project Area and APEs

The mine project area includes the Permit Area (mine area, mine access, haul route connecting the mine Permit NM 605, and the escape raise). Descriptions of the facilities and activities planned at these different areas can be found in the MPO. The CNF has consulted with the Section 106 Consulting Parties on the definition of the APEs for the project area and the activities planned there.

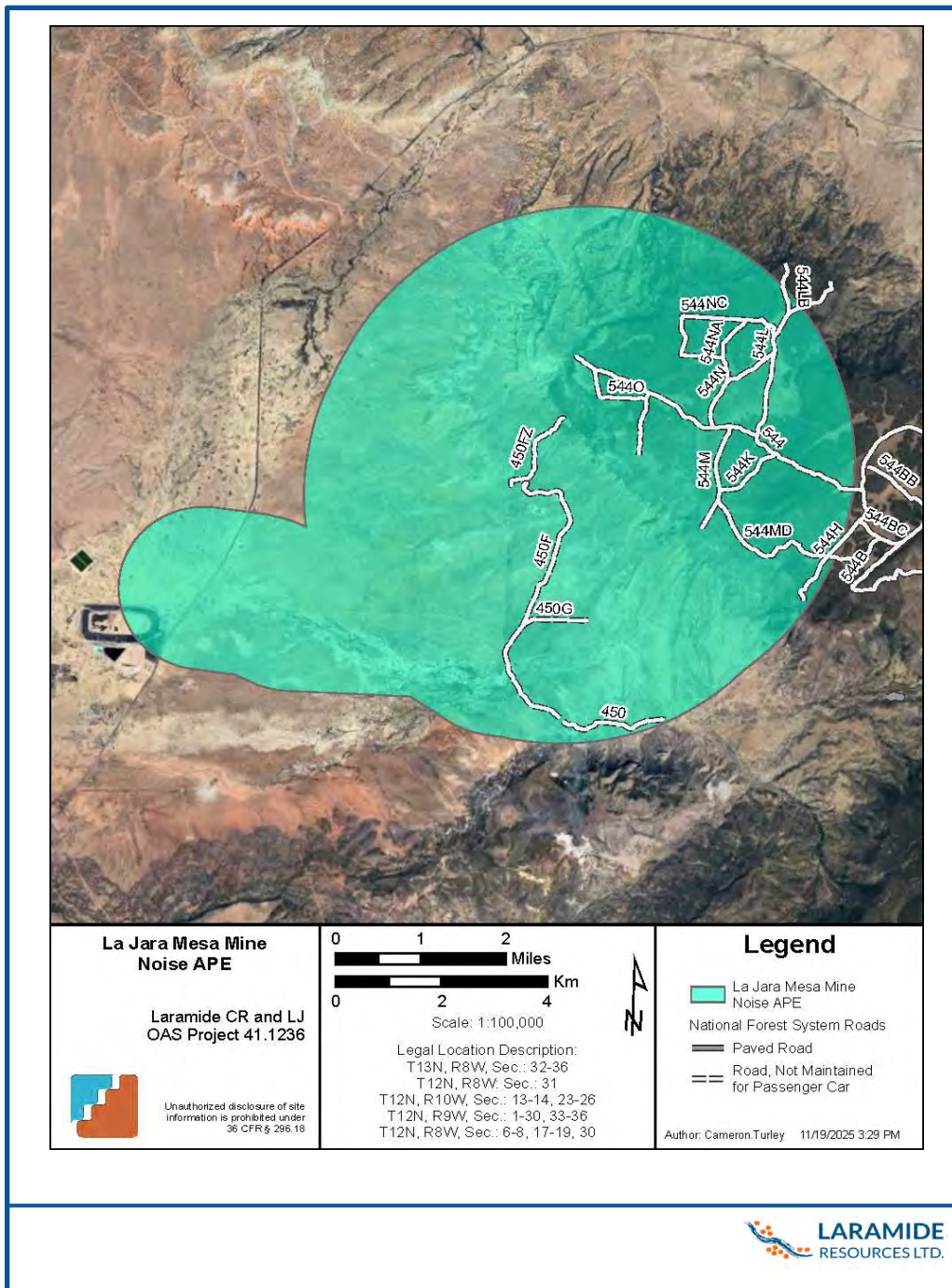
The CNF has determined that there are three APEs:

1. Physical APE—This APE is the area within which the ground could be disturbed by the undertaking, and thus there is risk for physical damage or destruction to properties/resources/uses. There are two separate Physical APEs: one surrounding the mine Permit Area and haul road, and one surrounding the escape raise. The 213-acre Physical APE, shown in Map 12-1, is defined as follows:
 - Mine Permit Area = Permit Area plus a 20-meter buffer
 - Haul Road = 20-meter-wide road plus a 20-meter buffer on each side
 - Escape Raise = 1-acre area plus a 20-meter buffer



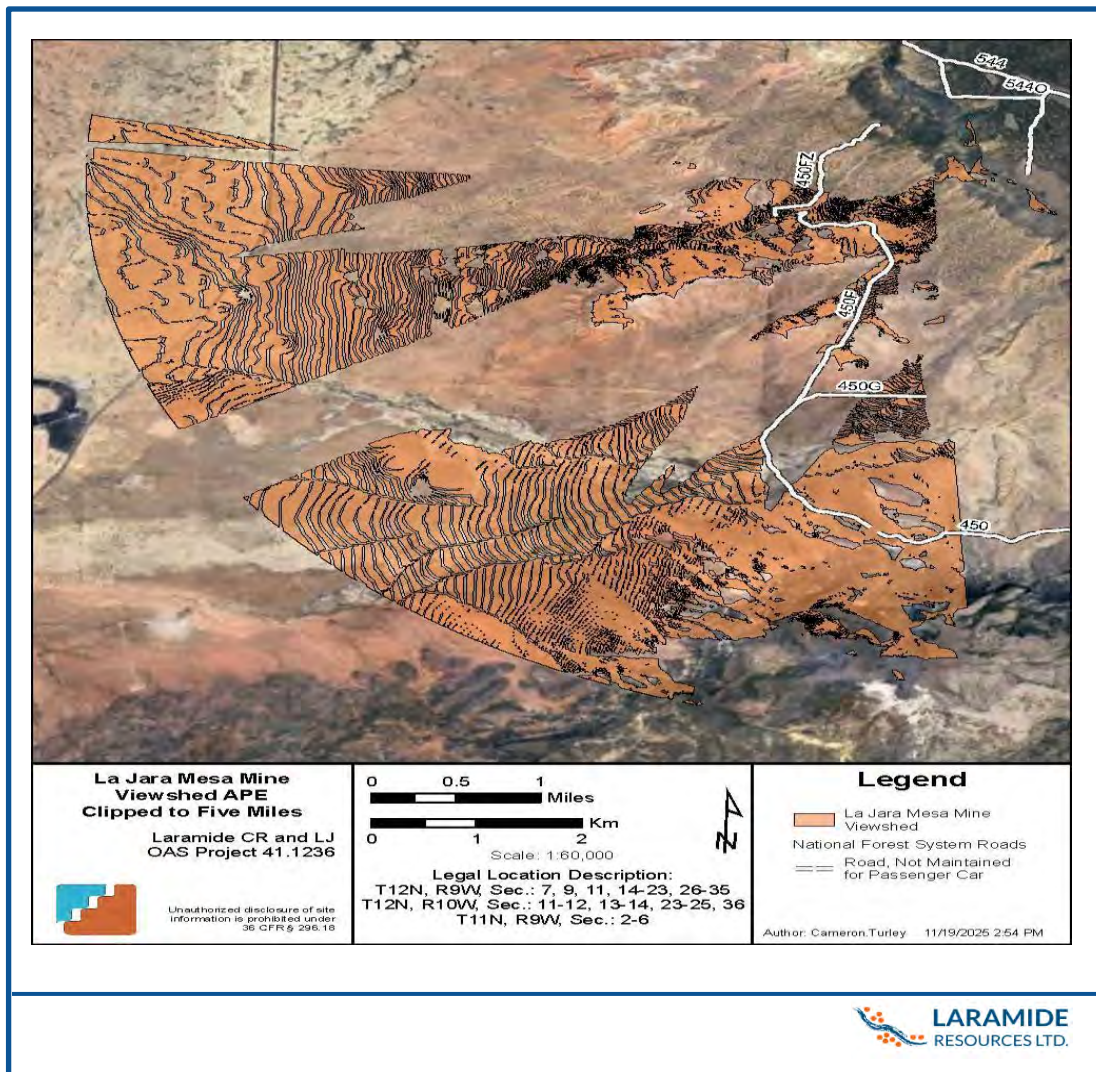
Map 12-1 Proposed Physical APE

2. Noise APE—This APE is the area within which noise from the undertaking could affect the setting of properties/resources/uses. There is no Noise APE around the escape raise because the activities and operations in that area of the undertaking are not expected to generate noise. The Noise APE surrounds the mine Permit Area (3-mile radius) and haul route (1-mile radius) for a total size of 24,311 acres, as shown in Map 12-2.



Map 12-2 Proposed Noise APE

- Visual APE—This APE is the area within which the introduction of modern elements or activities into the viewshed of properties/resources/uses could affect the setting of those properties/resources/uses. The Visual APE is defined as the area within 5 miles of the center of the mine Permit Area from which there is line-of-sight to the mine Permit Area. The total size of this APE is 6,456 acres, as shown in Map 12-3. This encompasses the haul route. The escape raise was determined not to have the potential to affect viewsheds because of its low profile and surrounding forest that hides it from view.



Map 12-3 Proposed Visual APE

12.2.2 Field Methods

Archeological fieldwork by the OAS team will conform to standards set forth in the *First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among New Mexico Historic Preservation Officer and Arizona State Historic Preservation Officer and Texas State Historic Preservation Officer and Oklahoma State Historic Preservation Officer and The Advisory Council on Historic Preservation and United States Department of Agriculture, Forest Service, Region 3 (R3 PA)* as a non-exempt undertaking subject to standard consultation (R3 PA Appx. A.I.J), the USDA USFS R3 Cultural Resources Handbook, hereafter Forest Service Handbooks or FSH (United States Department of Agriculture, Forest Service 2309.24 R3 5/87). All supervisory personnel will meet or exceed the Secretary of the Interior's Professional Qualifications Standards (48 *Federal Register* 44738-9).

Per the project scope of work (SOW), Tribal representatives will be fully integrated into the work process, working side-by-side and providing direct input on all tasks, including pre-field research, all aspects of fieldwork, and post-field data analysis and interpretation.

Field methods that meet or exceed the requirements in the R3 PA and the FSH are based on approaches developed, field-tested, and calibrated during surveys of tens of thousands of acres throughout New Mexico for federal agencies and private-sector entities. These methods apply state-of-the-art Global Navigation Satellite System (GNSS)-enabled GPS and digital tablet-based data collection, combined with reliance on high-quality GIS management of all archaeological data. The field methods and treatment of cultural resources outlined here are subject to consultation with the Cibola Forest archaeologist, both during the specified pre-work conference and for the duration of fieldwork. All work will be completed under the direct supervision of a qualified field supervisor and CNF-permitted supervisory archeologist. That individual will also be responsible for assessing “on-the-ground” field conditions, adjusting field methods (such as decreasing the transect interval from 15 m to 10 m), conducting limited testing, and determining when slope, vegetation, or other factors affect field conditions. All factors affecting or constraining the fieldwork will be documented in field notes and included in the report. If any contingencies encountered might require a significant alteration in field methods, fieldwork in that area will stop pending consultation with the CNF archaeologist.

The undertaking includes APEs for noise and viewshed in addition to the proposed physical or ground-disturbing APE. OAS will identify cultural properties, resources, and uses within these APEs that may be affected by the undertaking. A literature review, other existing data, input from TCSs, and other tribal experts will inform the identification of potential impacts. Under the guidance of the USFS/CNF, and per the SOW, the OAS will collaborate with each tribe to determine the appropriate approach for collecting tribal input. We propose that information can be gathered through OAS interviews with the appropriate Tribal representative in consultation with THPOs and TCSs. Interviews will be concurrent with other research and fit within the overall project schedule (so that the results can be incorporated with the final report as appropriate).

If field visits are approved, they will be determined prior to the start of fieldwork, so they can be incorporated into the discussion of logistics and level of effort outlined in this approach and will keep the number of mobilizations at a reasonable level. Additional proposed investigations of cultural resources within these two APEs will be submitted to the CNF for approval on a case-by-case basis. Investigations of cultural resources not located on National Forest System lands require obtaining the right of entry from landowners or land managers.

Prior to fieldwork, OAS will conduct the requisite literature review and background research using the New Mexico Cultural Resource Information System (NMCRIIS) online GIS and site records database, BLM General Land Office records, Natural Resource Management database records, physical records held at the CNF Supervisor’s Office, OAS records, prior ethnographic research reports available through the USFS CNF office, along with other archival sources and professional reports. Upon receiving data from the USFS/CNF, OAS will prepare a working Geographic Information System (GIS) project. Applicable data from database research will populate the GIS project and provide background information for use during the survey, enhancing the accuracy and efficiency of inventory coverage. The GIS project will include the following:

- Locations of all previously recorded sites
- Locations of all access roads
- Any no-access areas if such are identified by the agencies
- Other environmental and topographic coverages (e.g., contour lines, satellite imagery, vegetation types, etc.)

These layers will be downloaded to computer tablets with GPS units so that crew members will have instant access to project data while in the field. The computer tablets will facilitate data collection by using a custom-built data dictionary for New Mexico archaeology synchronized with a secure account via the cloud-based Field Maps application. In addition to having the locational data of previously recorded sites on GPS units, the field supervisor will carry paper copies of original site records for previously recorded sites within or adjacent to the study area. This will enable the crew to field-check any apparent discrepancies in the nature, location, or extent of sites shown on the GPS units versus what was reported on the site forms and what is encountered on the ground.

Pre-field controls will include pre-plotted 15 x 15-meter grids superimposed across all survey areas; shape files showing these 15 x 15-meter grids loaded onto all GPS units will ensure that each crew member always knows their precise location, and that accurate transect spacing is maintained throughout survey and site recording. A blinking cursor showing the location(s) of GPS units on the grid will allow our experienced crew members to position themselves in the center(s) of each 15-meter-wide transect. Crews will log each transect by recording a continuous track and monitoring their positions along each transect as they move across the landscape. This procedure will also facilitate survey accuracy of any designated sampling areas.

Pedestrian surveys of the designated areas will be comprehensive and systematic. The objectives of this effort are to identify, document, and record *all* cultural resources in the project parcels, including the following:

- Archeological sites
- Historic structures and buildings
- Isolated manifestations
- Intangible cultural heritage
- Other properties (50 or more years old) of potential historic or scientific interest that can be identified through an inventory of the ground surface augmented by examination of exposed profiles (such as arroyo cuts) and through full collaboration with tribal governments, TCSs, and other Tribal experts as identified by each Tribe

The survey will be accomplished by a trained crew of professional archaeologists, who will traverse and examine the project areas on transects spaced no more than 15 meters apart. Intervals will be adjusted depending on field conditions (i.e., if field conditions require smaller spacing for adequate coverage). All newly discovered archeological sites, historic structures or buildings, and cultural properties that are 50 years old or older will be fully assessed for significance by applying the National Register Criteria for Evaluation (36 CFR 60.4[a-d]). Previously recorded sites will be documented to meet USFS and state standards, and updated site records will be completed. Full re-documentation of sites will be undertaken when:

- Previous documentation is identified by the lead agency as insufficient to permit accurate evaluation.
- The character or condition of a site has changed substantively since originally recorded, and the previous documentation no longer accurately captures the characteristics and/or significance of the site.
- The original date of the investigation is 10 years prior.
- Determined in consultation with the USFS and CNF.

All data will be automatically synchronized to the cloud-based field maps service provided by Esri. This provides the project leads the opportunity to quickly and easily perform daily quality assurance and quality control (QA/QC) checks on the data. Thus, any data loss, errors, or irregularities can be identified and corrected efficiently. Once the QA/QC process has been completed, data will be downloaded onto the secure server in the OAS office and backed up using the Department of Cultural Affairs computer cloud and centralized server storage system.

12.2.3 Collaboration with TCSs

As stipulated in the SOW, OAS will collaborate directly with the tribes to finalize the protocols that are used in the field prior to fieldwork. We are proposing that a framework, similar to that used previously and referred to as the “Acoma method” (Simms, Taylor-Montoya, and Billings 2017; Goodwin et al. 2017; Taylor-Montoya 2025), can be used to successfully execute the SOW and satisfy the requirements of full participation by the TCSs and tribal representatives. The fundamentals of that method, as applied to a Section 106 archaeological survey and cultural resource inventory, are as follows:

- TCSs are embedded with archaeological survey crews on the ground.
- TCSs traverse the survey area with their respective survey crews.
- TCSs, during consultation, will have the opportunity to establish the specifics of how they traverse the survey area. TCSs will not be expected to maintain 15-meter spacing along transects like the archaeological crew but will be expected to keep pace with the archaeological field crew (moving as a team across the landscape).
- A protocol for recording cultural resources in the field is adopted whereby TCSs are actively communicating with and engaged with the archaeological field crews about resources encountered. In this way, the TCSs can best ensure that all cultural resources are appropriately documented and incorporated into the inventory results.
- TCSs will function as liaisons with other tribal experts, as necessary. Appropriately designed information packages, the contents of which will be outlined during kick-off, will be transmitted by the TCSs to and from experts to the OAS and the USFS CNF. This process will facilitate the flow of information into the identification, interpretation, and reporting processes.
- The protocol for recording resources may entail adopting a classificatory system so that TCSs can readily communicate to field crews that a cultural resource is in the vicinity and the level of sensitivity the resource requires. For example, some resources may be at the highest level of cultural sensitivity, and the appropriate treatment is to keep them confidential, even from field archaeologists. In this case, the TCSs may elect to have the field crew delineate a proposed avoidance area with a buffer that protects the confidential nature of the resource. This methodology was successfully applied in the field during a Section 106 survey on Pueblo of Acoma land in 2014 (Taylor-Montoya 2025).

Traditional knowledge that is considered highly sensitive or confidential, but that the Tribes and USFS CNF deem critical to evaluating cultural resources in the study area, will be included in a separate, confidential appendix. Tribes will have the opportunity to contribute to, review, and edit the information contained in the confidential appendix. This process will need to conform to the schedule of deliverables so the appendix can be included with the final report and data deliverables.

- Archaeological sites will be documented to the appropriate federal and state standards (see next section). TCSs will also provide their input on those resources to the extent determined appropriate by the Tribes. This will be recorded in the field and incorporated into the evaluation and reporting as specified in the SOW.
- Because there will potentially be up to 14 individual TCSs, we are proposing that multiple TCSs accompany the archaeological field crew per mobilization. This is to manage the logistics and costs associated with multiple mobilizations.
- If TCSs from some Tribes require that they traverse the survey area in a separate mobilization, OAS will provide two field personnel to accompany them, at least one of whom will be a qualified field supervisor familiar with the project and survey area. Likewise, if field visits are approved for the Visual and Noise APEs, OAS will provide two field personnel, including a qualified field supervisor, to accompany the Tribal representatives.
- The level at which information is documented and shared that derives from traditional knowledge provided by the TCSs and Tribal representatives will be determined prior to fieldwork by consultation with all parties. However, every effort will be made to incorporate that information into the interpretation, evaluation, and recommendations that result from the inventory. As noted above, confidential or highly sensitive information deemed necessary for fully understanding and assessing the potential impacts of the project will be included in a separate appendix.

12.2.4 Treatment of Isolated Occurrences and Archaeological Sites

Except as otherwise agreed upon by the USFS and Tribes for cultural resources identified by traditional knowledge experts (see previous section), definitions and identification of isolated occurrences (IOs) and Sites shall follow guidelines established in the USDA Forest Service Handbooks (FSH 2309.24 R3: 10.5). The FSH (10.5(7)) defines a Site as a “location of purposeful prehistoric or historic human activity” which left a deposit of cultural materials that meet the minimum size and complexity requirements outlined below. Documentation of Sites will be accomplished using the CNF version of the Laboratory of Anthropology site record. Per USFS guidelines, identified cultural materials that do not meet these minimum requirements are recorded as IOs. The FSH (10.5(7)) clearly defines the requirements. A cultural resource qualifying as a site under this definition should exhibit at least one of the following:

- One or more features
- One formal tool, if associated with other cultural materials, or more than one formal tool.
- An occurrence of cultural material (such as pottery sherd, chipped stone, or historic items) that contains one of the following:

Three or more types of artifacts or raw materials:

1. Two types of artifacts or material at a density of at least 10 items per 100 square meters
2. A single type of artifact or material at a density of at least 25 items per 100 square meters

When cultural materials are encountered, the crew will stop the 15-meter transect survey pace and determine whether the find is an isolated occurrence or part of a site by surveying at closely spaced intervals within the vicinity of the initial find. Isolated occurrences will be recorded in real time using a pre-programmed, comprehensive GPS-resident data dictionary that encompasses information about the myriad prehistoric and historic artifact types common in the project area. Our newly revised, region-specific data dictionary contains ceramic types specific to the region; the full range of lithic classifications

(formal and informal tool types, projectile point types, core types, debitage classes, raw material classes, etc.); 46 ground stone classes (including mano and metate types); 26 prehistoric rock art and exotic artifact classes; over 200 historic artifact types and makers' marks (e.g., cans, glass containers, firearm cartridges, etc.); 124 prehistoric and historic feature classes (from prehistoric structures to historic mine shafts); and 34 other classes of commonly encountered objects and features such as fence lines and civil monuments (survey markers). All IOs will be recorded in real time during the survey, and all diagnostic or rare/exotic artifacts will be photographed and documented according to standards. At the discretion of the qualified supervising archaeologist and under provisions established by the USFS (R3 PA Appx.: K(IV)), OAS may collect a rare or unique artifact for analysis and protection. Any such artifact will be accessioned to an appropriate facility for permanent curation in compliance with the rules established in the R3 PA.

If a site is found, site recording protocols will be applied. All artifacts and features will be characterized and analyzed in the field by recording a variety of attributes that provide information about function, form, age, and condition. At the assemblage level, these data will provide a robust sample of the material at the site and its distribution across the site. A variety of field recording forms have been developed during previous projects, and we have found that it is most efficient to tailor forms to specific artifact classes, such as historic glass or prehistoric lithic artifacts, to support consistent measurements of artifact classes.

These forms include guides for measuring and recording artifact sizes, edge angles, and other key attributes. Generally, OAS performs 100% recording and in-field analysis of surface artifacts, which number in the hundreds. When identified artifacts are in the thousands, the supervising archaeologist will determine a recording and analysis sampling strategy to capture at least 25% of the observed assemblage. Establishment of site boundaries will conform to FSH criteria, which include the following:

- All features, formal tools, and identifiable activity areas
- All areas of artifactual debris with a density of 10 or more cultural items per 100 square meters. To aid in boundary establishment or in an assessment of National Register of Historic Places (NRHP) eligibility for certain sites, the supervising archaeologist may determine that test excavations, bucket auger probes, or soil probes are necessary. Any site testing program initiated by the supervising archaeologist will conform to all guidelines outlined in the R3 PA Appendices K and L, including the potential need for additional consultations. The quality of the data we collect will allow us to make comprehensive assessments and recommendations for eligibility that address the NRHP criteria (36 CFR 60.4[a-d]) in detail. In addition to archaeological data, crews will also assess and document the potential for hazards, such as fire, to affect each site. The field supervisor will apply standard criteria, like fuel load, to make management recommendations.

As fieldwork progresses, project managers will review GIS data on the distribution of IOs and nearby formal sites. In this manner, any clusters of isolated occurrences are reevaluated to ascertain instances where isolated clusters might be treated better as formal "sites." This routinized management of isolated occurrences relying on GPS logging and detailed data dictionaries allows a high degree of quality control throughout the project, both during daily operations and at the end, when quality assurance from a project-wide perspective is necessary. Upon completion of fieldwork, field data will be compiled in a database hosted on our secure server located at the OAS facility in Santa Fe. Photographs, field notes, field forms, and GPS data will be digitally scanned and securely stored at this location, forming a comprehensive and complete record of cultural resources within the surveyed areas.

Laramide does not anticipate encountering human remains during pedestrian surveys. However, if such a discovery is made, all work will stop, and measures will be taken to protect the area from disturbance. The field crew will notify the Principal Investigator, CNF, and local law enforcement. Parties will implement procedures pursuant to NMAC 4.10.11 if the remains are discovered on private land, subject to applicable stipulations. If human remains are discovered on federal lands, protocols will follow federal regulations, specifically the Native American Graves Protection and Repatriation Act (NAGPRA). If found on the CNF, consultation will take place and proceed at the direction of the lead agency, USFS CNF, pursuant to pertinent regulations, including NAGPRA.

12.2.5 Photographs, Field Logs, and Location Maps

Digital photographs will be taken of those IOs that warrant photo documentation and/or additional visual analysis outside of the field inspection. At cultural resource sites, digital photographs will be taken of all diagnostic, rare, or exotic artifacts; all features; all evidence of disturbance (if applicable); and at least two overview photographs from different viewpoints.

All photographs will be logged on standardized forms that record the photographer, location (UTM coordinates), point of view, and a description of the photograph's contents. All digital photographs will adhere to appropriate standards (minimum 300 dpi). A photo log will be delivered as an Excel and/or Access database file as specified by the agency.

Both sites and IO locations will be plotted on the appropriate 7.5' quadrangle maps digitally using GIS technology. Map graphics showing site and IO locations on quads backgrounds will be generated and delivered as part of the final deliverables. Tables listing the required information for IOs, including IO number, location data, and descriptions, will be included in the final deliverables. For the geospatial data, a geodatabase conforming to agency standards, along with metadata, will be provided in accordance with the project requirements.

12.2.6 Reporting

The OAS will adhere to USFS/CNF reporting requirements as detailed in the SOW. The results of archeological investigations will be presented in draft and final inventory reports prepared to professional and USFS standards as established in the R3 Programmatic Agreement Forest Service Handbooks (FSH 2309.24 Chapter 10), and adhere to modifications of those guidelines established by the Cibola Forest Archaeologist presented in the SOW. A fully prepared Inventory Standards and Accounting Form (R3-FS-2300-4) will accompany the approved final inventory report as a cover sheet. The reports will minimally include: 1) descriptions of the survey areas' contemporary environmental landscape with further discussion of changes over time, 2) a culture history overview designed with TCSs and the experts with which they liaise to include context statements for evaluation of important themes and period(s) of significance of the landscape, 3) reviews of previous investigations, previously recorded cultural resources, and landscape use developed with TCSs and experts, 4) descriptions of archival, field, and laboratory methods developed with TCSs and experts, and 5) discussions of testing results, formal evaluations applying those measures of significance and integrity defined in the National Register Criteria for Evaluation (36 CFR 60.4 [a-d]) and USDI-National Register Bulletin 15, and statements of effects considering type, duration, and scale developed collaboratively with TCSs and experts. Except where sensitivity or confidentiality prevents it, tribal input will be seamlessly incorporated into chapter narratives with full and appropriate attribution. The report will discuss the new information arising from this technical approach that was not captured in prior efforts and how that new information impacted determinations of effect and eligibility. The draft report deliverable will also contain copies of the Laboratory of Anthropology

site forms and site plan maps, the IO table, and IO maps. All project and site data will be curated in NRM, NMCRIS, and the Center for New Mexico Archaeology. Any Historic Cultural Property Inventory (HCPI) forms for structures or the built environment will be submitted to the Forest Service and curated in appropriate databases.

Sensitive or confidential information that cannot be included in a public-facing document may appear in a separate, clearly marked appendix, which can be redacted in its entirety prior to dissemination. Information and input important for determinations of effect and eligibility that should not appear in the report in any form will be identified by the TCSs and other tribal experts and communicated directly to the CNF Archaeologist in written or verbal exchanges. Other treatments for sensitive and confidential information may emerge during the collaborative process and will be brought to the Forest Archaeologist for review and approval.

After completion of the technical reports and site forms, OAS will coordinate with the Historic Preservation District (HPD), the USFS, and tribal stakeholders via TCSs and tribal experts to develop a public document that summarizes the project and findings, excluding sensitive and privileged information. Pursuant to the mission of OAS and the New Mexico Department of Cultural Affairs and in accordance with statutory obligations in NM Stat 18-3 and NMAC 4.10.15.21, a short, written popular media summary of the project will be crafted for public consumption. This summary will have the same full tribal collaboration as the formal inventory and assessment report.

The OAS will submit an electronic version (PDF) of the full draft report to the Cibola for review and comment. The draft report will be complete and have undergone technical editing and formatting. The OAS will revise the report to address the Cibola's comments and submit a PDF of the final report to the CNF. The CNF will provide the final report to Section 106 Consulting Parties for input. It is not anticipated that a revision to the OAS report will be necessary based on Consulting Party comments received. However, if it is determined that another revision is necessary, the process described above will be followed.

13 LAND USE

The proposed Permit Area is located on private and CNF-managed lands (Maps 1-1, 3-1). The mine portal and related surface facilities and escape raise areas are entirely on CNF-managed surface lands, while a portion of the haul road from NM 605 along Forest Service Road 450 is on private land. A BLM parcel borders the Permit Area along a portion of the haul road, and there are state-owned parcels in the surrounding vicinity. The proposed haul road improvement will realign the existing road and avoid BLM-managed lands. Land uses in the vicinity of the Permit Area include grazing, mining, watershed, wildlife habitat, and recreation.

13.1 Objective

The objective of collecting baseline land-use data is to provide information on current land uses, inform post-mining land uses, and support the development of reclamation measures and objectives.

13.2 Sampling Design and Methods

Land use baseline data were collected and presented to state agencies in Laramide's draft BDR. Forest Service records were evaluated to determine the primary land use designations for the Permit Area and surrounding areas. The NRCS and New Mexico Bureau of Mines were consulted to determine land use

on the surrounding private lands. Soil Survey information was accessed to determine the land capability classification. The state review of this information in 2024 resulted in a request to add the impacted unit designations to the BDR V.0.

The BDR V.0 will also rely on a new desktop review, and new field observations confirm Permit Area land uses. Resources for desktop review include the CNF, current RMP, GIS datasets such as oil and gas wells, water wells, land ownership, utilities, and roads. These data are publicly available from sources such as the New Mexico Resource Geographic Information System, the New Mexico Oil Conservation Division, BLM, and Homeland Infrastructure Foundation-Level Data. Field observations of land uses will overlap with other field deployments and will not require a separate survey.

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Appendix A

QAPP

Quality Assurance Project Plan

La Jara Mesa Uranium Mine Sampling and Analysis Plan

Prepared for
New Mexico Mining and Mineral Division

Prepared by
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Certification

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Name
Title
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Date

QAPP

La Jara Mesa Uranium Mine Sampling and Analysis Plan

February 2026

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Abbreviations

BDR	Baseline Data Report
CFR	Code of Federal Regulations
COC	Chain of Custody
DQO	data quality objective
GPS	global positioning system
ID	identification
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure

1 Quality Assurance Project Plan (QAPP)

A quality assurance project plan (QAPP) is an integral part of implementing the Sampling and Analysis Plan (SAP). It specifies the data quality and quantity requirements, as well as the procedures for collecting, analyzing, and reporting the data. The goal of the SAP/QAPP is to collect representative samples that yield results that meet the project's data quality objectives and needs. The goal of quality assurance (QA) and quality control (QC) is to limit errors and bias in the sampling and analysis process through an integrated implementation of management, assessment, and control measures—facilitating the generation of data that is useful for decision-making.

The QAPP can include one or more of the following:

- Project management, organization, and project personnel responsibilities
- Sampling, analysis, and measurement procedures
- Instrument calibration procedures
- Procedures for recording, reducing, validating, and reporting data
- Procedures for performing quality assurance verification and internal QC checks and preventive maintenance schedules
- Specific routine procedures to evaluate precision, accuracy, and completeness
- Steps for addressing deviations from plans and appropriate corrective actions
- Information on appropriate staff training

1.1 Project Management

Project organization, roles and responsibilities, training, record keeping, and documentation are discussed in the subsections that follow.

1.1.1 Project Organization Roles

- Project Manager and Technical Lead
- Quality Assurance/Quality Control (QA/QC) Manager
- Principal professional / Subject Matter Expert
- Project Manager (Task Level)
- Field Operation Lead
- Field Crew

1.1.2 Responsibilities

A generalized description of the roles and responsibilities of the staff supporting the implementation of the Plan is as follows:

Project Manager and Technical Lead

The Project Manager/Technical Lead provides overall project oversight and direction. Responsibilities include selecting and managing contractors performing survey or field work; coordinating with contractors, laboratories, and regulatory representatives; ensuring project activities adhere to the approved work plans

and QA requirements; and monitoring progress of field and reporting tasks. The Project Manager is responsible for overall project execution, including schedule, budget, and deliverable management.

QA/QC Manager

The QA/QC Manager is responsible for ensuring that project activities and deliverables meet established quality standards of this QA Plan and applicable standards. Responsibilities include conducting reviews of reports and supporting documentation and verifying the completeness, accuracy, and usability of technical data.

Principal Professional / Subject Matter Expert

The Principal Professional (or Subject Matter Expert) serves as the technical authority for specific disciplines addressed in the Baseline Data Report. This role may be fulfilled by personnel from consulting firms or Laramide. Responsibilities include reviewing sampling plans, providing technical oversight of sampling and field activities, evaluating data usability and quality, conducting data analysis and interpretation, and contributing to preparation and review of report sections within their area of expertise.

Project Manager (Task-Level)

Task-level Project Managers oversee planning and execution of specific components of the Baseline Data Report. In some cases, this role may be combined with the Principal Professional or Field Operations Lead. Responsibilities include coordinating task planning, managing field and reporting activities, tracking progress against schedule and budget, and ensuring project tasks comply with QA/QC requirements.

Field Operations Lead

The Field Operations Lead is responsible for planning and coordinating field activities. Duties include developing and implementing sampling plans, supervising field teams, coordinating with analytical laboratories regarding sample handling and analysis, and ensuring proper field documentation and chain-of-custody procedures. The Field Operations Lead also evaluates data quality and usability, supports data analysis and interpretation, and contributes to report preparation.

Field Crew

Field crew members conduct field sampling and data collection activities under the direction of the Field Operations Lead and/or Project Manager. Responsibilities include implementing sampling procedures according to approved plans and standard operating procedures, maintaining accurate field records, handling, and documenting samples appropriately, and following all project quality assurance and safety requirements.

1.2 Training Requirements

1.2.1 Health and Safety Training

Personnel conducting on-site activities must be qualified and experienced professionals working under the supervision and management of specialized firms (Contractors). Contractors are retained to perform the various field surveys and sampling activities required to support updates to the Baseline Data Report.

Contractors are responsible for ensuring that their personnel meet internal training, qualification, and competency requirements appropriate to the work being performed. Personnel assigned to field activities must be trained in hazard recognition, hazard avoidance, and safe work practices relevant to site conditions and project tasks.

In accordance with applicable Occupational Safety and Health Administration (OSHA) requirements, including the general duty provisions of Occupational Safety and Health Administration regulations (e.g., Occupational Safety and Health Act General Duty Clause Section 5(a)(1) and applicable standards under 29 CFR 1910 and 29 CFR 1926), contractors are responsible for implementing appropriate health and safety programs for their personnel. These programs must include hazard communication, required training, development and implementation of health and safety plans where applicable, and provision and use of appropriate personal protective equipment (PPE).

All field personnel are expected to follow the health and safety procedures established by their employer and to utilize appropriate equipment, including required Personal Protective Equipment, to minimize risks associated with fieldwork and site conditions.

1.3 Documentation and Records

Accurate and complete documentation is essential for evaluating the quality and reliability of environmental data collection activities. Proper recordkeeping ensures that field activities, observations, and measurements can be reviewed, verified, and reproduced, as necessary. This section describes the requirements for documenting field activities and maintaining project records.

Field personnel will document field activities, observations, measurements, and sample collection information using permanently bound field logbooks or approved digital data collection systems. Field logbooks, where used, will contain sequentially numbered pages. Entries will be made in sufficient detail to allow reconstruction of field activities and will include, as appropriate, the date, time, personnel present, weather conditions, sampling locations, procedures performed, and deviations from approved sampling plans or standard operating procedures.

Digital data collection tools or electronic datasheets may be used where appropriate and must maintain equivalent documentation standards, including traceability, version control, and secure storage of records.

Each contractor will follow their internal company and/or resource-specific records management procedures (see standard operating procedures [SOPs], Appendix A). Records generated during field activities will be maintained in accordance with these procedures to ensure data integrity, traceability, and accessibility for quality assurance review and reporting.

1.4 Data Acquisition

This section describes the requirements for the following:

- Sample Design and Data Collection
- Field Activities
- Sample Handling and Custody
- Analytical Methods
- Quality Control Sampling

- Equipment Testing, Inspection, and Maintenance
- Instrument Calibration Procedures
- Inspection and Acceptance Requirements for Supplies and Consumables
- Management of Work Plan Deviations

Additional details on data acquisition specific to the radiological sampling is included in Section 3.

1.4.1 Sample Design and Data Collection

The sampling design is described in detail in the SAP and specific SOPs. In general, GPS data will be collected using industry-accepted standards applicable to the sampling effort, and the resulting files will be maintained and provided to reviewing agencies, upon request. Other data, such as GPS coordinates, date, time, and other relevant information (e.g., sample ID, type, etc.) will be hand-recorded in hard-bound field notebooks or worksheets.

1.4.2 Sampling Method Requirements

Sampling techniques, including standard methods, sampling containers, and preservation procedures, are described in the SAP and attached SOPs.

1.4.3 Sample Handling and Custody Requirements

The following subsections describe sample handling procedures, including sample identification, labeling, documentation, Chain of Custody (COC), and shipping.

1.4.3.1 Sample Identification

Each sample collected during site assessment activities will be assigned a unique sample identification (ID) number and cross-referenced to the sample type (water, soil, sediment, waste, etc.), sample collection location, and the depth of the sample collection in the field notes. The sample ID would be recorded on the COC forms.

1.4.3.2 Sample Labels

Labels would be affixed to each sample container. The label would be completed with the following information written in indelible ink:

- Project name and location
- Sample identification number
- Date and time of sample collection
- Preservative used (if any)
- Analysis required

The sample would also be refrigerated (if necessary) by placing it on ice in a cooler.

1.4.3.3 Sample Documentation

Documentation during sampling is essential to promote proper sample identification. Field personnel would adhere to the following general guidelines for maintaining field documentation, though each contractor may deviate slightly in accordance with policies or standards applicable to the resources sampled.

- Documentation would be completed in permanent black or blue ink. All entries would be legible.
- Errors would be corrected by crossing out the entry with a single line and then dating and initialing the line out.
- Any serialized documents would be maintained and referenced in the site logbook.
- Unused portions of pages would be crossed out, and each page would be signed and dated.

1.4.3.4 Chain of Custody (COC)

Field personnel would use standard sample custody procedures to maintain and document sample integrity during collection, transportation, storage, and analysis. COC procedures provide an accurate written record that traces the possession of individual samples from the time of collection in the field to the time of acceptance at the laboratory. The COC form would be used to document all samples collected and the analyses requested. Information that the field personnel would record on the COC form includes the following:

- Project name and number
- Sampling location
- Name and signature of sampler
- Destination of sample (laboratory name)
- Sample ID
- Date and time of collection
- Number and type of containers filled
- Analyses requested
- Preservatives used (if applicable)
- Filtering (if applicable)
- Signatures of individuals involved in custody transfer, including the date and time of transfer
- Airbill number (if applicable) or courier information
- Project contact and phone number

Unused lines on the COC form would be crossed out, and field personnel would sign it. The airbill number would be recorded. It is expected that samples would be hand-carried to a local analytical laboratory for analysis. If samples were shipped by courier or air carrier, the COC form would be placed in a waterproof plastic bag and taped to the inside of the shipping container. Signed airbills would serve as evidence of custody transfer between field personnel and the courier, and between the courier and the laboratory. Copies of the COC form and the airbill would be retained and filed by field personnel before the containers are shipped.

The laboratory sample custodian would receive all incoming samples, sign the accompanying COC forms, and retain copies of the forms as permanent records. The laboratory sample custodian would record all pertinent information concerning the samples, including the persons delivering the samples, the date and time received, sample condition at the time of receipt (sealed, unsealed, or broken container; temperature; or other relevant remarks), the sample IDs, and any unique laboratory identification numbers for the samples. When the sample transfer process is complete, the custodian is responsible for maintaining internal logbooks, tracking reports, and other records necessary to maintain custody throughout sample preparation and analysis.

The laboratory would provide a secure storage area for all samples. Access to this area would be restricted to authorized personnel. The custodian would ensure that samples requiring special handling,

including those that are heat- or light-sensitive, radioactive, or have other unusual physical characteristics, are properly stored and maintained prior to analysis.

1.4.3.5 Analytical Methods

Analytical methods proposed for completing sampling and analysis are provided in Attachment A (A-1 through A-7).

1.4.3.6 Quality Control Sampling

The subsections below specify QA/QC protocols for field and laboratory samples. Duplicate samples would be collected during the investigation at a frequency of 10% of the total number of samples collected.

1.4.3.7 Instrument/Equipment Testing, Inspection, and Maintenance

All equipment used during the site assessment would be properly tested, inspected, maintained, and calibrated. Samples collected during this investigation would be analyzed only by laboratory equipment. The laboratory's QA plan and written operating procedures describing specific testing, inspection, maintenance, and calibration procedures for equipment would be followed. Operation of the GPS unit and subsequent differential data corrections will be performed in accordance with the operator's manual. Daily GPS checks will include battery life, position dilution of precision, and known-point and data-acquisition checks. Daily quality control checks for gamma survey meters will include battery life, high-voltage and threshold, background, and known radioactive source checks.

1.4.3.8 Field Instrument Calibration Procedures

All field equipment used for this project (e.g., water quality meters, soil pH kit, etc.) would be calibrated regularly according to the associated manufacturer's Operation Manuals. The gamma survey meters employed will be calibrated by the manufacturer. The minimum detectable activity level will be defined for all gamma survey meters using the calculations described in NUREG-1507 and NUREG/CR-5849 Section 5. Additionally, the meters will be tested periodically at the Calibration Pad facility outside of Grants, New Mexico, and in accordance with the literature (Leino et al., 1994; George et al., 1985).

1.4.4 Plan Deviations

Minor deviations, including field instrument malfunction (pH meter, etc.), would be addressed by the field crew and the project manager using professional judgment. Any deviation from the SAP would be detailed in the field notebook and included in the final report to the client and regulatory agency representative. Any significant deviation would be addressed by the field crew, the project manager, the client, and the regulatory representative. A consensus on correcting the deviation would be achieved prior to executing any work plan changes. If a situation arises that requires a deviation from the work plan and attempts to contact the client and regulatory representative are unsuccessful, and the need for a decision is time-critical, the project manager would use professional judgment to adjust work plan specifications as needed.

1.5 Data Validation and Usability

This section describes the procedures that are planned to review and evaluate field and laboratory data. This section also discusses procedures for verifying that the data are sufficient to meet the data quality

objectives. Additional details on data validation and usability specific to the radiological sampling are included in Section 3.

1.5.1 Data Review, Validation, and Verification Requirements

For this project, 100 percent of the laboratory results will be reviewed. Validation will be performed by the certified analytical laboratory only. Data will be reviewed for holding times, handling and preservation procedures, COC, acceptance within control limits, and to ensure that method control limits for project goals are met.

1.5.2 Data Evaluation and Usability

Laboratory personnel would verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any nonconformance with the analytical method requirements. Laboratory personnel would make a systematic effort to identify any outliers or errors before they report the data. Outliers that result from errors found during data verification would be identified and corrected; outliers that cannot be attributed to errors in analysis, transcription, or calculation would be clearly identified in the case narrative section of the analytical data package. All laboratory and previously collected data would be reviewed to ensure usability. The data evaluation strategy would determine if the analytical results were within the QC limits set for the project, and data usability would be assessed. Specifically, sample analytical methods, handling requirements, holding times, duplicate results, and QC control limits would be reviewed.

1.5.3 Data Management

Field data would be recorded in logbooks and/or field forms, and scanned copies would be included in the appendices of the Baseline Data Report (BDR). Analytical data would be received in electronic form and summarized, tabulated, analyzed, and provided in the body of the report. The original laboratory data would also be provided in the appendices. As appropriate, some data would be presented graphically. Environmental data collection will undergo appropriate assessment and audit activities. Any problems encountered during field investigations or laboratory activities would require appropriate corrective action to ensure problems are resolved.

1.6 Reporting

Progress reports will be prepared summarizing the results of the field investigation activities and monitoring results for the duration of the field investigations at a frequency determined by Laramide. The outcome of these investigations would be documented in a final BDR. This report would include a description of all field operations, any deviations from the original SAP, a review of previously collected data and data limitations, all raw and processed analytical data collected during this investigation, and graphical representations of all spatial data. The report would also include other related supporting information and recommendations for subsequent data collection if data gaps are identified upon completion of the current investigation.

2 Analytical Tables

2.1 Soils

Table 1 Soil Testing Parameters and Detection Limits

Parameter	Method	Detection Limit
Metals Analysis		
Arsenic, total (3050)	EPA 6020B	0.1 mg/Kg
Boron, total (3050)	EPA 6010D	3 mg/Kg
Cadmium, total (3050)	EPA 6020B	0.025 mg/Kg
Calcium, soluble (Sat. Paste)	EPA 6010D	0.1 mEq/L
Chromium, total (3050)	EPA 6010D	2 mg/Kg
Copper, total (3050)	EPA 6010D	1 mg/Kg
Iron, total (3050)	EPA 6010D	6 mg/Kg
Lead, total (3050)	EPA 6020B	0.05 mg/Kg
Magnesium, soluble (Sat. Paste)	EPA 6010D	0.2 mEq/L
Magnesium, total (3050)	EPA 6010D	20 mg/Kg
Manganese, total (3050)	EPA 6010D	1 mg/Kg
Mercury by Direct Combustion AA	EPA 7473	4 ng/g
Molybdenum, total (3050)	EPA 6010D	2 mg/Kg
Nickel, total (3050)	EPA 6010D	0.8 mg/Kg
Phosphorus, total (3050)	EPA 6010D	10 mg/Kg
Potassium, total (3050)	EPA 6010D	50 mg/Kg
Selenium, total (3050)	EPA 6020B	0.05 mg/Kg
Sodium Adsorption Ratio	Calculation	Calculation
Sodium, soluble (Sat. Paste)	EPA 6010D	0.2 mEq/L
Thorium, total (3050)	EPA 6020B	0.5 mg/Kg
Uranium, total (3050)	EPA 6020B	0.05 mg/Kg
Zinc, total (3050)	EPA 6010D	2 mg/Kg
Radiochemistry		
Radium 226 (3050)	EPA 903.1	0.5 pCi/g
Sample Preparation		
Air Dry at 34 Degrees C	USDA No. 1, 1972	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	
Digestion—Hot Plate	EPA 3050B	
Saturated Paste Extraction	USDA No. 60 (2)	
Sieve-2000 um (2.0mm)	ASA No.9 15-4.2.2	
Sieve-250 um (60 mesh)	ASA No.9 15-4.2.2	
Water Extraction	ASA No. 9 10-2.3.2	
Soil Analysis		
Acid Generation Potential (calculation on Sulfur total)	EPA 600/2-78-054 3.2.4	Calculation
Acid Neutralization Potential (calculation)	EPA 600/2-78-054 1.3	Calculation
Acid-Base Potential (calculation)	EPA 600/2-78-054 1.3	Calculation
Conductivity @25C	SM 2510 B-2011	0.001 mmhos/cm
Net Neutralization Potential	EPA 600/2-78-054 1.3	Calculation
Neutralization Potential as CaCO ₃	EPA 600/2-78-054 3.2.3	0.1%
pH, Saturated Paste	EPA 600/2-78-054 3.2.2	0.1 units

Parameter	Method	Detection Limit
Sample Weight	Rad Disposal Compliance	G
Solids, Percent	D2216-80	0.1%
Sulfur Forms	EPA 600/2-78-054 3.2.4 Modified	0.01%
Texture by Hydrometer	ASA No. 9 15-5	0.1%
Wet Chemistry		
Nitrate as N, soluble (Water)	Calculation (NO ₃ NO ₂ -NO ₂)	Calculation
Nitrate/Nitrite as N, soluble (Water)	EPA 353.2	0.1 mg/Kg
Nitrite as N, soluble (Water)	EPA 353.2	0.05 mg/Kg

2.2 Surface Water

Table 2 Analytical Methods for Chemical Analyses of Water Samples

Metals/Radiochemistry	Method	Mdl	Units
Aluminum, total	EPA 200.7	0.35	mg/L
Antimony, total	EPA 200.8	0.0008	mg/L
Arsenic, total	EPA 200.8	0.0004	mg/L
Barium, total	EPA 200.7	0.045	mg/L
Beryllium, total	EPA 200.8	0.0002	mg/L
Boron, total	EPA 200.7	0.15	mg/L
Cadmium, total	EPA 200.8	0.0001	mg/L
Calcium, total	EPA 200.7	0.5	mg/L
Chromium, total	EPA 200.7	0.1	mg/L
Cobalt, total	EPA 200.7	0.1	mg/L
Copper, total	EPA 200.7	0.05	mg/L
Iron, total	EPA 200.7	0.3	mg/L
Lead, total	EPA 200.8	0.0002	mg/L
Magnesium, total	EPA 200.7	1	mg/L
Manganese, total	EPA 200.7	0.05	mg/L
Mercury, total	EPA 245.1	0.0002	mg/L
Molybdenum, total	EPA 200.7	0.1	mg/L
Nickel, total	EPA 200.7	0.04	mg/L
Potassium, total	EPA 200.7	2.5	mg/L
Selenium, total	EPA 200.8	0.0002	mg/L
Silver, total	EPA 200.8	0.0002	mg/L
Sodium, total	EPA 200.7	1	mg/L
Thallium, total	EPA 200.8	0.0002	mg/L
Thorium, total	EPA 200.8	0.002	mg/L
Uranium, total	EPA 200.8	0.0002	mg/L
Zinc, total	EPA 200.7	0.1	mg/L
Combined Radium, total	RA226 + RA228		pCi/L
Gross Alpha	EPA 900.0	8.5	pCi/L

Metals/Radiochemistry	Method	Mdl	Units
Gross Beta	EPA 900.0	24	pCi/L
Radium 226, total	EPA 903.1	2.1	pCi/L
Radium 228, total	EPA 904.0	19	pCi/L
Radon-222	ASTM D5072-92	100	pCi/L
Wet Chemistry	Method	Mdl	Units
Bicarbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Carbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Chloride	SM 4500-Cl E-2011	1	mg/L
Cyanide, total	EPA 335.4	0.003	mg/L
Fluoride	SM 4500-F C-2011	0.3	mg/L
Hydroxide as CaCO ₃	SM 2320 B-2011	2	mg/L
Nitrate as N	NO ₃ NO ₂ -NO ₂	0.02	mg/L
Nitrate/Nitrite as N	EPA 353.2	0.02	mg/L
Nitrite as N	EPA 353.2	0.01	mg/L
Residue, Filterable (TDS) @180C	SM 2540 C-2011	200	mg/L
Sulfate	ASTM D516-07/-11/-16	1	mg/L
Total Alkalinity	SM 2320 B-2011	2	mg/L
Turbidity	EPA 180.1	0.5	NTU

Table 3 Analytical Methods for Chemical Analyses of Sediment Samples

Metals	Method	Mdl	Units
Arsenic	EPA 6020B	0.1	mg/Kg
Barium	EPA 6020B	0.1	mg/Kg
Cadmium	EPA 6020B	0.025	mg/Kg
Chromium	EPA 6020B	0.25	mg/Kg
Cobalt	EPA 6020B	0.025	mg/Kg
Copper	EPA 6010D	1	mg/Kg
Lead	EPA 6020B	0.05	mg/Kg
Manganese	EPA 6010D	1	mg/Kg
Mercury	EPA 7473	4	ng/g
Molybdenum	EPA 6010D	2	mg/Kg
Nickel	EPA 6010D	0.8	mg/Kg
Selenium	EPA 6010D	0.005	mg/Kg
Silver	EPA 6010D	0.1	mg/Kg
Zinc	EPA 6010D	0.01	mg/Kg
Thorium	EPA 6020B	0.5	mg/Kg
Uranium	EPA 6020B	0.05	mg/Kg

Metals	Method	Mdl	Units
Radiochemistry	Method	Mdl	Units
Gross Alpha and Beta	EPA 9310	1 to 2	pCi/g
Radium 226	EPA 903.1	0.5	pCi/g
Radium 228	EPA 9320	3	pCi/g
Additional Analyses	Method	Mdl	Units
pH, Saturated Paste	EPA 600/2-78-054 3.2.2	0.1	
Conductivity @25C	SM 2510 B-2011	0.001	mmhos/cm
Saturation Percentage	SLS, 1954-Method 27a		
Particle-Size Distribution	ASA No.9 15-4.2.2		
Rock Fragment			

2.3 Groundwater

Table 4 Field Parameters Measured during Well Purging and Groundwater Sampling

Parameter	Method	Units	Stabilization Criteria
Conductivity	Standard Method 2510B	µmhos/cm	±5%
Dissolved Oxygen	ASTM Method D888-09 (C)	mg/L	±10% (>0.5 mg/L; three consecutive readings below 0.5 mg/L will be considered stabilized even if the change between readings is more than +/-10%)
Oxidation-Reduction Potential	Standard Method 2580A	mV	±10 mV
pH	Standard Method 4500-H ⁺ B	Standard Units	±0.1 standard units
Temperature	Standard Method 2550B	°C	±0.5°C
Turbidity	Standard Method 2130B or ISO7027	NTU or FNU	±10% (>5 NTU or FNU; three consecutive readings below 5 NTU/FNU will be considered stabilized even if the change between readings is more than +/-10%)

Table 5 Analytical Methods for Chemical Analyses of Groundwater Samples

Metals	Method	Mdl	Units
Aluminum, dissolved	EPA 200.7	0.08	mg/L
Antimony, dissolved	EPA 200.8	0.0004	mg/L
Arsenic, dissolved	EPA 200.8	0.0002	mg/L
Barium, dissolved	EPA 200.7	0.009	mg/L
Beryllium, dissolved	EPA 200.8	0.0001	mg/L
Boron, dissolved	EPA 200.7	0.03	mg/L
Cadmium, dissolved	EPA 200.8	0.00005	mg/L
Calcium, dissolved	EPA 200.7	0.2	mg/L

Metals	Method	Mdl	Units
Chromium, dissolved	EPA 200.8	0.0005	mg/L
Cobalt, dissolved	EPA 200.8	0.00005	mg/L
Copper, dissolved	EPA 200.8	0.0008	mg/L
Iron, dissolved	EPA 200.7	0.09	mg/L
Lead, dissolved	EPA 200.8	0.0001	mg/L
Magnesium, dissolved	EPA 200.7	0.2	mg/L
Manganese, dissolved	EPA 200.7	0.02	mg/L
Mercury, total	EPA 245.1	0.0002	mg/L
Molybdenum, dissolved	EPA 200.7	0.02	mg/L
Nickel, dissolved	EPA 200.7	0.008	mg/L
Potassium, dissolved	EPA 200.7	0.5	mg/L
Selenium, dissolved	EPA 200.8	0.0001	mg/L
Silver, dissolved	EPA 200.8	0.0001	mg/L
Sodium, dissolved	EPA 200.7	0.2	mg/L
Thallium, dissolved	EPA 200.8	0.0001	mg/L
Thorium, dissolved	EPA 200.8	0.001	mg/L
Uranium, dissolved	EPA 200.8	0.0001	mg/L
Zinc, dissolved	EPA 200.7	0.02	mg/L
Radiochemistry	Method	Mdl	Units
Combined Radium (dissolved)	RA226 + RA228		pCi/L
Gross Alpha, dissolved	EPA 900.0	2–4	pCi/L
Gross Beta, dissolved	EPA 900.0	2–4	pCi/L
Radium 226, dissolved	EPA 903.1	0.4	pCi/L
Radium 228, dissolved	EPA 904.0	1.5	pCi/L
Radon-222, dissolved	ASTM D5072-92	100	pCi/L
Wet chemistry	Method	Mdl	Units
Bicarbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Carbonate as CaCO ₃	SM 2320 B-2011	2	mg/L
Chloride	SM 4500-Cl E-2011	1	mg/L
Cyanide, total	EPA 335.4	0.003	mg/L
Fluoride	SM 4500-F C-2011	0.15	mg/L
Hydroxide as CaCO ₃	SM 2320 B-2011	2	mg/L
Nitrate as N	NO ₃ NO ₂ -NO ₂	0.02	mg/L
Nitrate/Nitrite as N	EPA 353.2	0.02	mg/L
Nitrite as N	EPA 353.2	0.01	mg/L
Residue, Filterable (TDS) @180C	SM 2540 C-2011	20	mg/L
Sulfate	ASTM D516-07/-11/-16	1	mg/L
Total Alkalinity	SM 2320 B-2011	2	mg/L

Metals	Method	Mdl	Units
Turbidity	EPA 180.1	0.1	NTU

Table 6 Analytical Parameters and Methods (RAD)

Parameter	Reporting Limit	Units	Method
Total Uranium	5	mg/kg	USEPA 3050/6010
Total Thorium	5	mg/kg	USEPA 3050/6010
Radium-226	0.2	pCi/g	USEPA 901.1M
Radium-228	0.2	pCi/g	USEPA 901.1M
Gross alpha/beta	10	pCi/g	SM 7110-B

Table 7 Standard Operating Procedures and Titles (RAD)

See Attachment A for the SOPs listed below.

SOP Number	SOP Title
ITC.201	Operational Checkout of Single-Channel Detector with Meter
ITC.207	Operational Checkout of Single-Channel Detector with a Ludlum Model 3000
PWT.102	Field Logbook Use
PWT.105	Performing a GPS-Based Gamma Radiation Survey
PWT.106	Making Exposure Rate Measurements Using an HPIC
PWT.108	Soil Sampling for Analytical Purposes

3 Radiological Quality Assurance Details

Below are specific handling, labelling, and QA/QC assurance details for radiological sampling.

3.1 Sample Labeling and Handling

Sample Identification

All samples will be labeled with a project-specific ID following the formats below. The areas of interest will be identified as follows in the ID:

Environmental Sample IDs No.:

mmddyy-XXXX-SS-## - P/D

Where –

mmddyy specifies the month, day, and year of the sample collection date with two digits for each

XXXX specifies the sampling area

MFPA – Main Facilities Permit Area (includes escape raise location)

RUC – Road and Utility Corridor (i.e., new road segment)

SS indicates a surface soil sample (0–15 cm)

indicates the sample location identifier (e.g., 01, 02, etc.)

P/D specifies the type of sample, either P for parent or primary sample, and D for field duplicate. If neither a P nor a D is present in the sample ID, then the samples will be considered primary.

Sample ID Example:

Primary surface soil sample from MFPA at location 03 collected on January 21, 2026, would result in the following sample ID –

01212026 – MFPA – SS – 03 – P

Sample Labels

The sample bags will be labeled at the time of sample collection, but the labeling will occur prior to the sample being placed within the bag. Each label should include the following information:

Sample identification number

Date/time of sample collection

Sampler's initials

Labels will be completed with waterproof ink

Chain-of-Custody

Each sample will be properly documented to facilitate timely, accurate, and complete laboratory analysis. The documentation system is used to identify, track, and monitor each sample from the point of collection through final data reporting. Where practicable, this documentation system may be electronic. Chain of custody (COC) protocols will be implemented and followed for samples submitted to off-site laboratories. A sample is in a person's custody if it is 1) in a person's physical possession; 2) in view of the person after taking possession; 3) sealed in a tamper-proof manner after having been in someone's physical possession; or 4) in a secure area restricted to authorized personnel.

COC forms will be used for sending or shipping samples to off-site laboratories to verify that the integrity of each sample is maintained. Each COC form will include the following information:

Sample ID

Date/time of collection

Sample depth (if applicable)

Testing requirements

Number of sample containers

Recipient laboratories

Signatures of parties relinquishing and receiving the sample at each transfer point (excluding signatures of overland couriers)

Whenever a change of custody takes place from the sampler to the laboratory, both parties will sign and date the COC form, with the relinquishing person retaining a copy of the form (physical copy or photograph). The project laboratory will perform laboratory custody procedures for receiving samples and logging in, sample storage, tracking during sample preparation and analysis, and storage of data in accordance with their SOPs. The laboratory project manager will be responsible for ensuring that laboratory custody protocol is maintained.

Packaging and Shipping

After collection, soil samples will be properly stored to prevent degradation of the integrity of the sample prior to its analysis. As applicable, this includes proper containerization and analyzing the sample within prescribed holding times, if necessary.

The COC will be sealed in a resealable plastic bag and placed inside the shipping container (e.g., cooler) prior to sealing the container. The shipping containers will be taped shut using tape over the hinges, and custody seals will be placed across the top and sides of the container. Custody seals will be used to preserve the integrity of each shipping container from the time the sample is collected until it is opened by the laboratory. One or more custody seals will be signed, dated, and placed on the sample container prior

to transport. Clear tape will be placed over the custody seals to prevent inadvertent damage during shipping. The tape should not allow the seals to be lifted off with the tape and reaffixed without breaking the seal. Samples will be shipped to Pace Analytical.

Pace Analytical
Contact: Wade Nieuwsma
1673 Terra Avenue
Sheridan, WY 82801
307-672-8945

3.2 Data Quality Assurance / Quality Control

Adherence to the procedures specified in this SAP will help to ensure that data uncertainty due to sampling error is minimized. The proposed contract laboratory (Pace Analytical, Sheridan, Wyoming, branch) is qualified for radiochemical analyses with appropriate National Environmental Laboratory Accreditation Program accreditations. Each batch of samples will include standard laboratory QC measurements (e.g., sample spikes, method blanks, duplicate analyses, etc.), and QC results will be provided with each data report.

Field duplicates will be collected at a rate of 5% of soil sampling locations (1 in 20) for confirmatory analysis at the contract laboratory. Any laboratory duplicates (splits) will be analyzed in accordance with the lab's standard QC protocols. Samples will be submitted to the laboratory under strict COC protocols and analyzed for the applicable radionuclides using the applicable methods and reporting limits provided above.

While specific QA/QC protocols for each of the radiological baseline parameters presented are provided in the applicable sections above, this section provides a consolidated and more generalized outline of QA/QC requirements applicable to the radiological baseline studies. All radiological surveys and sampling described are subject to the data QA/QC program described in this section to help provide confidence in the results and ensure that the data generated are reliable and technically defensible, with a minimal amount of uncertainty introduced by variability in instrument response, field survey, monitoring, sampling methods, or natural environmental factors (e.g., variations in soil moisture, diurnal radon fluctuations, etc.).

In general, quality assurance (QA) includes qualitative factors that provide confidence in the results, while quality control (QC) includes quantitative evidence that enables estimation of data uncertainty (e.g., accuracy and precision).

A generalized summary of QA protocols and requirements is as follows:

- All radiological surveys and sampling described for radiological characterization studies are subject to the data QA/QC protocols specified in this section.
- Any deviations from the planned survey or sampling designs or methods specified in this SAP will be documented and evaluated in the BDR.
- A systematic data quality objective (DQO) planning process was used as the basis for the study designs and analytical approaches described in this SAP to ensure the type, quantity, and quality of environmental data necessary to reliably characterize radiological conditions across the site.

- The radioanalytical approaches, methods, and QA/QC protocols to be used are consistent with relevant regulatory guidance (e.g., New Mexico Environmental Department and the Nuclear Regulatory Commission).
- Any proposed off-site analytical laboratory will be fully qualified and appropriately accredited for analysis. The vendor will be certified to perform radiochemical analysis and analysis of metals/metalloids, as necessary.
- Detailed field notes will be kept in field logbooks to document daily field study activities and any relevant observations about environmental conditions or equipment-related performance that could affect data.
- Standard sample COC protocols will be followed for sample shipping and laboratory analysis.
- All field data will be qualitatively and quantitatively reviewed by an experienced health physicist and evaluated for suitability and defensibility in terms of DQOs.
- Both raw electronic gamma survey files and shapefiles (or geodatabase files) will be saved in a cloud-based project directory and backed up on a secure server. Shapefiles specifying gamma survey boundaries/transects, target sample locations, etc., will be uploaded to GPS-enabled field tablets to guide any survey/sampling locations.

Data QC Summary:

Calibration of all field measurement instruments will be performed within 1 year prior to use on the project. Calibration certificates will be kept on file in the project records.

For field gamma surveys lasting multiple days, daily QC measurements (function checks) will be performed in the field for all gamma survey instruments and scanning systems to ensure 1) proper instrument/system performance, 2) acceptable measurement precision within/between instruments, and 3) quantitative evaluation of analytical uncertainty in study results.

Any commercial laboratory used for analysis of environmental samples will perform routine QC measurements for each batch of samples in accordance with the lab's Quality Assurance Plan and standard QC procedures for QA/QC and data acceptance (e.g., duplicate sample analyses, matrix spikes, method blanks, etc.) to provide quantitative indications of accuracy and precision.

Attachment A- Standard Operating Procedures

**Groundwater
RAD**



Standard Operating Procedure

Collection of Groundwater Samples from a Temporary or Permanent Monitoring Well (Includes Well Purging and Stabilization)

Revision 3

March 8, 2021

Approved By:

			
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Review of the SOP has been performed and the SOP still reflects current practice.

Initials: <u></u>	Date: <u>08/04/23</u>
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Initials: <u></u>	Date: <u></u>

Collection of Groundwater Samples from a Monitoring Well (Includes Well Purging and Stabilization)

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the methods used for monitoring well purging, stabilization, and sampling (excluding residential/water supply systems). The SOP also provides details regarding the calculation of purge volumes and measurement of groundwater stabilization criteria and identifies the common container, preservative, and holding times for typical groundwater sample analyses.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Sample collection methods can vary by project. If not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance.
- Collection of groundwater samples from residential/water supply systems are not discussed within this SOP.
- Dedicated sampling equipment, disposable sampling equipment, and/or decontamination of sampling equipment is required to prevent cross-contamination.
- Low-flow sampling methods are not discussed within this SOP (see Barr's SOP 'Collection of Groundwater Samples Using Low-Flow Purging and Sampling' for details).
- Sample collection using 'clean hands/dirty hands' methods is not discussed within this SOP.
- If sampling for per- and polyfluorinated alkyl substances (PFAS), special consideration must be taken to avoid accidental contamination of environmental samples - see Barr's SOP 'Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples'.

3.0 Responsibilities

The Project Manager, in conjunction with the client, develops the site-specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technician(s) are responsible for the measurement of well pumping rates, calculation of well purge volume, field screening procedures, field equipment and calibration, proper sample identification, collection of samples, quality control procedures, and documentation.

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

Project staff are responsible for ordering sample containers prior to the sampling event.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling waters contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies*

- Water quality meter (e.g., YSI, or equivalent)
- Polyethylene bailer and rope
- Sample tubing and fittings
- Turbidimeter (optional)
- Coolers
- Ice
- Chemical resistant gloves (e.g., nitrile)
- Calculator
- Locks/keys
- Pump (peristaltic or submersible), power source, and appropriate drive tubing
- Cord reel (optional)
- Graduated measuring container
- Plastic bags
- Waterproof ink pen or pencil
- Clock or stopwatch
- Sample containers (method specific)
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

* See Barr's PFAS SOP for a list of prohibited and acceptable items if samples are expected to be collected for PFAS.

6.0 Procedure

This section describes the procedure(s) for calibrating field equipment, measuring pumping rates, calculating purge volumes, well purging, measuring well stabilization, and the sampling, handling, and delivery of groundwater samples. Best practices include setting up the purging, stabilization, and sampling equipment in an upwind direction from any potential source of contamination.

This SOP describes the groundwater collection from a borehole, temporary well, or permanent monitoring well. Typically, a direct-push (Geoprobe® or equivalent) will be used to create the bore hole or temporary well by advancing the direct-push sampler to the desired sampling interval (sampling depth). When the sampling depth is reached, small diameter extension rods are inserted through the steel probe rods to hold the groundwater sampler screen in place while the rods and screen sheath are retracted, exposing the screen. The groundwater sampler screen can typically be exposed up to 41 inches, but can be exposed a shorter length depending on project requirements. Alternately, a small diameter PVC well screen and riser pipe may be installed in the bore hole for use as a temporary well. Polyethylene (or project specified) tubing is placed into the bore hole or temporary well, and a peristaltic pump (or equivalent) or project

specified pump is used to draw water samples to the surface for collection. Well stabilization is not always necessary for temporary wells but if required by the project, see Section 6.2.6 of this SOP.

After each borehole or temporary well is constructed, the probe rods are decontaminated by the drilling contractor in accordance with project requirements. The polyethylene (or project specified) tubing is discarded after each sample is collected and new tubing is used for the collection of the next sample. Borehole and temporary well locations will be permanently sealed following applicable state and local regulations.

6.1 Calibration

The water quality meter and turbidimeter will be calibrated as per the applicable Barr SOP. The meters will undergo calibration checks, at a minimum, before and after sampling. The calibration check will be documented on a calibration form (as appropriate) and/or in the field notebook. Any significant issues found during the calibration check will be noted in the field notebook and the Equipment Technicians will be notified.

6.2 Purging/Well Stabilization/Sampling

Prior to sampling, purging of the monitoring well is performed to remove stagnant water from within the well and to stabilize the well to allow for representative groundwater sample collection. The term 'purge volume' refers to the amount of water removed from a well before groundwater sample collection occurs.

Purging well volumes and stabilizing to remove stagnant water from a temporary well may not be necessary due to the short time frame between well installation and sampling. Purging and well stabilization procedure for temporary wells may vary by project or by well. Recommended practice is to purge a temporary well until the water clears, if possible, prior to sampling; however, purging prior to sampling may not be possible at all if water is limited (as it might be in a perched water zone), or water recharge is slow (as it would be in a clayey or silty water bearing zone).

6.2.1 Purge Volume

The volume of standing water in the well is calculated to determine the purge volume that needs to be removed from the well. The water level must be measured in order to determine the volume (see applicable Barr SOP). Calculation of the purge volume is addressed in Section 6.3, Data Reduction/Calculation of this SOP and Table 1. If a well is pumped dry, this constitutes an adequate purge and the well can be sampled following recovery. Refer to project documentation for volumes required to be purged.

6.2.2 Bailer Purging

A bailer can be used for slowly recovering wells with minimal water volume and a depth to groundwater greater than 25 feet. A new disposable polyethylene bailer with a check valve can be attached to a cord reel or a downrigger and support assembly. Polyethylene bailers can be hauled using stainless steel wire or new nylon line (rope).

- Put on gloves for skin protection and to prevent sample contamination.

- Secure the bailer and lower slowly into the water column until the bailer is submerged. Avoid rapid movements of the bailer to minimize turbidity. A cord reel can be used to aid in the lowering of the bailer.
- Raise the bailer and empty the water collected from the bailer into a graduated measuring container.
- Sampling may begin once desired volume is purged and the well has stabilized (see Section 6.2.6, Well Stabilization of this SOP).

6.2.3 Peristaltic Pump Purging

A peristaltic pump is used when the water level is within suction lift (e.g., within about 25 feet of the ground surface, but may be less at higher altitudes). It usually is a low-volume suction pump with low pumping rates suitable for sampling shallow, small-diameter wells.

- Put on gloves for skin protection and to prevent sample contamination.
- Lower tubing into the well water to the desired depth (typically near the middle of the water column within the well screen interval) and cut to the desired length.
- Connect the well tubing to the drive tubing entering the pump.
- Connect the drive tubing exiting the pump to the short section of tubing entering the flow-through cell or graduated measuring container.
- Turn on pump and set the speed at the desired rate of flow.
- Sampling may begin once desired volume is purged and the well has stabilized (see Section 6.2.6, Well Stabilization of this SOP).

6.2.4 Submersible Pump Purging

A submersible pump is used when the water level is greater than the suction lift associated with a peristaltic pump. It is commonly used in conjunction with a control box to achieve the desired pumping rate (low to high). Variable rate submersible pumps are available to fit inside 2 inch or larger wells.

6.2.4.1 1.5-inch Submersible Pump

This is a type of submersible pump that can be used in 2-inch or larger diameter wells. It can purge water from depths down to 200 feet or greater, depending on pump model and manufacturer.

- Put on gloves for skin protection and to prevent sample contamination.
- Attach appropriate diameter tubing to pump intake, secure the tubing to the pump using a hose clamp or zip tie, lower pump, and secure at desired depth (typically near the middle of the water column within the well screen interval).
- Cut off tubing, allowing additional tubing length for discharge.
- Plug the pump into the controller. Pump will begin pumping using the variable speed controller. There are varieties of speed controllers available, typically designed for a specific pump.
- Attach the controller to the power supply (e.g., car battery, generator).
- Attach the tubing to the flow-through cell for the water quality meter.

Note: If water is considerably turbid after initial pump start-up, the flow-through cell may be connected after purge water has cleared visually.

Turn on the controller and dial the speed control to the desired flow rate. The controller can slow the purge rate down to the optimum rate.

Note: If the submersible pump is not running, turn off the pump and then disconnect from the power supply. Check connections and try again.

- Sampling may begin once desired volume is purged and the well has stabilized (see Section 6.2.6, Well Stabilization of this SOP).

6.2.4.2 3 or 4-inch Submersible Pump

This pump may be used to purge water samples from any depth.

- Put on gloves for skin protection and to prevent sample contamination.
- Attach purging hose to the pipe connected on the top of the submersible pump.
- Lower the submersible pump slowly into the well until it is completely submersed into the water and secure at desired depth (typically near the middle of the water column within the well screen interval).
- Connect the pump to a sufficiently sized generator with an extension cord.
- Attach the flow-through cell for the water quality meter.

Note: If water is considerably turbid after initial pump start-up, the flow-through cell may be connected after purge water has cleared visually.

- Turn on pump and if it does not start, check connections to generator.
- Adjust flow rate to desired rate with the valve and measure the flow rate with the graduated measuring container.
- Sampling may begin once desired volume is purged and the well has stabilized (see Section 6.2.6, Well Stabilization of this SOP).

6.2.5 Well Purging with In-place Plumbing

In-place plumbing consists of dedicated, submersible pumps that are permanently installed in a well.

- Put on gloves for skin protection and to prevent sample contamination.
- Turn switch to start the generator, put choke on, pull recoil rope, and let generator idle until it is running smooth.
- Connect the pump to the generator with an extension cord.
- Connect the pipe, elbow, and valve to the discharge pipe of the submersible pump (located at the top of the well) and turn on the generator.

Note: If the pump does not start, check the connection from the generator to the pump.

- When water flows from discharge of the pump, adjust the flow according to desired flow rate and measure the flow rate with the graduated measuring container.
- Attach the flow-through cell for the water quality meter.

Note: If water is considerably turbid after initial pump start-up, the flow-through cell may be connected after purge water has cleared visually.

- Sampling may begin once desired volume is purged and the well has stabilized (see Section 6.2.6, Well Stabilization of this SOP).

Note: Each dedicated pump has its own pipe, elbow, and valve. These pieces are left at each well.

6.2.6 Well Stabilization

Well stabilization is typically conducted to help verify that the groundwater sample is representative of aquifer conditions. A well is considered 'stabilized' after the well purge volume has been met and the groundwater (or well) stabilization parameter measurements are within acceptable limits for three consecutive readings. Well stabilization parameters may vary by project or regulatory agency but at a minimum typically include pH, temperature, and specific conductance (temperature corrected electrical conductivity). Dissolved oxygen (DO) and oxidation-reduction potential (ORP) may also be used as stabilization parameters.

The procedure to stabilize a well includes recording well stabilization parameter measurements collected with the water quality meter at the beginning of the well purging process and after subsequently purged well volumes. A well volume is measured as the volume of water present inside a well screen and/or casing (i.e., from the base of the well to the water level measurement) and is defined in the footnotes of Table 1. Groundwater aliquots used for stabilization parameter measurements are typically collected by either directing the purge water discharge line through a flow-through cell or by pouring groundwater from a bailer into a container holding the water quality meter probe (depending on the purging method used).

Documentation of the well stabilization process typically includes recording pertinent information such as the pump type, pumping rate, volume pumped, and well stabilization measurements on the field log data sheets or field notebook. If only the minimum parameters are used for stabilization, the DO and ORP should still be measured and recorded as they may be needed to interpret other chemical parameter results. Turbidity is typically not used as a stabilization parameter. A qualitative determination of turbidity may also be noted (e.g. clear, cloudy, very cloudy, etc.).

The well may be sampled after three consecutive measurements (typically one well volume per measurement), collected at the intervals described above, are within specific project criteria or the criteria presented in Section 7.2, Measurement Criteria of this SOP.

If field parameters do not stabilize after five well volumes have been purged, then the field technician will verify that the probes and related equipment are functioning properly and that operator error is not an issue. They will also re-evaluate whether or not water is being withdrawn from the appropriate depth to effectively evacuate the well. If the checks produce no new insight, a decision will need to be made by the project team on whether to collect samples for laboratory analysis. When samples are collected, it will be clearly documented that stabilization was not achieved; at a minimum, this fact will be reported on the field log data sheets and in the Field Sampling Report.

If the well was purged dry, it shall be allowed to recharge and the samples should then be collected. If there is insufficient sample volume for the analyses being sampled, the project team will need to decide if sampling should be carried out or if a reduced prioritized list of analyses should be collected.

6.2.7 Sampling

The project team will determine the order for sampling the wells but general guidelines are below:

- Where water quality data are available, the least contaminated wells would be sampled first, proceeding to increasingly contaminated wells.

- Where the distribution of contaminants is not known, wells considered to be up gradient from likely sources of contamination would be sampled first and downgradient wells closest to the suspected contamination would be last.
- Make certain to keep records of the order in which wells were sampled.

Similar to purging, sampling requires the use of pumps or bailers. It may be appropriate to use a different device to sample than that which was used to purge. The most common example of this is the use of a pump to purge and a bailer to sample. There are several factors to take into consideration when choosing a sampling device. The experience of the project team will be used to determine which is appropriate and care should be taken when reviewing the advantages or disadvantages of any one device.

To reduce potential contamination, samples for PFAS should be collected first. See Barr's SOP 'Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples'. To prevent the possible loss of some volatile organic compounds (VOCs), samples for volatile parameters should be collected second with as little agitation and disturbance as possible, then proceed in order towards the least volatile parameter as listed in Barr's 'Water Sampling Guidelines' form. The 40 mL vials used to collect the VOC samples should be checked for air bubbles. Air bubbles may be caused by insufficient meniscus when sealing the vial, degassing after sample collection or during sample shipment, or reaction between the sample and preservative (HCl). If air bubbles > 6 mm (pea-sized) are observed during sampling, discard the vial and recollect the sample using a new vial. If air bubbles are believed to be due to the sample reacting with the preservative, the sample should be collected in an unpreserved vial if possible.

Put on new sampling gloves at each sampling site to reduce the risk of sample cross-contamination and exposure to skin. Never reuse gloves.

Prepare sampling containers by filling out the label, using an indelible permanent pen, with the following information at a minimum:

- Sample ID
- Date and time of sample collection
- Preservative
- Sample analysis (if required by the lab)

When filling the containers, do not insert the tubing into the containers and do not overfill preserved containers. When samples are containerized, place the filled sample containers in a sampling cooler with ice, turn off any equipment, disassemble the sampling apparatus, dispose of one-time use (disposable) equipment, and decontaminate reusable equipment per Barr's SOP 'Decontamination of Sampling Equipment'.

6.2.7.1 Bailer Sampling

After the well has been purged and stabilized, secure the bailer and slowly lower into the top of the water column making certain not to stir up the water with the bailer, which could result in volatilizing the samples. Keep the bailer in the top portion of the water column when collecting the sample.

When the bailer is filled, slowly raise the bailer out of the well. A clean tarp may be used to cover the ground to minimize the contact of the rope with the ground. Fill containers in the order listed in Barr's 'Water Sampling Guidelines' form.

6.2.7.2 Peristaltic / Submersible Pump Sampling

After the well has been purged and stabilized, disconnect the tubing exiting the pump from the flow-through cell, if used and fill containers as listed in Barr's 'Water Sampling Guidelines' form.

6.2.7.3 Check Valve Sampling

Sampling temporary wells through tubing with a check valve may be conducted following a drilling subcontractor's procedure.

6.2.8 Preservation

Container volume, type, and preservative are important considerations in sample collection. Container volume must be adequate to meet laboratory requirements for quality control, split samples, or repeat analyses. The container type varies with the analysis required. Typically, the analytical laboratory will preserve the container before shipment. Preservation and shelf life vary; contact the laboratory to determine if an on-hand container is still useful. Barr's 'Water Sampling Guidelines' form lists the parameter, container type, container volume, and preservative for many of the most common parameters collected.

6.2.9 Handling

The samples will be bubble wrapped or bagged after collection, stored in a sample cooler, and packed on double bagged wet ice. Samples will be kept cold ($\leq 6^{\circ}\text{C}$, but not frozen), until receipt at the laboratory (where applicable).

Note: Samples may need to be stored indoors in winter to prevent freezing.

6.2.10 Shipment/Delivery

Once the cooler is packed to prevent breaking of bottles, the proper chain-of-custody (COC) documentation is signed and placed inside a plastic bag then added to the cooler.

Samples will be kept secured to prevent tampering. If sample coolers are left in a vehicle or field office for temporary storage, the area will be locked and secured.

Custody seals may be present, but at a minimum, the coolers must be taped shut to prevent the lid from opening during shipment.

The coolers must be delivered to the laboratory via hand or overnight delivery courier, if possible, in accordance with Federal, State and Local transportation regulations and Barr's SOP 'Domestic Transport of Samples to the Laboratory'.

6.3 Data Reduction/Calculations

Table 1 provides the volume of water (per foot or meter of depth) based on the diameter of the casing or hole. The following are two examples of calculations used in Table 1:

Volume of Standing Water (V), cubic feet

$$V = (\pi)(r^2)(h)$$

Where: π = 3.1416

r = Well radius (ft)

h = Total well depth (ft) – depth to static water (ft) = Water column height (ft)

Note: For the table calculations, 'h' is equal to one foot.

Well Volume (WV), gallons

$$WV = (V)(7.48)$$

Where: V = Volume of standing water, cubic feet

7.48 = Cubic foot to US Gallons conversion factor

Calculate the volume of water to be purged using the equation below:

$$VP = (WV)(NMV)$$

Where: VP = Volume of water to be purged

WV = Well volume in gallons

NMV = Number of well volumes to be purged per project requirements

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed at the frequency noted in the project scope of work and/or documentation (e.g., Work Plan, SAP, or QAPP).

7.2 Well Stabilization Criteria

Well stabilization criteria to be used if there are no project specific criteria:

- pH $\pm$ 0.1 standard units
- Temperature $\pm$ 0.5 °C
- Specific conductance $\pm$ 5%
- Optional Criteria:
 - o ORP $\pm$ 10 mV
 - o Dissolved oxygen $\pm$ 10% (> 0.5 mg/L)

Note: Three consecutive readings $\leq$ 0.5 mg/L can be considered stabilized.
 - o Turbidity $\pm$ 10% (> 5 Nephelometric Turbidity Units (NTU))

Note: Three consecutive readings $\leq$ 5 NTU can be considered stabilized.

8.0 Records

The field technician will document the pumping flow rate, well volume, time purged, volume purged, water level, total well depth and stabilization test measurements on the field log data sheet and/or field notebook. They will also document the type and number of bottles on the chain-of-custody record, as appropriate. The analysis for each container and the laboratory used will be documented on the chain-of-custody record. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Chain-of-custody (COC)
- Sample label
- Custody seal (if applicable)
- Water Level Data Sheet
- Field Log Data Sheet
- Field Log Cover Sheet
- Field Sampling Report
- Water Sampling Guidelines (includes sampling order, container, preservation, and holding time)

The field documents and COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: water level measurement, water quality meter, turbidimeter, collection of QC samples, collection of PFAS samples, decontamination of sampling equipment, investigative derived waster, domestic transport of samples, and documentation on a COC.

9.0 References

Environmental Protection Agency. *Title 40 of the Code of Federal Regulations, Part 136.3.*

Environmental Protection Agency, EPA/540/P-91/007. 1999. *Compendium of ERT Groundwater Sampling Procedures.*

Minnesota Pollution Control Agency, Water Quality Division. 2006. *Sampling Procedures for Groundwater Monitoring Wells.*

Table 1
Volume of Water in Casing or Hole

Diameter of Casing or Hole (In)	Gallons per Foot of Depth (WV)	Cubic Feet per Foot of Depth (V)	Liters per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
1½	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
2½	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
3½	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
4½	0.826	0.1104	10.26	10.26×10^{-3}
5	1.020	0.1364	12.67	12.67×10^{-3}
5½	1.234	0.1650	15.33	15.33×10^{-3}
6	1.469	0.1963	18.24	18.24×10^{-3}
7	2.000	0.2673	24.84	24.84×10^{-3}
8	2.611	0.3491	32.43	32.43×10^{-3}
9	3.305	0.4418	41.04	42.04×10^{-3}
10	4.080	0.5454	50.67	50.67×10^{-3}
11	4.937	0.6600	61.31	61.31×10^{-3}
12	5.875	0.7854	72.96	72.96×10^{-3}
14	8.000	1.069	99.35	99.35×10^{-3}
16	10.44	1.396	129.65	129.65×10^{-3}
18	13.22	1.767	164.18	164.18×10^{-3}
20	16.32	2.182	202.68	202.68×10^{-3}
22	19.75	2.640	245.28	245.28×10^{-3}
24	23.50	3.142	291.85	291.85×10^{-3}
26	27.58	3.687	342.52	342.52×10^{-3}
28	32.00	4.276	397.41	397.41×10^{-3}
30	36.72	4.909	456.02	456.02×10^{-3}
32	41.78	5.585	518.87	518.87×10^{-3}
34	47.16	6.305	585.68	585.68×10^{-3}
36	52.88	7.069	656.72	656.72×10^{-3}

1 gallon = 3.7854 liters

1 liter = 0.26417 gallons

1 meter = 3.281 feet

1 gallon water weighs 8.33 lbs. = 3.785 kilograms

1 liter water weighs 1 kilogram = 2.205 lbs.

1 gallon per foot of depth = 12.419 liters per foot of depth

1 gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth



Standard Operating Procedure

Collection of Groundwater Samples using Low-Flow Purging and Sampling

Revision 2

April 26, 2021

Approved By:

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Print	Technical Reviewer	Signature	Date
<u>Michael Dupay</u>			<u>04/26/21</u>
Print	QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: <u>JWJ</u>	Date: <u>7/17/2023</u>
Initials: _____	Date: _____
Initials: _____	Date: _____
Initials: _____	Date: _____

Collection of Groundwater Samples using Low-Flow Purging and Sampling

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the methods used for low-flow purging and sampling of monitoring wells. Low-flow sampling maximizes the potential for representative groundwater samples. A representative groundwater sample should accurately reflect the physical and chemical properties of the groundwater in the portion of the formation open to the well. This SOP also provides details regarding the measurement of groundwater stabilization criteria, and identification of common container, preservative, and holding times for typical groundwater sample analyses.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Sample collection methods can vary by project. If not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance.
- Best practice is to have a minimum of one week pass between monitoring well development and monitoring well sampling unless there are other project requirements.
- It is recommended that low-flow sampling be conducted when the air temperature is above 32 °F (0 °C). If the procedure is used below 32 °F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell should be used to observe if ice is forming in the cell.
- Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of volatile organic compounds (VOCs) and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.
- Collection of groundwater samples from residential/water supply systems are not discussed within this SOP.
- Dedicated sampling equipment and/or decontamination of sampling equipment is required to prevent cross-contamination.
- Sample collection using 'clean hands/dirty hands' methods is not discussed within this SOP.
- If sampling for per- and polyfluorinated alkyl substances (PFAS), special consideration must be taken to avoid accidental contamination of environmental samples - see Barr's SOP 'Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples'.

3.0 Responsibilities

The Project Manager, in conjunction with the client, develops the site-specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technician(s) are responsible for the measurement of well pumping rates, field screening procedures, field equipment and calibration, proper sample identification, collection of samples, quality control procedures, and documentation. They should be familiar with the procedures described in this document and use professional judgment when sampling, especially when conditions are not routine, in order to collect a representative sample.

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

Project staff are responsible for ordering sample containers prior to the sampling event.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling waters contaminated with corrosive materials, emergency eye flushing facilities should be available.

5.0 Equipment, Reagents, and Supplies*

- Water quality meter (e.g., YSI, or equivalent)
- Turbidimeter
- Water level indicator
- Graduated measuring container
- Clock or stopwatch
- Inline filters (if applicable)
- Sample containers (method specific)
- Waterproof ink pen or pencil
- Coolers and ice
- Pump (peristaltic[^], submersible, bladder) power source, and appropriate drive tubing
- Compressed air source (bladder pump only)
- Ring stand, or equivalent, to secure tubing
- Sample tubing[#]
- Chemical resistant gloves (e.g., nitrile)
- Calculator
- Plastic bags
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

* See Barr's PFAS SOP for a list of prohibited and acceptable items.

[^]Due to the negative pressure used to lift the sample when using a peristaltic pump, loss of some VOCs could occur, especially at depths to groundwater approaching suction lift limitations (>20 feet). The project team should decide if VOCs should be collected from a peristaltic pump based on their project requirements.

[#]Teflon® tubing is preferred when sampling VOCs, SVOCs, pesticides, PCBs, and inorganics but not when collecting PFAS. Other materials may be used if information is available showing that there is no leaching of contaminants or interferences for the analyses being performed. PVC, polypropylene or polyethylene tubing may be used when collecting samples for metals and other inorganics.

6.0 Procedure

This section addresses the procedure(s) for calibrating field equipment, measuring pumping rates, well purging, measuring well stabilization, and the sampling, handling, and delivery involving groundwater sampling. Best practices include setting up the purging, stabilization, and sampling equipment in an upwind direction from any potential source of contamination.

6.1 Calibration

The water quality meter and turbidimeter will be calibrated as per the applicable Barr SOP. The meters will undergo calibration checks, at a minimum, before and after sampling. The calibration check will be documented on a calibration form (as appropriate) and/or in the field notebook. Significant issues found during the calibration check will be handled as per the applicable Barr SOP, noted in the field notebook, and the Equipment Technicians will be notified.

6.2 Purging/Well Stabilization/Sampling

Prior to sampling, water levels are measured (see applicable Barr SOP) and purging of the monitoring well is performed to remove stagnant water from within the well and to stabilize the well to allow for representative groundwater sample collection. The term 'purge volume' refers to the amount of water removed from a well before groundwater sample collection occurs.

Low-flow purging may be completed using one of the following, depending on the well and the sampling requirements: an electric submersible pump, bladder pump, or peristaltic pump. Pumps constructed of stainless steel or Teflon® are preferred but other materials may be used if information is available showing that there is no leaching of contaminants or interferences for the analyses being performed (e.g., PFAS). Dedicated equipment should be installed when possible to minimize disturbance in the well. Non-dedicated (portable) sampling devices will be slowly and carefully lowered into the well to minimize disturbance. The intake port for the pump being used will be placed at a depth typically near the middle of the water column within the well screen interval.

Pumping rates during low-flow purging are typically kept below 500 mL/min; however, this is dependent on the site-specific hydrogeology and will be adjusted to minimize drawdown during purging. Drawdown is the lowering of the water level in a monitoring well due to water being evacuated (purged) faster than the groundwater recharge rate. An electronic water level indicator will be used to determine that a minimal amount of drawdown is occurring within the well, ideally, no more than 4 inches (0.33 ft). Flow rate will be measured using a graduated measuring container and a watch/clock. During the first purge/sampling event, a purge rate will be established for each monitoring well. Samplers should attempt to match the same purge rate during subsequent events, if possible. Pump powering equipment that generates air emissions will be kept downwind of the well that is being sampled.

If the well was purged dry at the intake tubing, the samples should be collected within 24 hours of when the well was purged dry or when sufficient recharge allows (e.g., enough volume for analyses). If there is insufficient sample volume for the analyses being sampled, the project team will need to decide if sampling should be carried out or if a reduced prioritized list of analyses should be collected.

6.2.1 Peristaltic Pump Purging

A peristaltic pump is used when the water level is within suction lift (e.g., within about 25 feet of the ground surface but may be less at higher altitudes). It usually is a low-volume suction pump with low pumping rates suitable for sampling shallow, small-diameter wells.

- Put on gloves for skin protection and to prevent sample contamination.
- Lower tubing intake into the well and secure at desired depth typically near the middle of the water column within the well screen interval.
- Connect the well tubing to the drive tubing entering the pump.
- Connect the drive tubing exiting the pump to the short section of tubing entering the flow-through cell or graduated measuring container.
- Set the pump speed to zero. Turn on pump and slowly increase the speed to the desired rate of flow.
- Attach the flow-through-cell for the water quality meter after initial turbidity in the purge water has cleared visually.
- Sampling may begin once the well has stabilized (see Section 6.2.4, Well Stabilization of this SOP).

6.2.2 1.5-inch Submersible Pump Purging (Temporary or Dedicated)

A submersible pump is used when the water level is greater than the suction lift associated with a peristaltic pump. It can purge water from depths down to 200 feet depending on pump model and manufacturer. A variable speed controller is required for operation of the pump. There are a variety of speed controllers available, typically designed for a specific pump.

- Put on gloves for skin protection and to prevent sample contamination.
- Attach appropriate diameter tubing to pump intake, lower pump, and secure at desired depth typically near the middle of the water column within the well screen interval.
- Cut off tubing, allowing additional tubing length for discharge.
- Set the controller speed or voltage to zero.
- Plug the pump into the controller.
- Attach the controller to the power supply.
- Turn on the controller and dial the speed control to the desired flow rate and measure the flow rate with the graduated measuring container. The controller can slow the purge rate down to the optimum rate.

Note: If the submersible pump is not running, turn off the pump and then disconnect from the power supply. Check connections and try again.

- Attach the flow-through-cell for the water quality meter after initial turbidity in the purge water has cleared visually.
- Sampling may begin once the well has stabilized (see Section 6.2.4, Well Stabilization of this SOP).

6.2.3 Bladder Pump Purging

A bladder pump may be used when the static water level is > 25 feet or at shallower depths when concerns with VOC loss via peristaltic pumping is identified by the project team.

- Put on gloves for skin protection and to prevent sample contamination.

- Hook air and sampling tubing to the pump.
- Lower pump into the well at the desired depth typically near the middle of the water column within the well screen interval.
- Attach the air side of the tubing to the controller.
- Attach controller to the air source (e.g., air compressor or compressed CO₂).
- Set the air pressure to the manufacturer's recommendation based on the well depth.
- Set the number of pumping cycles, recovery times, and discharge times.
- When water flows from discharge of the pump, adjust the flow according to desired flow rate and measure the flow rate with the graduated measuring container.
- Attach the flow-through-cell for the water quality meter after initial turbidity in the purge water has cleared visually.
- Sampling may begin once the well has stabilized (see Section 6.2.4, Well Stabilization of this SOP).

6.2.4 Well Stabilization

Well stabilization is typically conducted to help verify that the groundwater sample is representative of aquifer conditions. A well is considered 'stabilized' after the groundwater (or well) stabilization parameter measurements are within acceptable limits for three consecutive readings. The stabilization parameters should be monitored at a frequency of five-minute intervals or greater unless there are other project requirements. The pump's flow rate must be able to 'turn over' at least one flow-through cell volume between measurements (e.g., flow rate = 50 mL/min, flow-through cell = 250 mL, monitor every five minutes; every 10 minutes with a 500 mL flow-through cell). Well stabilization parameters may vary by project or regulatory agency but at a minimum typically include pH, specific conductance (temperature corrected electrical conductivity), oxidation-reduction potential (ORP), turbidity, and dissolved oxygen (DO). Temperature should also be measured and recorded but will not be used to determine stability. Turbidity and DO usually require the longest time for stabilization.

Most wells should stabilize within two hours. Prior to going on-site, review previous low-flow groundwater sampling logs from the site (if available) and discuss with the project or task manager what should be done if wells take longer than two hours to stabilize (e.g., collect a pair of filtered/unfiltered samples for metals analysis when turbidity > 5 NTU). Initially, the field technician should verify that the field equipment is functioning properly, and that operator error is not an issue. If the checks produce no new insight, one of three optional courses of action may be taken: 1) continue purging until stabilization is achieved, 2) discontinue purging, do not collect any samples, and record in the field log data sheets or field notebook and in the Field Sampling Report that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), or 3) discontinue purging, collect samples and clearly document in the field log data sheets or field notebook and in the Field Sampling Report that stabilization was not achieved.

The procedure to stabilize a well includes recording well stabilization parameter measurements collected with the water quality meter during the well purging process and recording the purged well volumes. Groundwater aliquots used for stabilization parameter measurements (aside from turbidity) are measured by utilizing in-line, flow-through cell equipment. Turbidity is typically measured with a standalone

turbidimeter by collecting samples from a sample port on a sampling valve installed upstream of the flow-through-cell.

Documentation of the well stabilization process typically includes recording pertinent information such as the pump type, pumping rate, volume pumped, and well stabilization measurements on the field log data sheets or field notebook.

The well may be sampled after three consecutive measurements are within specific project criteria or the criteria presented in Section 7.2, Measurement Criteria of this SOP.

6.2.5 Sampling

After the well has been purged and stabilized, disconnect the tubing exiting the pump from the flow-through cell or sampling valve if used. Do not collect samples from the discharge of the flow-through cell. The same pump that is used for purging will be used for low-flow sampling. The project team will determine the order for sampling the wells, but general guidelines are below:

- Where water quality data are available, the least contaminated wells would be sampled first, proceeding to increasingly contaminated wells.
- Where the distribution of contaminants is not known, wells considered to be upgradient from likely sources of contamination would be sampled first and downgradient wells closest to the suspected contamination would be last.
- Make certain to keep records of the order in which wells were sampled.

To reduce potential contamination, samples for PFAS should be collected first. See Barr's SOP 'Collection of Per- and Polyfluorinated Alkyl Substances (PFAS) Samples'. To prevent the possible loss of some volatile organic compounds (VOCs), samples for volatile parameters should be collected first with as little agitation and disturbance as possible, then proceed in order towards the least volatile parameter as listed in Barr's 'Water Sampling Guidelines' form. The 40 mL vials used to collect the VOC samples should be checked for air bubbles. Air bubbles may be caused by insufficient meniscus when sealing the vial, degassing after sample collection or during sample shipment, or reaction between the sample and preservative (HCl). If air bubbles > 6 mm (pea-sized) are observed during sampling, discard the vial and recollect the sample using a new vial. If air bubbles are believed to be due to the sample reacting with the preservative, the sample should be collected in an unpreserved vial if possible.

Depending on project requirements, groundwater samples being analyzed for metals may or may not be filtered and in some cases, both filtered and unfiltered samples may be collected. If samples are to be filtered, see Barr's SOP 'Filtering of Water Samples'. Inline filters should typically be used to collect field filtered samples.

Put on new sampling gloves at each sampling site to reduce the risk of sample cross-contamination and exposure to skin. Never reuse gloves.

Prepare sampling containers by filling out the label, using an indelible permanent pen, with the following information at a minimum:

- Sample ID
- Date and time of sample collection

- Preservative
- Sample analysis (if required by the lab)

When filling the containers, do not insert the tubing into the containers and do not overfill preserved containers. When samples are containerized, place the filled sample containers in a sampling cooler with ice, turn off any equipment, disassemble the sampling apparatus, carefully remove non-dedicated equipment to minimize disturbance to the well, dispose of one-time use (disposable) equipment, and decontaminate reusable equipment per Barr's SOP 'Decontamination of Sampling Equipment'.

6.2.6 Preservation

Container volume, type, and preservative are important considerations in sample collection. Container volume must be adequate to meet laboratory requirements for quality control, split samples, or repeat analyses. The container type varies with the analysis required. Typically, the analytical laboratory will preserve the container before shipment. Preservation and shelf life vary; contact the laboratory to determine if an on-hand container is still useful. Barr's 'Water Sampling Guidelines' form lists the parameter, container type, container volume, and preservative for many of the most common parameters collected.

6.2.7 Handling

The samples will be bubble wrapped or bagged after collection, stored in a sample cooler, and packed on double bagged wet ice. Samples will be kept cold ($\leq 6^{\circ}\text{C}$, but not frozen), until receipt at the laboratory (where applicable).

Note: Samples may need to be stored indoors in winter to prevent freezing.

6.2.8 Shipment/Delivery

Once the cooler is packed to prevent breaking of bottles, the proper chain-of-custody (COC) documentation is signed and placed inside a plastic bag then added to the cooler.

Samples will be kept secured to prevent tampering. If sample coolers are left in a vehicle or field office for temporary storage, the area will be locked and secured.

Custody seals may be present, but at a minimum, the coolers must be taped shut to prevent the lid from opening during shipment.

The coolers must be delivered to the laboratory via hand or overnight delivery courier, if possible, in accordance with Federal, State and Local transportation regulations and Barr's SOP 'Domestic Transport of Samples to the Laboratory'.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed at the frequency noted in the project scope of work and/or documentation (e.g., Work Plan, SAP, or QAPP).

7.2 Well Stabilization Criteria

Well stabilization criteria to be used if there are no project specific criteria:

- pH $\pm$ 0.1 standard units
- Temperature $\pm$ 3%
- Specific conductance $\pm$ 3%
- ORP $\pm$ 10 mV
- Dissolved oxygen $\pm$ 10% ($>$ 0.5 mg/L)
Note: Three consecutive readings $\leq$ 0.5 mg/L can be considered stabilized.
- Turbidity $\pm$ 10% ($>$ 5 Nephelometric Turbidity Units (NTU))
Note: Three consecutive readings $\leq$ 5 NTU can be considered stabilized.

8.0 Records

The field technician will document the flow rate, drawdown, time purged, volume purged, water level, total well depth, stabilization test measurements, and any unusual conditions that occurred (e.g., excessive drawdown, noticeable discoloration, presence of sediment, odor in the water, etc.) on the field log data sheet and/or field notebook. They will also document the type and number of bottles on the chain-of-custody record, as appropriate. The analysis for each container and the laboratory used will be documented on the chain-of-custody record. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- COC
- Sample label
- Custody Seal (if applicable)
- Water Level Data Sheet
- Field Log Data Sheet
- Field Log Cover Sheet
- Field Sampling Report
- Water Sampling Guidelines (includes sampling order, container, preservation, and holding time)

The field documents and COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: water level measurement, water quality meter, turbidimeter, well development, filtering of water samples, collection of QC samples, collection of PFAS samples, decontamination of sampling equipment, investigative derived waster, domestic transport of samples, and documentation on a COC.

9.0 References

Environmental Protection Agency, Region 1. 1996, revised 2010 and 2017. *Low Stress (low-flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*.

Environmental Protection Agency, EPA/540/S-95/504. 1996. Groundwater Issue. *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures*.

Environmental Protection Agency. *Title 40 of the Code of Federal Regulations, Part 136.3*.

Michigan Department of Environmental Quality. 2004. *RRD Operational Memorandum No.2, Attachment 5*.



Standard Operating Procedure

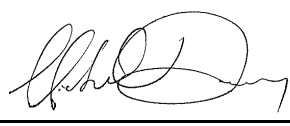
Collection of Quality Control Samples

Revision 8

April 15, 2021

Approved By:

Andrea Nord		04/15/21
_____ Print	_____ Technical Reviewer Signature	_____ Date

Michael Dupay		04/15/21
_____ Print	_____ QA Manager Signature	_____ Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Collection of Quality Control Samples

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures used in the collection and handling of field quality control (QC) samples: field blanks, equipment (rinsate) blanks, trip blanks, field (masked) duplicate samples, matrix spikes and matrix spike duplicate samples.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- The type and frequency of quality control samples can vary by project. If not specified in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)), consult with the appropriate regulatory agency for guidance.
- Laboratory analysis specific QC samples (e.g., method blanks, laboratory control samples) are not discussed within this SOP.

3.0 Responsibilities

Experienced Field Technicians are responsible for the accurate collection of QC samples and the laboratory is responsible for the accurate set-up and analysis of QC samples.

Project staff are responsible for ordering sample containers prior to the sampling event.

The role of the Field Safety Representative is to oversee on-site safety activities.

The Project Manager, in conjunction with the client, develops the site-specific scope of work (e.g., Work Plan, Sampling Analysis Plan (SAP), etc.).

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling soils contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies*

- Laboratory-certified containers appropriate for the required analysis
- Sample containers/media (method specific)
- Chemical resistant gloves (e.g., nitrile)
- Sample labels
- Matrix specific sampling devices and equipment
- Analyte-free water
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

* See Barr's PFAS SOP for a list of prohibited and acceptable items.

6.0 Procedure

This section provides the definitions and sampling procedure(s) for field derived QC samples.

6.1 Calibration

Calibration is not applicable to this SOP.

6.2 Sampling

General considerations to be taken into account when planning and conducting sampling operations are the required sample amount, sample holding times, sample handling, and special precautions for trace contaminant sampling. Matrix-specific sampling SOPs should be followed for the collection and preservation of samples. The QC samples will be handled in the same manner as the sample group for which they are intended (i.e., stored and transported with the sample group).

6.2.1 Blank Samples

Blank samples are used to monitor for potential contamination at a sampling site and may consist of field, equipment, rinsate, and trip blank samples. Each of these measure different potential sources of contamination. When collecting a blank for dissolved parameters, the blank water sample should be filtered before adding it to the sample container.

6.2.1.1 Field Blank

A field blank (FB) is prepared on-site and is a sample of analyte-free water exposed to environmental conditions at the sampling site by either 1) transferring the water from one container to another or 2) by removing the lid and exposing a container filled with analyte-free water to the atmosphere for the time necessary to fill the container(s). It measures the potential for sample cross-contamination due to site conditions.

6.2.1.2 Equipment Blank

An equipment blank (EB) is prepared on-site and is a sample of analyte-free water that has been collected after field decontamination of sampling equipment (e.g., bailer or pump, hand-trowel and bowl) and prior to sampling the next location. It measures the potential for sample cross-contamination due to insufficient decontamination. An equipment blank is not collected from disposable or dedicated equipment.

Note: Prior to May 2019, the terms 'Equipment Blank' and 'Rinsate Blank' were used interchangeably and carried the same definition. To help better define the blank being collected, the term 'Rinsate Blank' is defined as listed below.

6.2.1.3 Rinsate Blank

A rinsate (or rinse blank, RB) is a sample of analyte-free water that has been collected from the rinsing of sampling equipment. It is used to check that equipment being considered for use at a project site would not introduce the target analyte of concern to the samples being collected. Best practice is to evaluate prior to using the equipment at the project site.

6.2.1.4 Trip Blank

A trip blank (TB) is a sample of analyte-free water prepared or provided by the laboratory along with the sampling containers. Trip blank sample containers are not to be opened in the field and accompany the samples during collection, storage, and transport to the analytical laboratory. It measures the potential for sample cross-contamination due to sample transport and handling.

A trip blank sample is used when sampling volatile parameters (e.g., volatile organic compounds (VOC)/gasoline range organic (GRO)/ total petroleum hydrocarbon (TPH)). Trip blanks may also be used for per- and polyfluorinated alkyl substances (PFAS). Analyte-free water is used for an aqueous trip blank and methanol (or other applicable sample preservative) is used for a soil trip blank. A trip blank should be included for each sample cooler containing VOC (or PFAS, as required) samples and documented on the chain-of-custody (COC) form along with the samples and the required analysis.

6.2.2 Material Check

A material check (MC) is a sample of material (e.g. bentonite, sand) that has been collected to verify that the material being considered for use at a project site will not introduce the target analyte of concern to the samples being collected.

6.2.3 Field (Masked) Duplicate

A field (masked) duplicate is a sample collected at the same time as an original/source sample using the same procedures, equipment, and types of containers. It measures the precision associated with sample homogeneity, collection, preservation, and storage, as well as laboratory procedures.

The field duplicate is collected in a separate container and assigned a different sample identification (e.g., M-1 or FD) than the original/source sample. The date sampled must be included on the sample container label and COC for holding time determination but not the time sampled so that the original/source sample will be blind to the laboratory. Containers designated for a particular analysis (e.g., semi-volatile organic compounds) must be filled sequentially before jars designated for another analysis are filled (e.g., metals). The field duplicate sample is analyzed using the same method as the original/source sample.

6.2.4 Matrix Spike and Matrix Spike Duplicate

Matrix Spikes (MS) and Matrix Spike Duplicate (MSD) samples are two aliquots of a sample to which known quantities of analytes are added (spiked) in the laboratory. The MS and MSD are prepared and analyzed exactly like their original/source sample aliquot. For some analyses, it is required that three separate sample aliquots are collected in the field for each analysis. One aliquot is analyzed to determine

the concentrations in the original/source sample, a second sample aliquot serves as the MS, and the third sample aliquot serves as the MSD. The purpose of the MS and MSD is to quantify the bias and precision caused by the sample matrix. Additional sample volume for MS/MSD samples may be requested by the laboratory or may be required at a specified frequency as part of the project SAP or QAPP.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's 'Investigative Derived Waste' SOP. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

The frequency of QC samples is generally one field blank or equipment blank/field duplicate/MS/MSD per twenty samples; however, specific project requirements may require alternative sampling frequencies.

7.2 Measurement Criteria

Criteria are defined in project specific documentation or in Barr's data evaluation SOPs.

8.0 Records

The field technician will document the type and number of QC samples collected during each sampling event on a COC and in a project dedicated field logbook or on field log data sheets.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Field Log Data Sheet
- COC form
- Sample label
- Custody seal (if applicable)

Field documentation and COC are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: sample collection, investigative derived waste, decontamination of sampling equipment, and documentation on a COC.

9.0 References

EPA QA/G-5. 2002. Guidance for Quality Assurance Project Plans.

EPA SW-846. 2014. *Chapter One: Project Quality Assurance and Quality Control*.



Compendium Of Field Documentation

Sample Origination State

☐ CO ☐ MI ☐ MN ☐ MO ☐ ND ☐ NV ☐ TX ☐ UT ☐ WI ☐ WY ☐ Other: _____

REPORT TO				INVOICE TO																							<u>Matrix Code:</u>		<u>Preservative Code:</u>	
Company:				Company:																							GW = Groundwater		A = None	
Address:				Address:																							SW = Surface Water		B = HCl	
Address:				Address:																							DW = Drinking Water		C = HNO ₃	
Name:				Name:																							PW = Pore Water		D = H ₂ SO ₄	
email:				email:																							WW = Waste Water		E = NaOH	
Copy to: BarrDM@barr.com				P.O.																							WQ = TB, FB, EB, etc.		F = MeOH	
Project Name:				Barr Project No:																							W = Unspecified		G = NaHSO ₄	
Location				Sample Depth			Collection Date (mm/dd/yyyy)	Collection Time (hh:mm)	Matrix Code	Perform MS/MSD Y / N	Total Number Of Containers																% Solids			
				Start	Stop	Unit (m./ft. or in.)																						Preservative Code		
																											Field Filtered Y/N			
1.																														
2.																														
3.																														
4.																														
5.																														
6.																														
7.																														
8.																														
9.																														
10.																														
BARR USE ONLY				Relinquished by:				On Ice? Y N	Date	Time	Received by:				Date	Time														
Sampled by:				Relinquished by:				On Ice? Y N	Date	Time	Received by:				Date	Time														
Barr Proj. Manager:																														
Barr DQ Manager:				Samples Shipped VIA: ☐ Ground Courier ☐ Air Carrier						Air Bill Number:				Requested Due Date: ☐ Standard Turn Around Time ☐ Rush _____ (mm/dd/yyyy)																
Lab Name:				☐ Sampler ☐ Other: _____																										
Lab Location:				Lab WO:				Temperature on Receipt (°C):				Custody Seal Intact? ☐ Y ☐ N ☐ None																		

Distribution - White-Original: Accompanies Shipment to Laboratory; **Yellow Copy:** Include in Field Documents; **Scan and email:** a copy to BarrDM@barr.com for tracking and filing procedures

Barr Engineering Co. Chain of Custody for Air Canisters

Sample Origination State

☐ CO ☐ MI ☐ MN ☐ MO ☐ ND ☐ NV ☐ TX ☐ UT ☐ WI ☐ WY ☐ Other: _____

REPORT TO			INVOICE TO					Analysis Requested				COC Number:	
Company:			Company:					☐ TO-14 ☐ TO-15 ☐ TO-15SIM ☐ 3C ☐ Other				COC _____ of _____	
Address:			Address:					Lab Deliverable Contents (check all that apply) ☐ Sample Data with QC ☐ TIC Library Search ☐ Sample Chromatograms ☐ Individual Canister Certification Data				Matrix Code: AI = Indoor Ambient Air AO = Outdoor Ambient Air SV = Soil Vapor/Landfill Gas/SVE AQ = Air Quality (Blanks, etc.) OTH = Other: _____ _____	
Address:			Address:										
Name:			Name:										
email:			email:										
Copy to: BarrDM@barr.com			P.O.										
Project Name:			Barr Project No:										
Location	Canister		Flow Controller Serial #	Vacuum		Collection Date (mm/dd/yyyy)	Collection Time		Total Time (hh:mm)	Matrix Code	PID Reading (ppm/ppb)	Sample Comments	
	Serial #	Size L		Initial (in Hg)	Final (in Hg)		Initial (hh:mm)	Final (hh:mm)					
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													
BARR USE ONLY			Relinquished by:				Date	Time	Received by:			Date	Time
Sampled by:			Relinquished by:				Date	Time	Received by:			Date	Time
Barr Proj. Manager:			Samples Shipped VIA: ☐ Ground Courier ☐ Air Carrier				Air Bill Number:			Requested Due Date: ☐ Standard Turn Around Time ☐ Rush _____ (mm/dd/yyyy)			
Barr DQ Manager:			☐ Sampler ☐ Other: _____										
Lab Name:													
Lab Location:			Lab WO:				Custody Seal Intact? ☐ Y ☐ N ☐ None						

Distribution - **White-Original:** Accompanies Shipment to Laboratory; **Yellow Copy:** Include in Field Documents; **Scan and email:** a copy to BarrDM@barr.com for tracking and filing procedures

Meter Calibration Summary Form

Barr Engineering Company Meter Calibration Summary

Project _____

Technician _____

Meter type and number	Date	Time	Temperature C	Standard Used	Meter Reading	Slope	Conductivity Redline
Conductivity	Date	Solution Used	Cell Result				
Cell Check							
ORP Probe	Date	Temp.	ORP Reading	Calculation Result			
Check							
231mV = Display Value + [Display Temp.-25 C] x (1.3 mV)]							

Weather Conditions

Date	Wind Direction	Wind Speed	Temperature F	Cloud Cover	Comments

Comments: _____



Barr Engineering Company Troll Checklist / Data Sheet

Client:	Monitoring Point:
Location:	Troll Serial Number:
Project #:	Date:

- Memory Status (approximate):
- Battery Status (approximate):
- Test Running?:
- Time Downloaded:

Water Level Measurements:			
Time	Water Level Measured by Hand	Troll Water Level Reading	Difference in Measurements*

*consider restarting test with a new reference if difference between measurements is >0.15 feet

- Troll Removed? circle one: **Yes** **No**

Complete the following if Troll was removed

Time removed:

Time reinstalled:

Post Reinstallation Water Level Measurements:			
Time	Water Level Measured by Hand	Troll Water Level Reading	Difference in Measurements

- For Troll 9500 only
 - o Calibrated?

WATER LEVEL DATA SHEET

Date: _____

[illegible]



Field Log Data Sheet

Client:				Monitoring Point:				
Location:				Date:				
Project #:				Sample time:				
GENERAL DATA			STABILIZATION TEST					
Barr lock:		Time/ Volume	Temp. °C	Cond. @ 25	PH	ORP mV	D.O.	Turbidity NTU (not appearance)
Casing diameter:								
Total well depth:*		NA						
Static well level:*								
Water depth:*								
Well volume: (gal)								
Purge method:								
Sample method:								
Start time:		Odor:						
Stop time:		Purge Appearance:						
Duration: (minutes)		Sample Appearance:						
Rate, gpm:		Comments:						
Volume purged:								
Duplicate collected:								
Sample collection by:								
Others present:			Well condition:					
MW: groundwater monitoring well WS: water supply well SW: surface water SE: sediment Other: sump								
VOC	Semi-volatile	General	Nutrient	Cyanide	DRO	Sulfide		
Oil, grease	Bacteria	Total Metal	Filtered Metal	Methane		Filter		
Others:								

* Measurements are referenced from the top of riser pipe, unless otherwise indicated.



Barr Engineering Company

Field Log Data Sheet

Soil Samples

[illegible]



Sediment Core/Boring Log

page _____ of _____

VC: vibracore

PC: push core

Proj#:	Project:			Core/Boring#:
Collection Date(s):	GPS X:	Length of Push (feet):	Driller:	Drilling Method:
Ice Thickness (feet):	GPS Y:	Recovery (feet):	Crew:	Logged by:
Water Depth (feet):	GPS Z:	% Recovery:	Observer:	Checked by:

Collection Date(s):	GPS X:	Length of Push (feet):	Driller:	Drilling Method:
----------------------------	---------------	-------------------------------	-----------------	-------------------------

Ice Thickness (feet): _____ **GPS Y:** _____ **Recovery (feet):** _____ **Crew:** _____ **Logged by:** _____

Water Depth (feet): _____ **GPS Z:** _____ **% Recovery:** _____ **Observer:** _____ **Checked by:** _____

Drilling Method:

Logged by:

Checked by: _____

[illegible]

Recovery Rate Test Form

Recovery Rate Test

Project: _____ Sampled by: _____

Date: _____

Well Number: _____

Water Level Before Evacuation (0.01 Ft.): _____

Time Well Was Evacuated: _____ Sample Time: _____

Time from Evacuation (min.)	Water Level (0.01 ft.)	Time from Evacuation	Water Level (0.01 ft.)
:00			
:30			
1:00			
1:30			
2:00			
2:30			
3:00			
3:30			
4:00			
4:30			
5:00			
6:00			
7:00			
8:00			
9:00			
10:00			
11:00			
12:00			
13:00			
14:00			
15:00			



FIELD LOG COVER SHEET

Client:

Project No.:

Technician:

Sampling Period:

Date	Temperature	Wind Speed	Wind Direction	Cloud Cover
------	-------------	------------	-------------------	-------------

Summary of Field Activities



FIELD SAMPLING REPORT

Date:

Project:

Contact:

Field Sampling

Field Report

Attachments:

- | | |
|---|---|
| • | • |
| • | • |
| • | • |
| • | • |
| • | • |

Laboratory Analysis Status

<Name here>
Environmental Technician

Dangerous Goods in Excepted Quantities Label Examples



Courier Form Example



FedEx Tracking Number: 8549 4339 7651

Form ID No: 0200

1 From Please print and press hard.

Date _____ Sender's FedEx Account Number _____

Sender's Name _____ Phone () _____

Company _____

Address _____ Dept./Room/Suite/Room _____

City _____ State _____ ZIP _____

2 Your Internal Billing Reference (For 24 characters will appear on invoice) _____

3 To

Recipient's Name _____ Phone () _____

Company _____

Recipient's Address _____ Dept./Room/Suite/Room _____

We cannot deliver to P.O. boxes or R.D. ZIP codes.

Address _____ To require a package be held at a specific FedEx location, print FedEx address here.

City _____ State _____ ZIP _____

Try online shipping at fedex.com

By using this Airbill, you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

Questions? Go to our Web site at fedex.com

or call 1.800.USFedEx 1.800.463.3339.

4a Express Package Service To add SATURDAY Delivery, see Section 6. **Packages up to 150 lbs.**

☐ FedEx Priority Overnight ☐ FedEx Standard Overnight ☐ FedEx First Overnight

☐ FedEx 2Day ☐ FedEx Express Saver

4b Express Freight Service To add SATURDAY Delivery, see Section 6. **Packages over 150 lbs.**

☐ FedEx 1Day Freight* ☐ FedEx 2Day Freight ☐ FedEx 3Day Freight

5 Packaging

☐ FedEx Envelope* ☐ FedEx Pak* ☐ FedEx Box ☐ FedEx Tube ☐ Other

6 Special Handling

☐ SATURDAY Delivery Available ONLY for FedEx Priority Overnight, FedEx 2Day, FedEx 1Day Freight, and FedEx 2Day Freight select ZIP codes.

☐ HOLD Weekday at FedEx Location NOT Available for FedEx First Overnight.

☐ HOLD Saturday at FedEx Location Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Does this shipment contain dangerous goods?

☐ No ☐ Yes ☐ Yes ☐ Yes ☐ Dry Ice ☐ Cargo Aircraft Only

7 Payment Bill to: Enter FedEx Acct. No. or Credit Card No. below.

☐ Sender ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

FedEx Acct. No. or Credit Card No. _____ \$ _____

Total Packages _____ Total Weight _____ Total Declared Value* \$ _____

8 NEW Residential Delivery Signature Options If you require a signature, check Direct or Indirect.

☐ No Signature Required ☐ Direct Signature ☐ Indirect Signature

520

RETAIN THIS COPY FOR YOUR RECORDS.

Rev. Date 5/08 • Form 5200 • ©1994-2008 FedEx • PRINTED IN U.S.A. 507

Sample Label Examples

ANALYSIS	_____
SAMPLE I. D.	_____
PRESERVATIVE	DATE

Sample Site:	_____
Station:	_____
Depth:	_____
Collection Date:	_____ Time: _____
Collected by:	_____
Project #:	_____

The BARR logo consists of a black square with the word "BARR" in white, bold, sans-serif capital letters.

Custody Seal Example



Soil Sampling Guidelines

Some of the analyses below require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

Sampling Order	Analysis	Container	Preservation	Holding Time
1	PFAS^	4 oz. HDPE jar w/unlined cap	Cool, ≤ 6 °C	28 days
2	VOC	Glass jar or vial w/PTFE-lined lid, pre-weighed by laboratory	Cool, ≤ 6 °C, 1:1 w/chemical preservation (e.g., methanol, sodium bisulfate)	14 days
		En Core®	Freeze or extrude into chemical preservative	48 hours
3	TCLP VOC	4 oz. glass jar w/PTFE-lined lid	Cool, ≤ 6 °C, no headspace	14 days
4	WI GRO/PVOC	Glass jar or vial w/PTFE-lined lid	Cool, ≤ 6 °C, 1:1 w/methanol	21 days / 14 days
5	WI DRO*	2 or 4 oz. jar w/PTFE-lined lid, pre-weighed by laboratory	Cool, ≤ 6 °C	10 days
6	TPH as Jet Fuel, Fuel Oil, Motor Oil (etc.)	2 or 4 oz. jar w/PTFE-lined lid	Cool, ≤ 6 °C	14 days
7	SVOC/PAH, Pesticides, Herbicides	2 or 4 oz. jar w/PTFE-lined lid	Cool, ≤ 6 °C	14 days
8	TCLP SVOC, TCLP Pesticides, TCLP Herbicides	4 oz. jar w/PTFE-lined lid	Cool, ≤ 6 °C	14 days
9	PCB	2 or 4 oz. jar w/PTFE-lined lid	Cool, ≤ 6 °C	None
10	Metals / Mercury	2 or 4 oz. jar w/PTFE-lined lid	Cool, ≤ 6 °C	6 months (mercury 28 days)
11	TCLP Metals / TCLP Mercury	4 oz. jar w/PTFE-lined lid	Cool, ≤ 6 °C	6 months (mercury 28 days)
12	General Chemistry	2 or 4 oz. jar w/PTFE-lined lid	NA	Various depending on analysis

^ Use PFAS-free materials – see Barr's PFAS SOP

* 25-35 g, for best data quality results, do not use less than 25 grams/sample.

Note: Hold times are from initial sampling event to first analytical process. The times stated above do not reflect hold times extended due to extraction or other preparatory methods.

Note: Container types and sizes listed are for guidance only. Refer to your specific regulatory agency sampling protocols. Laboratories may use different containers or combine analyses into larger volume containers.

Water Sampling Guidelines

Safety Considerations: Acids and bases are used for some of the preservatives - use appropriate PPE when sampling, Minimum protection of gloves and safety glasses should be worn to prevent sample contact with the skin and eyes.

Sampling Order	Parameter Group	Container Type, Size, and Number	Preservation	Sampling Instructions	Holding Time
1	PFAS	250 mL HDPE w/unlined cap	Cool, $\leq 6^{\circ}\text{C}$ Trizma (if chlorine present)	Fill slowly to minimize sample agitation. Fill bottle with enough water to minimize headspace. Use PFAS-free materials – see Barr’s PFAS SOP.	14 Days (drinking water), 28 days (non-potable water)
2	VOCs, WI GRO, TPH as Gasoline	3-40 mL VOA glass vials, Teflon® septum cap	HCl, pH < 2, Zero Headspace; Cool, $\leq 6^{\circ}\text{C}$	Allow slow stream of water to fill vial at an angle to minimize agitation. Near top, return vial to vertical and add water until meniscus forms, avoid overfilling. Cap tightly, invert and tap lightly; should be no headspace, if bubbles appear (> 6mm), recollect sample.	14 Days, 7 Days if pH > 2
3	SVOCs, Pesticides, Herbicides, Dioxin/Furans	1 L amber glass, Teflon® septum cap	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation. Fill bottle with enough water to minimize headspace.	7 Days
4	WI DRO	1 L amber glass, Teflon® septum cap	HCl, pH < 2; Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation. Fill bottle with enough water to minimize headspace.	7 Days
5	TPH as Jet Fuel, Fuel Oil, Motor Oil (etc.)	1 L amber glass, Teflon® septum cap	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation. Fill bottle with enough water to minimize headspace.	7 Days
6	PCBs	1 L amber glass, Teflon® septum cap	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation. Fill bottle with enough water to minimize headspace.	None
7	Metals, Mercury	500 mL polyethylene; LL Hg – fluoropolymer or glass	HNO ₃ , pH < 2; Cool, $\leq 6^{\circ}\text{C}$ (not required, best practice)	Fill slowly to minimize sample agitation.	180 days; Hg 28 days; LL Hg preserve w/in 48 hrs. or if oxidized, 28 days
8	Dissolved Metals, Mercury	500 mL polyethylene ; LL Hg – fluoropolymer or glass	HNO ₃ , pH < 2; Cool, $\leq 6^{\circ}\text{C}$ (not required, best practice)	Filter sample through a 0.45 μm filter. Fill slowly to minimize sample agitation.	180 days; Hg 28 days; LL Hg lab filter w/in 24 hrs., if field filtered see above
9	Cyanide	1 L polyethylene	NaOH, pH > 12; Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	14 days
10	Sulfide	500 mL polyethylene	NaOH, pH > 9 and zinc acetate; Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	7 days
11	General Chemistry	1 L	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	14-28 days (except below)
11	TDS, TSS	1 L polyethylene	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	7 days
11	BOD, CBOD	1 L polyethylene	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	48 hrs.
11	Nitrate <u>or</u> Nitrite Only	250 mL polyethylene	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	48 hrs.
11	Chromium VI	250 mL polyethylene	Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	24 hrs.
12	Phenolics, Ammonia, Nitrate+nitrite, TKN, COD	Varies by parameter	H ₂ SO ₄ , pH < 2; Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	28 days
12	HEM (Oil and Grease)	1 L amber glass	HCl or H ₂ SO ₄ , pH < 2; Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	28 days
13	Total / Fecal Coliforms	125 mL sterile	Na ₂ S ₂ O ₃ ; Cool, $\leq 6^{\circ}\text{C}$	Fill slowly to minimize sample agitation.	≤ 30 / ≤ 24 hrs

Note: Hold times are from initial sampling event to first analytical process. The times stated above do not reflect hold times extended due to extraction or other preparatory methods.

Note: Container types and sizes listed are for guidance only. Refer to your specific regulatory agency sampling protocols. Laboratories may use different containers or combine analyses into larger volume containers.

**Soil Gas Sample Collection
Field Sampling Quality Control Check List**

Project Name: _____

Project #: _____

Sample ID #: _____

- ☐ Soil vapor monitoring point purging was completed.
Volume purged: _____
- ☐ Vacuum based leak testing was performed. Vacuum: _____ Duration: _____
- ☐ Water leak testing was performed. Start Time: _____ Stop Time: _____ Duration: _____
- ☐ Initial summa canister vacuum was greater than 25 in. of Hg. Initial vacuum: _____
- ☐ PID screening was performed. Reading: _____ Background: _____
- ☐ Instantaneous differential pressure reading was performed. Reading: _____
- ☐ Sample information was added to the chain of custody form.
Chain of Custody Form #: _____
- ☐ Sample collection information added to summa canister tag
- ☐ Photo of sample location taken before and after installation

Soil Gas Sample Record

Project Number:

Sample Date:

Sampling Technician(s):

Sample ID:

Sample Type

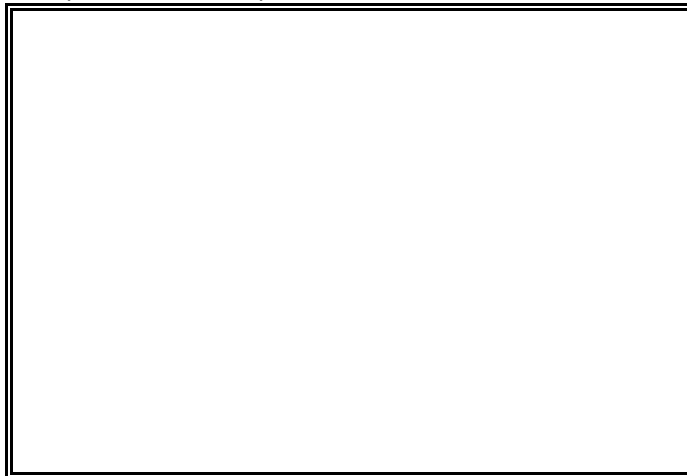
☐ Soil Vapor

☐ Sub-Slab Soil Vapor

☐ Pre-mitigation

☐ Post-mitigation

Sample Location Map:



Sample Equipment

Summa Canister ID #:

Flow Control ID #:

Certification Batch #:

Certification Date:

Barr Manifold #:

Leak Testing Data

Vacuum Test Start Time:

Vacuum Test Stop Time:

Vacuum Test Pressure:

Sample Collection Data

Purge Volume:

Sample Start Time:

Sample Stop Time:

PID Measurement:

Sub-slab Pressure Reading:

Notes:

Pin Installation Data

Time installed:

Permanent OR Temporary

Temporary: Hole patched with concrete? Y or N

Photo after patching? Y or N

Water Leak Test Start Time:

Water Leak Test Stop Time:

Sample Start Pressure:

Sample Stop Pressure:

Background PID Measurement:

☐ Sample information added to summa canister tag?

☐ Photos of sample location taken




**Minnesota Pollution
Control Agency**

 520 Lafayette Road North
St. Paul, MN 55155-4194

Vapor Intrusion Building SurveyForm

Remediation Program

Doc Type: Site Inspection Information

Preparer's name: _____ Date/Time prepared: _____

Affiliation: _____ Phone number: _____

Email: _____

Part 1: Property owner & building occupant information

1. Owner/Landlord information (Check if same as occupant: ☐)

Occupant name(s): _____ Interviewed: ☐ Yes ☐ No

Mailing address: _____

City: _____ State: _____ Zip code: _____

Home phone: _____ Office phone: _____

2. Occupant information

Occupant name(s): _____ Interviewed: ☐ Yes ☐ No

Mailing address: _____

City: _____ State: _____ Zip code: _____

Phone: _____ Fax: _____ Email: _____

Number of occupants at this location: _____ Age range of occupants: _____

Part 2: Building evaluation

3. Building use (Check appropriate response)

☐ Residential ☐ Child/Day Care ☐ School ☐ Church ☐ Hospital ☐ Long-term care facility ☐ Correctional facility

☐ Commercial ☐ Industrial

☐ Other (specify): _____

If the property is residential, what type? (Check appropriate response)

☐ Ranch rambler ☐ Raised rambler ☐ Townhouses/Condos ☐ Duplex ☐ Modular ☐ 2-Family

☐ Split level ☐ Contemporary ☐ Apartment house ☐ Cape cod ☐ Log home ☐ 3-Family

☐ Colonial ☐ Mobile home ☐ Other (specify): _____

4. Building description

If the property is commercial or industrial, describe the business use(s):
Indicate the number of floors and general use of each floor of the building beginning with lowest level:

If there are multiple residential units, indicate how many units: _____ When was building constructed: _____

 Type of insulation used in building: _____ Elevators or lifts: ☐ Yes ☐ No

Basement/Lowest level depth below grade: _____ (feet)

Observed basement characteristics (Check all that apply)

Is basement/lowest level occupied:	☐ Full time	☐ Occasionally	☐ Almost never	
Bedrooms in the basement/lowest level:	☐ Yes ☐ No	If yes, are the bedrooms occupied regularly: ☐ Yes ☐ No		
Basement type:	☐ Full	☐ Partial	☐ Slab	☐ Other:
Floor materials:	☐ Concrete	☐ Dirt	☐ Stone	☐ Other:
Floor covering:	☐ Uncovered	☐ Covered	☐ Covered with:	
Concrete floor:	☐ Unsealed	☐ Sealed	☐ Sealed with:	
Foundation walls:	☐ Poured	☐ Block	☐ Stone	☐ Other:
Basement finished:	☐ Unfinished	☐ Finished	☐ Partially finished	
Basement wetness:	☐ Wet	☐ Damp	☐ Seldom	☐ Moldy
Sump pump present:	☐ Yes ☐ No	If yes, was water present: ☐ Yes ☐ No		
Are there any crawl spaces present:	☐ Yes ☐ No	If yes, describe the crawl space floor conditions (earth, concrete, etc.) and construction (walls, use, connectivity to building, etc.) and illustrate location on the attached grid plans:		
Have there been any building additions	☐ Yes ☐ No	Describe addition construction including how it ties to the existing floor plan (footings, slab connectivity, etc.) illustrate locations of additions on the attached grid plans:		

Thickness of the concrete floor slab in the lowest level(s): _____ Inches.

Soil type present beneath the building: _____

Is there evidence of saturated or high moisture conditions beneath the floor slab? ☐ Yes ☐ No

If yes, explain:

Indicate sources of water supply sources (i.e., drinking, irrigation, etc.) and type of sewage disposal
(Check all that apply)

Water supply: ☐ Public water ☐ Drilled well ☐ Driven well ☐ Dug well

Sewage disposal: ☐ Public sewer ☐ Septic tank ☐ Leach field ☐ Dry well

5. Heating, venting, air conditioning, or other building controls (Check all that apply)

Type of heating system(s) used in this building (Check all that apply)

☐ Hot air circulation ☐ Space heaters ☐ Electric baseboard ☐ In-floor heating ☐ Heat pump

☐ Steam radiation ☐ Wood stove ☐ Hot water baseboard ☐ Radiant floor ☐ Outdoor wood boiler

☐ Other (specify): _____ **Primary type:** _____

Primary type of fuel used (Check appropriate response)

☐ Natural gas ☐ Fuel oil ☐ Kerosene ☐ Electric ☐ Propane
☐ Solar ☐ Wood ☐ Coal

If hot water tank present, indicate fuel source: _____

Boiler/furnace is located in: ☐ Basement ☐ Outdoors ☐ Main floor ☐ Other: _____

Type of air conditioning: ☐ Central air ☐ Window units ☐ Open windows ☐ No mechanical system

Is outside replacement (make-up) air provided for combustion appliances? ☐ Yes ☐ No

If no, explain:

Are there air distribution ducts present? ☐ Yes ☐ No

Describe the supply and cold air return ductwork and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram:

Describe the type of mechanical ventilation systems used within or for the building (e.g., air-to-air exchangers, HVAC, etc.). Indicate whether the interior spaces of the building use separate ventilation systems and/or controls. Provide information on any existing building mitigation system (e.g., radon mitigation, passive venting systems, etc.). If available, provide information on air exchange rates for any existing mechanical ventilation systems currently in use.

6. Summary of potential building vapor intrusion entry points

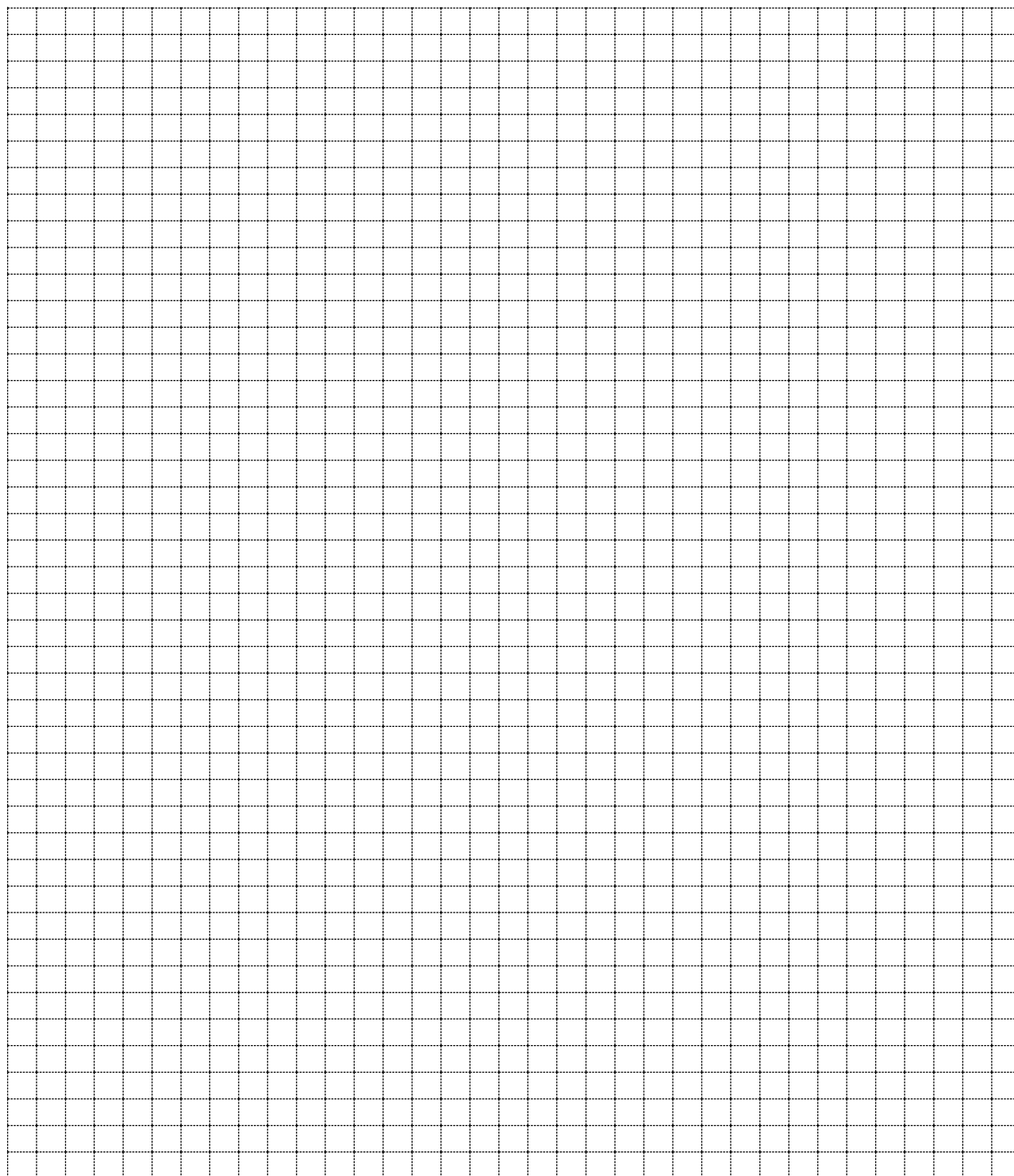
Earthen floors or incompetent floor slabs in the lowest level of building	☐ Yes	☐ No
Sumps (unsealed)	☐ Yes	☐ No
Large utility penetrations through floor and/or walls with exposure to sub-surface soils	☐ Yes	☐ No
Crawl spaces with earthen floors or incompetent floor conditions	☐ Yes	☐ No
Other (describe)	☐ Yes	☐ No

7. Is the use of the vapor intrusion attenuation factor (33X ISV screening level) valid for this building based on the above building conditions? ☐ Yes ☐ No

8. Grid plans

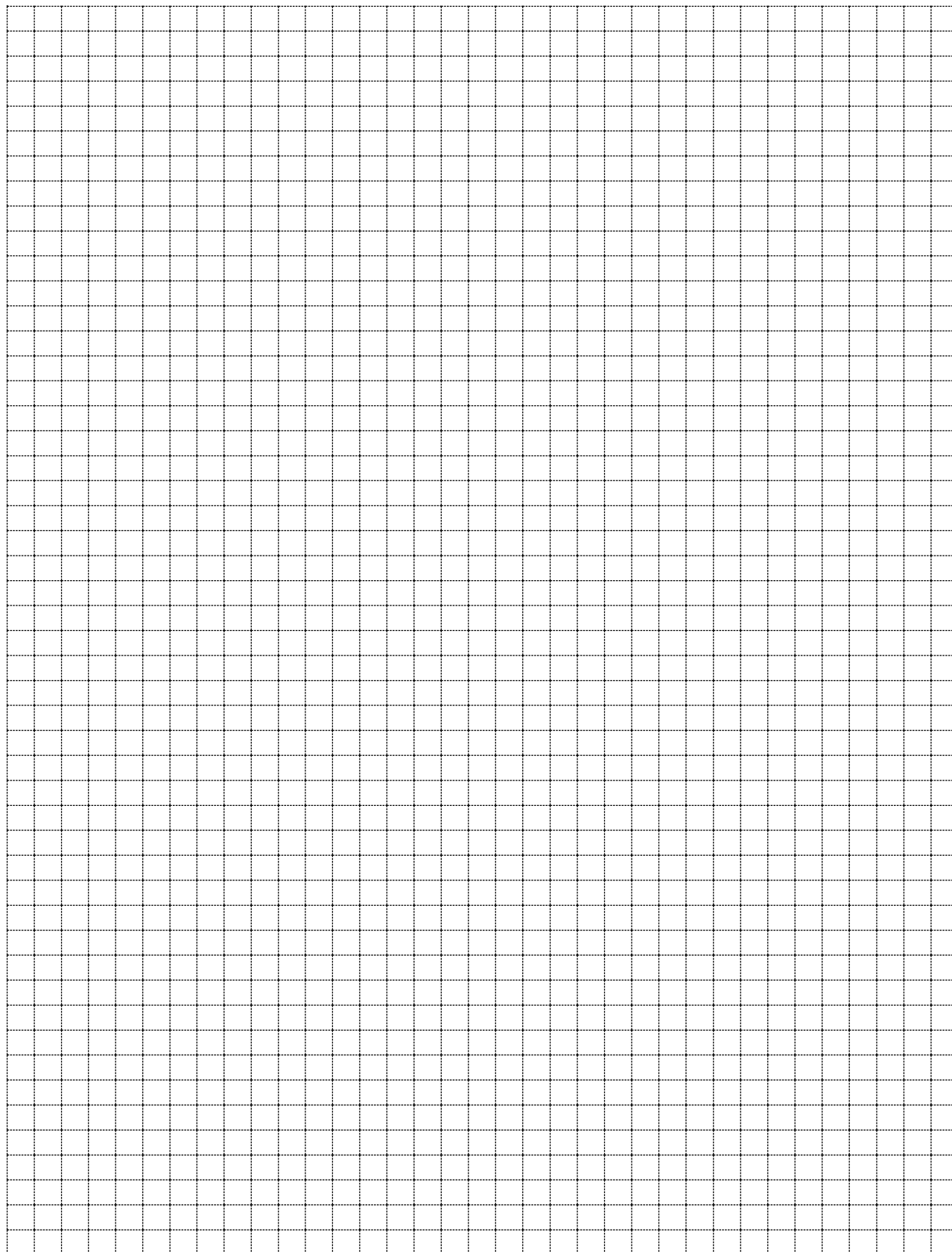
Use grid plans to describe floor plans, locate potential soil vapor entry points (e.g., cracks, utility ports, drains); and if applicable, identify sample locations (sub-slab, indoor air, outdoor air sampling).

Floor plan for basement or lowest level at property address: _____



Scale: _____ **North (indicate direction):** _____

Floor above lowest level at property address: _____

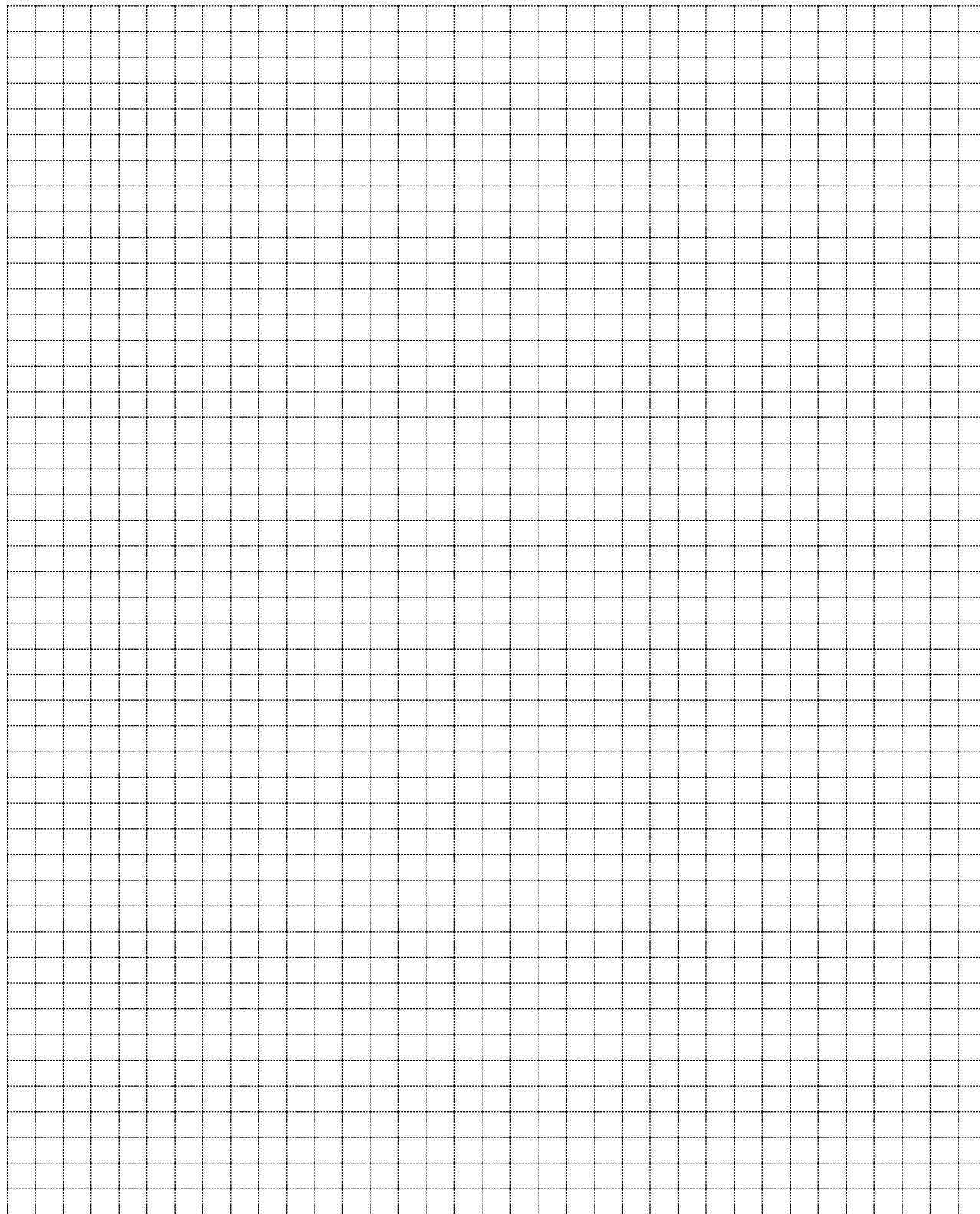


Scale: _____ North (indicate direction): _____

Outdoor grid plot (Include if outdoor ambient air samples collected):

Insert sketch (or attach separate document) of the area outside the building and locate outdoor air sample locations.

If applicable, provide information on spill locations, potential air contamination sources, locations of wells, septic system, etc., and PID meter readings. Indicate wind direction and speed during sampling.



Factors that may influence indoor air quality:

Please specify:

When:

Where & type:

How frequently:

When & type:

When & type:

Where & when:

Where & when:

Where & when:

When & type:

☐ Yes ☐ No☐ Yes ☐ No☐ Yes ☐ No

If yes, what types of solvents are used:

☐ Yes ☐ No

If yes, indicate approximately how frequent:

Make and model of field instrument used:

List specific products identified in the building that have the potential to affect indoor air quality (add or delete rows as needed):

[illegible]

Include photographs of product containers as appropriate to document products and ingredients.

Appendix D

[illegible]

* Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D). Include photographs of product containers as appropriate to document products and ingredients.

Interior Building Survey Inventory Form

Property Address: _____
Date/Time: _____
Technicians: _____

Instrument Name: _____ Serial Number: _____

Instrument Name: _____ Serial Number: _____

Location (Map ID & Description)	Temperature (°F) Instrument Reading	Air Velocity (ft/s) Instrument Reading	Photoionization Detector (ppb) Instrument Reading
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			
M			
N			
O			
P			
Q			
R			
S			
T			
U			
V			
W			
X			
Y			
Z			

Product Inventory Form

Property Address: _____

Date/Time: _____

Technicians: _____

Instrument Name: _____ Serial Number: _____

Location (Map ID & Description)	Product Label/Marking	Product Container Integrity*	Manufacture's intended use of chemical	Comments	Instrument Reading (ppb)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

*Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D). Include photographs of product containers as appropriate to document products and ingredients.

Reference: MPCA Vapor Intrusion Interior Building Survey Form, Part 2



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM

Date: _____ Survey Performed by: _____

1. OCCUPANT:

Rent: _____ Own: _____

Resident Name: _____

Address: _____

Telephone: Home: _____ Work: _____

How long have you lived at this location? _____

List current occupants/occupation below (attach additional pages if necessary):

Age (If under 18)	Sex (M/F)	Occupation

2. OWNER OR LANDLORD: (If same as occupant, check here ____ and go to Item No. 3).

Last Name: _____ First Name: _____

Address: _____

City and State: _____

County: _____

Home Phone: _____ Office Phone: _____



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

3. SENSITIVE POPULATION:

Daycare/Nursing Home/Hospital/School/Other (specify): _____

4. BUILDING CHARACTERISTICS:

Residential/Multi-family Residential/Office/Strip Mall/Commercial/Industrial/School

Describe Building: _____ Year Constructed: _____

Number of floors at or above grade: _____

Number of floors below grade: _____ (full basement/crawl space/slab on grade)

Depth of structure below grade: _____ ft. Basement size: _____ ft²

If the property is residential, what type? (Circle all appropriate responses.)

Ranch	2-Family	3-Family	Raised Ranch
Split Level	Colonial	Cape Cod	Contemporary
Mobile Home	Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other: _____	

If multiple units, how many? _____

If the property is commercial:

Business type(s) _____

Does it include residences (i.e., multi-use)? Yes No If yes, how many? _____

5. OCCUPANCY:

Is basement/lowest level occupied? (Circle one)

Full-time Occasionally Seldom Almost Never



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

Level	General Use (e.g., family room, bedroom, laundry, workshop, storage)
Basement	_____
1 st Floor	_____
2 nd Floor	_____
3 rd Floor	_____
4 th Floor	_____

(Use additional page(s) as necessary)

6. CONSTRUCTION CHARACTERISTICS: (Circle all that apply.)

a. Above Grade Construction: (Describe type: wood frame, concrete, stone, brick).

b. Basement Type: Full Crawlspace Slab Other: _____

c. Basement Floor: Concrete Dirt Stone Other: _____

d. Finished Basement Floor: Uncovered Covered

If covered, what with? _____

e. Foundation Walls: Poured Block Stone Other: _____

f. Foundation Walls: Unsealed Sealed Sealed with: _____

g. The Basement is: Wet Damp Dry

h. The Basement is: Finished Unfinished Partially Finished

i. Sump Present (Y / N) If yes, how many? _____

Where Discharged? _____

Water in Sump? Yes No Not Applicable



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

Identify all potential soil vapor entry points and estimated size (e.g., cracks, utility parts, drains).

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? Yes No

Type of ground cover outside of building: Grass Concrete Asphalt Other _____

Is an existing subsurface depressurization (radon) system in place? Yes No

If yes, is it active, or passive?

Is a sub-slab vapor/moisture barrier in place? Yes No

Type of barrier: _____

7. HEATING, VENTING, and AIR CONDITIONING

Type of heating system(s) used in this building: (Circle all that apply: Note the primary).

Hot Air Circulation	Heat Pump	Hot Water Baseboard
Space Heaters	Steam Radiation	Radiant Floor
Electric Baseboard	Wood Stove	Outdoor Wood Boiler
Other: _____		

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Location of Boiler/Furnace: Basement Outdoors Main Floor Other _____



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

Air Conditioning: Central Air Window Units Open Windows None

Are air distribution ducts present? Yes No

Is there a whole house fan? Yes No

Describe the air intake system (outside air supply, cold air return, ductwork, etc.) and its condition where visible.
Indicate the locations on the floor plan diagram.

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a) Is there an attached garage? Yes No

If yes, does it have a separate heating unit? Yes No

b) Are any petroleum-powered machines or vehicles stored
in an attached garage (e.g., lawn mower, ATV, car) Yes No

c) Has the building ever had a fire? Yes No

d) Is there a fuel burning or unvented gas space heater? Yes No

e) Is there a workshop or hobby/craft area? Yes No

If yes, where and what type? _____

f) Is there smoking in the building? Yes No

If yes, how frequently? _____



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

- g) Have cleaning products been used recently? Yes No
If yes, when and what type? _____
- h) Have cosmetic products been used recently? Yes No
If yes, when and what type? _____
- i) Has there been painting or staining in the last six months? Yes No
If yes, when and where? _____
- j) Is there new carpet, drapes, or other textiles? Yes No
If yes, when and where? _____
- k) Have air fresheners been used recently? Yes No
If yes, when and what type? _____
- l) Is there a kitchen exhaust fan? Yes No
If yes, where is it vented? _____
- m) Is there a clothes dryer? Yes No
If yes, is it vented outside? Yes No
- n) Has there been a pesticide application? Yes No
If yes, when and what type? _____

- o) Are there odors in the building? Yes No
If yes, please describe: _____



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

- p) Do any of the building occupants use solvents at work (e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetology)?

Yes No

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work?

Yes No

- q) Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response.)

No Unknown

Yes, use dry-cleaning regularly (weekly)

Yes, use dry-cleaning infrequently (monthly or less)

Yes, work at a dry-cleaning service

- r) Is there a radon mitigation system for the building/structure?

Yes No

If yes, what is date of installation? _____

Active Passive

- s) Additional mitigation system information (fan size, location, operating status, liner installed, etc.):



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

9. SAMPLE COLLECTION

This is to be completed by the sample collection team. On a separate sheet(s), provide a sketch of the building (including each floor as applicable), all (nonremovable) potential indoor sources found in the building (including attached garages), the location of the source (floor and room), and each sample location (see below). Any ventilation implemented after removal of potential sources shall be completed at least 24 hours prior to the commencement of the indoor air sampling event.

Photographs should be taken at each sample location, and of any nonremovable source, to supplement the documentation recorded below. The photographs must be of good quality and any labels must be legible.

Location	Sample ID	Sample Container Size	Sample Duration	Flow Rate Verification (Y / N)	Comments

Sampling Information:

Sample Technician: _____ Telephone No.: _____

Analytical Method: TO-15 / TO-17 / Other: _____

Laboratory: _____



Indoor Air Sampling Procedure Via USEPA Method TO-15

INDOOR AIR BUILDING SURVEY AND SAMPLING FORM (continued)

Were "Instructions for Occupants" followed?

Yes

No

If not, describe modifications:

Was field screening performed?

Yes

No

If yes, describe Make and Model of field instrument used:

Meteorological Conditions

Was there significant precipitation within 12 hours prior to (or during) the sampling event?

Yes

No

Describe the general weather conditions:

General Observations:

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process:



BUILDING: _____

FLOOR: _____

A full-page view of a blank sheet of graph paper. The grid consists of small, uniform squares formed by thin, light blue lines. The paper has a white background and no margins or text are visible.

Indoor/Outdoor Air Sample Record

Project Number: _____

Sample Date: _____

Sampling Technician(s): _____

Sample ID: _____

Sample Type

____ Indoor Air ____ Pre-mitigation
____ Outdoor Air ____ Post-mitigation
____ Emissions Sample

Sample Collection Time

____ Grab Sample ____ Time-weighted Sample - Target time: _____ hours

Sample Equipment

Summa Canister ID #: _____

Flow Control ID #: _____

Certification Batch #: _____

Certification Date: _____

Canister Volume (L): _____

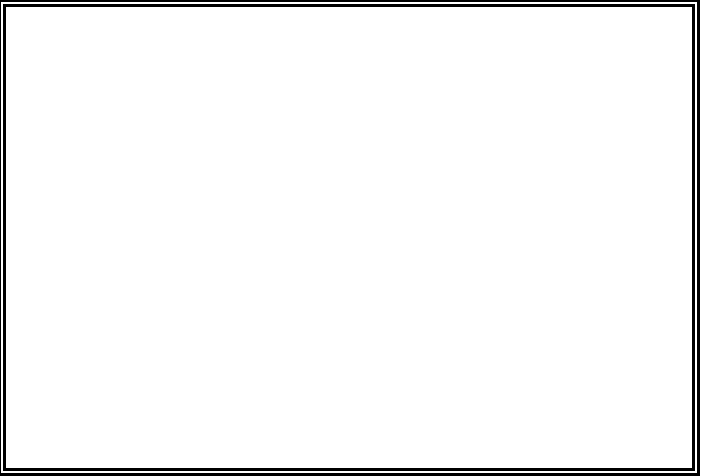
Sample Collection Data

Sample Start Time: _____

Sample Stop Time: _____

Start PID Measurement: _____

Sample Location Map:



Sample Information

Sample Height: _____

Wind Direction: _____

Weather Conditions: _____

Temperature: _____

Ambient Pressure: _____

Building HVAC: ON OFF

Sample Start Pressure: _____

Sample Stop Pressure: _____

Stop PID Measurement: _____

☐ Sample information added to summa canister tag?

☐ Photos of sample location taken

☐ Interior Building Survey Completed, Date: _____

Notes:





Standard Operating Procedure

Decontamination of Sampling Equipment

Revision 4

December 12, 2025

Approved By:

Alec Gierzynski

12/12/2025

Print

Signature

Date

Technical Reviewer

Anna Schneider

12/12/2025

Print

Signature

Date

QA Manager

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Decontamination of Sampling Equipment

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to define the process used for decontaminating environmental sampling-related equipment including pumps, meters, and materials coming into contact with actual sampling equipment or with sampling personnel. This procedure is applicable to all personnel who are collecting samples and/or decontaminating sampling and field equipment.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Procedures can vary by project as noted within the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)).
- Single-use equipment such as bailers, protective gear, and filtration devices are not part of this SOP.

3.0 Responsibilities

The equipment technician is responsible for ensuring field equipment has been thoroughly decontaminated and prepared for use out in the field. The field technician(s) are responsible for decontamination in the field at each individual sampling point and for ensuring adherence to any investigative derived waste (IDW) project-specific requirements set forth in a QAPP or SAP (if applicable).

The role of the Field Safety Representative is to oversee on-site safety activities.

4.0 Safety

Barr staff is responsible for implementing aspects of the job safely. Where available, refer to the appropriate Project Health and Safety Plan (PHASP) to determine the proper personal protection equipment (PPE) required when using this SOP. Barr staff is responsible for conducting all aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protection equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling soils contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Non-phosphorus detergent (e.g., Liquinox™)
- Scrub brush made of inert materials
- Oven
- Bucket
- Tap water
- Analyte-free water (e.g., distilled or deionized (DI) water, or equivalent)
- Kimwipes®, or equivalent
- Chemical resistant gloves (e.g., nitrile)
- Spray bottle
- Organic solvent (e.g. methanol)

6.0 Procedure

This section describes the procedure(s) for the decontamination of equipment used to sample water, soil, or air.

6.1 Calibration

Calibration is not applicable to this SOP.

6.2 Operation

Decontamination of sampling equipment will be performed before sampling and after working at each sampling point, if applicable. Due to the sensitive nature of PFAS sites and high risk of cross contamination, special considerations may be required for decontamination procedures and should be detailed in the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)).

6.2.1 Water Sampling Equipment

Equipment that does not contact sample water or the inside of the well should be rinsed with analyte-free water and inspected for remaining particles or surface film. If these are noted, repeat cleaning and rinse procedures.

Equipment that contacts sample water or the inside of the well should be cleaned (inside and outside where possible) with a non-phosphorus detergent solution applied with a spray bottle and/or scrub brush (if needed). Rinse with analyte-free water and containerize with other IDW if required by the SAP or QAPP and inspect for remaining particles or surface film. If these are noted, repeat cleaning and rinse procedures. Shake off remaining water and allow to air dry.

The internal surfaces of pumps and tubing that cannot be adequately cleaned by the above methods alone will also be cleaned by first circulating a non-phosphorus detergent solution through them followed by circulating analyte-free water. Special care will be exercised to ensure that the "rinse" fluids will be circulated in sufficient quantities to completely flush out contaminants and detergents. At a minimum, three volume equivalences of each rinse fluid will be circulated through the internal surfaces of pumps and tubing.

When transporting or storing equipment after cleaning, the equipment will be stored in a manner that minimizes the potential for contamination.

6.2.2 Soil/Sediment Sampling Equipment

A variety of samplers (split-barrel, split-barrel with brass liners, piston sampler, backhoe, hand-auger, or shovel) may be used to retrieve soil from sampling locations. The soil sample will either be sealed within the sampler (e.g., collecting volatile samples) or the soil sample will be transferred to laboratory-supplied containers depending on the analysis to be conducted on the soil sample. The equipment required to transfer the soil from the sampler to the laboratory-supplied sample containers includes: stainless-steel spoons or scoops, stainless-steel bowls, and the appropriate personal protective equipment necessary for collection and handling of soil samples as described in the PHASP.

All soil sampling equipment, including split-barrels, stainless-steel spoons and scoops, and stainless-steel bowls, will be carefully cleaned before and during sampling with a tap water and non-phosphorus detergent solution, using a brush if necessary to remove particulate matter and films. The equipment is then rinsed three times with tap water and/or three times with analyte-free water. Inspect equipment and repeat procedure if any residual soil or visible contaminants are present. Dry sampler with a Kimwipes®. Organic solvents (e.g., methanol) may be used to aid with desorbing organic material but should be kept to a minimum and must be collected and containerized if used.

At the completion of the work day, the samplers should be decontaminated following the procedure above and stored in a manner that minimizes the potential for contamination.

6.2.3 Air Sampling Equipment

For non-laboratory manifold equipment, soak manifold components in methanol for a minimum of two hours. Remove from the methanol bath and place in an oven pre-heated to 90°C and continue to heat manifold components for at least 3 hours or until interior and exterior surface inspections of the manifold components indicate that they are free of liquid methanol.

For manual post-run tubing (PRT) air sampling, Geoprobe rods and attachments should be cleaned after sampling with a tap water and non-phosphorus detergent solution, using a brush if necessary to remove particulate matter and films. The equipment is then rinsed three times with tap water and/or analyte-free water, then dried with Kimwipes® or paper towels. At the completion of the workday, the equipment should be decontaminated according to the procedure above and stored in a manner that minimizes the potential for contamination.

6.2.4 Handling

All equipment will be handled in a manner that minimizes cross-contamination between points. After cleaning, the equipment will be visibly inspected to detect any residues or other substances that may exist after normal cleaning. If inspection reveals that decontamination was insufficient, the decontamination procedures will be repeated.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

IDW generated by this process will be disposed of in accordance with Federal, State and Local regulations and/or as required by project-specific SAP or Work Plan. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Assurance and Quality Control (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

Decontamination procedures may be monitored through the use of an equipment blank which consists of analyte-free water processed through non-disposable or non-dedicated aqueous or solid sampling equipment after equipment decontamination and before field sample collection. The equipment blank is analyzed for the same parameters as the samples at a project-specific frequency (e.g., one per twenty samples).

7.2 Measurement Criteria

Equipment blank results should be below the laboratory's method detection limit or reporting limit (depending on the data quality objectives).

8.0 Records

When required, the field technician(s) will document the field equipment decontamination procedures in a project dedicated field logbook or on field log data sheets.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation is listed in the applicable sample collection SOP.

Field documentation and COC are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual."

Other Barr SOP subjects referenced within this SOP: collection of samples and investigative derived waste, collection of PFAS samples.

9.0 References

ASTM International, D5088-20. 2020. Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

Attachment 1

Revision Summary

Section	Revision Made	Reason for Revision
Throughout	Minor grammatical, formatting and spelling corrections	Consistency
2.0	Modified language to update single-use equipment as a limitation	Clarified wording
6.2.1	Added minimum rinse criteria for water sampling equipment	Updated procedure to reflect general best practices for rinsing equipment
6.2.3	Added paragraph addressing PRT	Updated procedure to reflect current practices
9.0	Updated ASTM reference	Reflects current reference method version
Attachments	Updated Attachment 1 to reflect revision summary format specific to most recent document changes	Consistency in revision summary documentation



Standard Operating Procedure

Documentation on a Chain-of-Custody (COC)

Revision 6

February 26, 2020

Approved By:

<u>Andrea Nord</u>			<u>02/26/20</u>
Print	Technical Reviewer	Signature	Date
<u>Terri Olson</u>			<u>02/26/20</u>
Print	QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: 	Date: <u>05/22/23</u>
Initials: _____	Date: _____
Initials: _____	Date: _____
Initials: _____	Date: _____

Documentation on a Chain-of-Custody (COC)

1.0 Scope and Applicability

The purpose of this procedure is to describe how to properly document information on a Chain-of-Custody (COC). A COC is a legally binding document that identifies sample identification, analyses required, and shows traceable possession of samples from the time they are obtained until they are introduced as evidence in legal proceedings. A Field Technician completes the information on the COC at the time he/she collects samples and the COC accompanies the samples during transport to a storage facility or to the laboratory for analysis.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- The SOP does not apply to sample aliquots that are only collected for field screening purposes.
- The SOP does not apply to samples remaining on-site.

3.0 Responsibilities

Experienced Field Technicians are responsible for the proper sample identification and for accurate and complete documentation on the COC.

4.0 Procedure

The COC is the most important sampling document; it must be filled out accurately and completely every time a sample is collected. The instructions below are specific to Barr's COC for air canisters and Barr's COC typically used for solid and liquid samples. The COC for air canisters is typically used when collecting soil gas, soil vapor, emissions, or indoor and outdoor air samples in an evacuated canister. The COC for solid and liquid samples is typically used when collecting matrices such as groundwater, surface water, drinking water, waste water, storm water, soil, sediment, oil, paint chips, bulk materials, etc. Information common to both COCs and specific to each COC are detailed below.

Some of the information on a COC may be filled out ahead of time (e.g., report and invoice recipient details, project number, project name, project manager, purchase order number, etc.) while other information should be completed during sampling. Complete one COC or more, as needed, for each set of project samples. The COC should be completed prior to leaving the sampling location.

Laboratory supplied COCs may be used but may differ in the information captured. The use of a Barr COC is recommended as it allows for more efficient data processing within Barr's systems. If there are any questions, please contact a member of Barr's Data Quality team.

The laboratory receiving the samples will sign the COC, record the date and time of sample receipt, assign a laboratory work order number, document sample condition, and document whether custody seals were used and if they were intact.

4.1 Common Chain-of-Custody Information

- Barr office location managing the work.
- Two digit identification for the state or province the samples originated from/sampled in.
- COC numbered pages (e.g., 1 of 1).
- Report and invoice recipient information.
- Purchase order number (if applicable).
- Barr project name and number.
- Sample location.
- Sample collection date and time.
- Sample matrix abbreviation (see "Matrix Code" on COC).
- Analysis requested.
- Field Technician (i.e. sampler) name.
- Barr Project Manager and project Data Quality (DQ) Manager names.
- Laboratory name and location in which samples are to be relinquished.
- Requested due date.
- Signature of Field Technician (i.e. sampler) under the first 'relinquished by'.
- Signature of sample transferee.
- Date and time of sample transfers.
- Method of transport (ground courier, air carrier, sampler, etc.).
- Air Bill number (if applicable).

4.2 Completing a Chain-of-Custody for Air Canisters

Lab deliverable contents (based on project needs).

- Canister serial # and size.
- Flow controller serial #.
- Initial and final vacuum measurement (in inches of mercury).
- Start and stop times that the canister was drawing sample.
- Total time calculated from the start and stop times.
- Matrix code.
- PID reading (indicate if ppm or ppb).
- Sample comments (if any).
- Identify the report deliverable contents and electronic data deliverable contents requested.

4.3 Completing a Chain-of Custody for Solid and Liquid Samples

- Sample start and stop depth (if applicable) and unit of measurement (meter, feet, inches, etc.).
- Information regarding whether to perform sample Matrix Spike (MS) and MS duplicate (MSD).
- Container preservative type (see "Preservative Code" on COC).
- Information regarding whether the sample was field filtered.
- Number of each container type and the total number of containers for the sample.
- Presence or absence of ice.

4.4 Distribution of the COC Pages

Page one (white copy) accompanies the sample shipment to the laboratory and page two (yellow copy) is the Field Document copy. The Field Technician must scan and email a copy to the Barr Data Management Administrator for filing on Barr's internal network project files. Alternatively, the yellow hardcopy may be routed to the Barr Data Management Administrator for electronic filing. This read-only electronic copy will be distributed to and available for use by the project team via Barr's internal network project file access.

5.0 Quality Control and Quality Assurance (QA/QC)

The Field Technician should review the COC for accurate and complete documentation.

6.0 Records

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Chain-of-Custody for Air Canisters
- Chain-of-Custody

A copy of the COC is provided to a Barr Data Management Administrator for storage on the internal Barr network files.

Additional records information can be found in Barr's "Records Management System Manual".

7.0 References

United States Environmental Protection Agency. 2002. *Guidance for Quality Assurance Project Plans*. EPA QA/G-5.



Standard Operating Procedure Domestic Transport of Samples to Laboratories within the United States of America – States and Territories

Revision 4

May 22, 2023

Approved By:

Charity Gachne

A handwritten signature in black ink, appearing to read "Charity Gachne", is written over a horizontal line.

05/22/23

Print

Technical Reviewer

Signature

Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Standard Operating Procedures for the Domestic Transport of Samples to the Laboratories within the United States of America – States and Territories

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures necessary for personal delivery or shipment of samples from locations within the United States of America (USA) and its territories to analytical laboratories located within the USA and its territories. This procedure applies to the transportation of ground and surface water, soil, wipe, sediment, paint chip, debris, air samples and their corresponding quality control samples to the appropriate laboratory. This SOP applies to samples that are classified as non-regulated, non-hazardous, or "Dangerous Goods in Excepted Quantities" samples prior to shipment.

Soil samples that are preserved with flammable chemicals (methanol) and unused sample vials containing flammable or corrosive chemical preservatives are examples of materials that are classified as "Dangerous Goods in Excepted Quantities". Materials classified as Dangerous Goods in Excepted Quantities have limitations on the volume/weight of the material allowed in each shipment, and have additional packaging, labeling, and shipping requirements than non-regulated and non-hazardous samples and sampling media.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Maintaining proper sample temperatures (<6°C or ambient air temperature in accordance with the analytical method requirements) and delivering samples to the laboratory within 24 to 48 hours from collection are primary concerns.
- This procedure does not apply to the transportation of samples to laboratories outside of the USA and its territories.
- This procedure does not apply to samples that are classified as "hazardous" according to USDOT, PHMSA, and/or RCRA and must be packaged, labeled, and/or transported in accordance with USDOT's hazardous materials regulations (49 CFR Parts 100-180).
- This procedure does not apply to samples that are classified as "dangerous goods" and must follow the International Air Transportation Association's (IATA) dangerous goods regulations (DGR) for packaging, labeling, and/or air transport.

3.0 Responsibilities

The field technician(s) shall ensure the security, temperature, and packaging of environmental samples during transport and shipment. Consult with field equipment staff at equip@barr.com if there are any questions or clarifications needed concerning shipping of environmental samples to the laboratories within the USA.

4.0 Safety

Barr staff is responsible for conducting the aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When samples may be contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of chemical preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Rigid cooler
- Heavy bag for containing ice and preventing leakage of melted water
- Ice
- Packing tape
- Absorbent padding
- Bubble-wrap/bubble bags (inner packing material)
- Ziploc® baggies
- Shipping Airbill – if shipping via overnight commercial courier service
- Dangerous Goods in Excepted Quantities Label with the number “8” added indicating the hazard class. This label must be used for coolers containing unused sample containers with corrosive preservative.
- Dangerous Goods in Excepted Quantities Label with the number “3” added indicating the hazard class. This label must be used for coolers containing methanol preservative
- Items listed in Section 8.0 Records

6.0 Procedure

6.1 Packaging of non-regulated or non-hazardous samples requiring ambient air temperature per the analytical method of analysis

Sample matrices that do not require thermal preservation (ice) typically include wipe, paint chip, debris, and air samples. These samples may or may not require chemical preservatives depending upon the analytical method of analysis. The classification of “non-regulated” or “non-hazardous” in this context is based upon the nature of the sample prior to chemical preservation/fixation.

For samples that are stored at ambient air temperature, the samples will be placed in a jar, baggie or shipping carton (i.e. cooler, cardboard box, envelope) and accompanied with the proper COC.

Place the samples in a shipping carton in a manner that will avoid breakage. Fill out the chain-of-custody (COC) completely and include required copies with the samples. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Once the shipping carton is packed to prevent samples breaking, the COC is signed off and placed in the cooler or box. Adhere two to three strips of packaging tape from top to bottom on the cooler or box.

Custody seals must be adhered over the shipping carton lid or enclosure if project quality assurance plan or sampling and analysis plan require them. The custody seal must be adhered to the crack of the lid on two opposing sides of the cooler or over the flap(s) of the box or envelope to ensure the carton remained shut and the contents have not been tampered with during transit.

6.2 Packaging of non-regulated or non-hazardous samples requiring thermal preservation per the analytical method of analysis

Samples matrices that require thermal preservation (ice) typically include water, soil and sediment samples. Glass containers should be packed in bubble wrap or other cushioning material to avoid breakage.

Note: Bubble-wrap is the preferred packing material.

Line a rigid plastic cooler (i.e. shipping container) with a strong plastic bag. This bag will serve as an outer liner and contain the wet ice, absorbent materials and sample containers.

Place samples and cushioning absorbent material inside the plastic bag and add enough absorbent padding to absorb the sample liquid within the package. Package ice in double-lined Ziploc® bags to ensure sample labels will not be compromised, and the cooler(s) will not leak melt water. Add enough ice to the cooler to maintain a constant temperature at $\leq 6^{\circ}\text{C}$, (but not frozen) until the samples arrive at the laboratory. Zip tie the plastic bag shut.

Before sealing cooler, fill out the COC completely and include required copies with the samples. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Adhere two to three strips of packaging tape on the cooler from top to bottom, and adhere an additional strip of tape covering the gap between the lid and sides of cooler to seal the cooler to avoid leakage.

Custody seals must be adhered on the cooler if project quality assurance plan or sampling and analysis plan require them. The custody seal must be adhered to the crack of the lid on two opposing sides of the cooler to ensure the contents have not been tampered with during transit.

Follow the labelling instructions in Section 6.4 of this SOP.

6.3 Packaging of samples classified as “Dangerous Goods in Excepted Quantities”

6.3.1 Soil Samples Preserved with Methanol (Flammable) – Hazard Class 3

Soil samples that are preserved with flammable chemicals (methanol) are an example of materials that are classified as hazard class “3” “Dangerous Goods in Excepted Quantities”.

Follow the packaging instructions listed in Section 6.2 of this SOP with the following addition: *Methanol sample containers must be placed in a Ziploc® Baggie to meet shipping requirements for preventing leakage.*

Each cooler shall not exceed 500 mL of methanol (50 vials, 10 mL of methanol per vial) and each vial shall not have more than 10 mL of methanol to meet the requirements of a Dangerous Goods in Excepted Quantities. A label with the hazard class number “3” indicates the cooler contains flammable (or reactive/oxidizer) materials (in this case a flammable methanol sample preservative). Additional labeling instructions are found in Section 6.4.2 of this SOP.

6.3.2 Unused Sample Jars – Hazard Class 3 (Flammable) and Hazard Class 8 (Corrosive) Chemicals

Unused sample vials containing flammable or corrosive chemical preservatives are examples of materials that are classified as “Dangerous Goods in Excepted Quantities”.

Follow the packaging instructions listed in Section 6.2 of this SOP with the following additions:

Each chemical, may have a limitation as to the volume or weight of the chemical and the number of inner containers (sample containers) allowed within each outer shipping container (cooler) to meet the requirements of a Dangerous Goods in Excepted Quantities. A label with the hazard class number “3” indicates the cooler contains flammable (or reactive/oxidizer) materials (in this case a flammable methanol sample preservative). A label with the hazard class number “8” indicates the cooler contains a corrosive material (in this case an acid or base sample preservative). Additional labeling instructions are found in Section 6.4.2 of this SOP.

6.4 Labeling of Outer Shipping Container or Carton

6.4.1 Shipping Label

Attach the shipping address label to the top of the cooler or to the cooler handle tag. Attach a second label with the same information should also be attached with packaging tape to the cooler in event that the original label is damaged or destroyed during sample shipment.

Directional arrow labels (Figure 1) must also be attached to the outside of the cooler according to the hazardous materials shipping regulations. Directional arrow labels indicate the upright position during sample shipment.

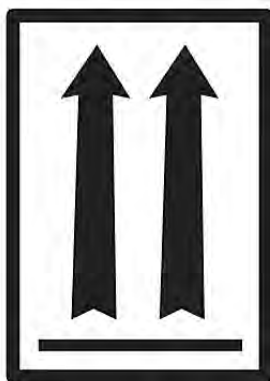


Figure 1 - Directional Arrows Label

6.4.2 Dangerous Goods in Excepted Quantities Label

When shipping materials classified as Dangerous Goods in Excepted Quantities, the cooler must have a Dangerous Goods in Excepted Quantities Label (Figure 2). This label is placed on two opposing sides of the cooler. The label indicates the hazard class number and the name and address of the shipper or consignee. In cases where the package contents have more than one hazard class assigned, the primary (most hazardous) hazard class is listed on the label. Table 1 includes a Summary of United Nations Hazard Classes.



Figure 2 - Dangerous Goods in Excepted Quantities Label

Footnotes:

- (1) The "*" must be replaced by the primary hazard class, or when assigned, the division of each of the hazardous materials contained in the package.
- (2) The "**" must be replaced by the name of the shipper or consignee if not shown elsewhere on the package.

Table 1 – Summary of United Nations Hazard Classes

Class 1	Explosives
Class 2	Gases
Class 3	Flammable Liquids
Class 4	Flammable Solids; Substances Liable to Spontaneous Combustion; Substances Which, in Contact with Water, Emit Flammable Gases (e.g., soil sample contaminated with high concentrations of gasoline released from an underground storage tank)
Class 5	Oxidizing Substances and Organic Peroxide
Class 6	Toxic and Infectious Substances (e.g., samples of refuse collected from a solid waste landfill)
Class 7	Radioactive Material
Class 8	Corrosives (e.g., nitric acid used for preservation of some groundwater samples) (see Note)
Class 9	Miscellaneous Dangerous Goods

6.4.2.1 Dangerous Goods Air Waybill Statement and Shippers Declaration

A shipping paper (i.e. bill of lading) is not required when offering the cooler for air transport via a commercial courier service (e.g. Federal Express or United Parcel Service).

A document such as an air waybill accompanies a shipment that is transported by aircraft. The air waybill must include the statement “Dangerous Goods in Excepted Quantities” and indicate the number of packages associated with each air waybill. This phrase is typically written behind the Barr project number in the PO or comments section on the air waybill.

A shipper’s declaration for dangerous goods is also required. Some air waybills also have a box you must also check off that says “Dangerous Goods no Shipper’s Declaration Required”.

6.5 Transport/Delivery Options

Account for the samples before shipping and compare to the COC. Refer to Barr’s SOP ‘Documentation on a Chain-of-Custody (COC) for further information. Ship samples during times when the laboratory will be able to accept and quickly analyze them. Whenever possible, select mode of transport/delivery to ensure delivery to the laboratory will occur with ample holding time remaining for the specified analytical methods required for the samples. Avoid sending samples during holidays and weekends. All Federal, State and Local shipping regulations must be met.

Personal Delivery. The samples are delivered to the laboratory by the field technician(s). The COC is signed and dated by the laboratory representative.

Ground Transport. The same procedures are followed as above; i.e., the COC is signed and dated and the top copy is sent with the samples. The cooler or box is then secured with packaging tape and a courier form is filled out for the designated laboratory. The cooler or box is then left in the services area for pickup via ground transport and delivery.

Air Transport. Follow the procedures above, replacing the courier form with the overnight courier air bill via Federal Express or United Parcel Service, for example. Include the date, project number, type of

delivery service desired, parcel weight, number of coolers or boxes on the air bill. Also include the phrase "Dangerous Goods in Excepted Quantities", when applicable.

7.0 Quality Control and Quality Assurance (QA/QC)

Not Applicable.

8.0 Records

Examples of common field documentation are available in Barr's "Compendium of Field Documentation".

Field documentation specific to this SOP are listed below:

- Chain-of-custody (COC)
- Custody seal (if applicable)
- Dangerous Goods in Excepted Quantities Label
- Directional Arrow Label

COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: documentation on a COC.

9.0 References

49 CFR Part 173.4a – Excepted Quantities October 1, 2011 Online

<https://www.govinfo.gov/app/details/CFR-2011-title49-vol2/CFR-2011-title49-vol2-sec173-4>

ASTM International. 2015. ASTM Method D6911 – 15 Standard Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis¹. ASTM January 15, 2015.



Standard Operating Procedure

Filtering of Water Samples

Revision 7

April 26, 2021

Approved By:

<u>John W. Juntilla</u>			<u>04/26/21</u>
Print	Technical Reviewer	Signature	Date
<u>Michael Dupay</u>			<u>04/26/21</u>
Print	QA Manager	Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: <u>JWJ</u>	Date: <u>7/17/2023</u>
Initials: _____	Date: _____
Initials: _____	Date: _____
Initials: _____	Date: _____

Filtering of Water Samples

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to describe the filtering process for water samples (e.g., groundwater and surface water) to remove silt, clay, and particles for laboratory analysis.

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Collection of water samples are not discussed within this SOP.

3.0 Responsibilities

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

Experienced Field Technicians are responsible for the proper collection and filtering of samples, field equipment, sample identification, quality control procedures, and documentation.

Project staff are responsible for ordering sample containers prior to the sampling event.

4.0 Safety

Barr staff is responsible for conducting aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protection equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When sampling water contaminated with corrosive materials, emergency eye flushing facilities should be available.

Some of the sample containers may require the use of preservatives. Consult the applicable Safety Data Sheet to review hazards and appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- Inline or disposable filters (e.g., 0.45 or 0.60 μm)
- Filtering device (base and funnel)
- Chemical resistant gloves (e.g., nitrile)
- Applicable water sampling equipment
- Items listed in section 8.0 Records

6.0 Procedure

This section describes the procedure(s) for the filtering of water samples for various laboratory analyses.

6.1 Calibration

Calibration is not applicable to this SOP.

6.2 Process

Representative samples are collected in an unpreserved container following Barr's matrix specific sampling SOP. The most common filter is a 0.45-micron (μm) pore size (typically defined as 'dissolved'); however, a pre-filter (0.60 μm pore size) may be used if the sample is very turbid to extend the life of the 0.45 μm filter. Filtering must be done within 15 minutes of collection. Filters require pre-rinsing to ensure that the filter media has equilibrated to the sample and to avoid possible sample contamination. A new disposable filtering device is used for each sampling location.

Note: Depending on the water sample matrix and volume required, additional filters may be needed.

6.2.1 In-line Filter

Attach a 0.45 μm filter to the end of the purge tubing, ensuring direction of flow is correct. Pre-rinse the filters following manufacturer's recommendations. If there are no recommendations for rinsing, pass through 500 to 1,000 milliliters of sample (depending on sample turbidity) following purging and prior to sampling. Make certain the filter is free of air bubbles before samples are collected. Place the appropriate sample container at the filter outlet and collect the sample. After filtering is complete, remove and dispose of the in-line filter.

6.2.2 Vacuum Pump

Connect the two sections of the 0.45 μm disposable filtering device (e.g., Corning® Disposable Sterile Filter). If needed, add the pre-filter (rough side up) over the 0.45 μm filter membrane. The 0.45 μm filter must be covered completely by the pre-filter to work properly. Attach the vacuum pump to the filtering device and turn on power to the pump. A hand powered vacuum pump may be used if a 110-volt power source is not available.

Pre-rinse the filters following manufacturer's recommendations. If there are no recommendations for rinsing, pass through 500 to 1,000 milliliters of sample (depending on sample turbidity) following purging and prior to sampling. After pre-rinsing of the filters, pour additional unpreserved sample water into the filter funnel and filter the amount needed for the analyses. After filtering is complete, pour the filtered sample into the appropriate sample container and dispose of the filtering device.

6.2.3 Preservation/Handling/Delivery

The filtered samples will be preserved and handled following Barr's matrix specific sampling SOP. The samples must be delivered to the laboratory via hand or overnight delivery courier in accordance with all Federal, State and Local transportation regulations and Barr's 'Domestic Transport of Samples to the Laboratory' SOP.

6.3 Data Reduction/Calculations

No data reduction or calculations are associated with this procedure.

6.4 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

The QC activities described below allow the self-verification of the quality and consistency of the work.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed as written in the project scope of work and/or documentation (e.g., Work Plan, SAP, or Quality Assurance Project Plan).

7.2 Measurement Criteria

Measurement criteria are not applicable to this SOP.

8.0 Records

The field technician will document the water sampling event on the field log data sheet and/or field notebook. They will also document the number and type of filters used for each sample filtered. The analysis for each container and the laboratory used will be documented on the chain-of-custody record along with identifying which samples/analyses were field filtered. Refer to Barr's SOP 'Documentation on a Chain-of-Custody (COC)' for further information.

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation is listed in the SOPs referenced in this procedure.

The field documents and COCs are provided to a Barr Data Management Administrator for storage on the internal Barr network.

Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: collection of samples, collection of QC samples, investigative derived waste, domestic transport of samples, and documentation on a COC.

9.0 References

Corning® Disposable Sterile Filter Information Booklet.

Environmental Protection Agency, Region 1. 1996, revised 2010 and 2017. *Low Stress (low-flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*.

Environmental Protection Agency, EPA/540/S-95/504. 1996. Groundwater Issue. *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures*.

Environmental Protection Agency, *Standard Operating Procedure For The Standard/Well Volume Method For Collecting A Ground-Water Sample From Monitoring Wells For Site Characterization*

<https://www.epa.gov/quality/standard-operating-procedure-standard-well-volume-method-collecting-ground-water-sample>



Barr Engineering Company Field Log Data Sheet

Client:				Monitoring Point:				
Location:				Date:				
Project #:				Sample Time:				
GENERAL DATA			STABILIZATION TEST					
Barr lock:								
Casing diameter:		Time/ Volume	Temp. °C	Cond. @ 25	pH	Eh	D.O.	Turbidity Appearance
Total well depth:*								
Static water level:*								
Water depth:*								
Well volume: (gal)								
Purge method:								
Sample method:								
Start time:		Odor:						
Stop time:		Purge Appearance:						
Duration: (minutes)		Sample Appearance:						
Rate, gpm:		Comments:						
Volume, purged:								
Duplicate collected?								
Sample collection by:		CO2-	Mn2-	Fe(T)-	Fe2-			
Others present:			Well Condition:					
MW: groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:								
VOC-	semi-volatile-	general-	nutrient-	cyanide-	DRO-	Sulfide-		
oil,grease-	bacteria-	total metal-	filtered metal-	methane-	filter-			
Others:								

*Measurements are referenced from top of riser pipe, unless otherwise indicated.



Standard Operating Procedure

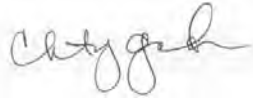
YSI Model 556 Multi-Probe System (MPS)

Water Quality Monitoring System

Revision 8

May 9, 2023

Approved By:

Charity Gachne		05/09/23
Print	Technical Reviewer Signature	Date
Marta Nelson		05/09/23
Print	QA Manager Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

YSI Model 556 Multi-Probe System Water Quality Monitoring System

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to clearly define the procedures required to accurately measure dissolved oxygen, conductivity, temperature, pH and oxidation reduction potential (ORP) in groundwater and surface water using the YSI Model 556 MPS water quality system.

The YSI 556 MPS (Multi-Probe System) is an easy-to-use hand-held unit. It includes a waterproof, impact-resistant case and it simultaneously measures dissolved oxygen, conductivity, temperature, pH and ORP.

Analysis	Conductivity	Oxidation Reduction Potential	pH	Dissolved Oxygen	Temperature
Analytical Method	Standard Method 2510B	Standard Method 2580A	Standard Method 4500-H ⁺ B	Standard Method 4500-O G	Standard Method 2550B

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- Procedures can vary by project as noted within the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)).
- Decontamination of reusable equipment is required to prevent cross-contamination.

3.0 Responsibilities

The Project Manager, in conjunction with the client, develops the site specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technicians are responsible for the proper field equipment calibration, measurement, quality control procedures, and documentation of dissolved oxygen, conductivity, temperature, pH and ORP.

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

4.0 Safety

Barr staff is responsible for conducting aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves

(e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When samples may be contaminated with corrosive materials, emergency eye flushing facilities should be available.

Consult the applicable Safety Data Sheet to review hazards involved with the calibration solutions and reagents listed in this SOP and to determine safe handling protocols and the appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- YSI Model 556 meter
- O-ring lubricant
- Four alkaline "C" batteries
- Mild detergent
- Screwdrivers
- Calibration/Storage Cups
- Moist Sponges
- Lint-free lab wipes
- pH buffer 4
- pH buffer 7
- pH buffer 10
- Conductivity (1409 $\mu\text{mhos/cm}$ @ 25 °C)
- Zobell standard
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

6.0 Procedure

This section below describes the procedures and equipment used for measuring dissolved oxygen, conductivity, temperature, pH and ORP in groundwater and surface water.

6.1 Maintenance/Installation

6.1.1 Instrument

The 556 requires occasional battery replacement and cleaning. Four alkaline "C" cells in the 556 provide approximately 180 hours of operation. Battery life is displayed on the keypad and the batteries should be changed when it is low.

- a. Loosen the four screws in the battery lid on the back of the instrument.
- b. Insert four "C" batteries in the clips following the polarity labels on the bottom of the battery compartment.
- c. Check the gasket for proper placement and place the lid.
- d. Do not over tighten the screws.
- e. Clean the display pad with a mild detergent and water solution.
- f. Wipe the solution on and off.
- g. Follow with a clean water wipe.

6.1.2 The Probe Module

To prepare the probe module for calibration and operation, the sensors need to be installed into the connectors on the probe module bulkhead. Whenever you install, remove or replace a sensor, it is important that the probe module and the sensors be dry. This will prevent water from entering the port.

- a. Unscrew and remove the probe sensor guard.
- b. Using the sensor installation tool, unscrew and remove the sensor port plugs.

- c. Locate the port with the connector that corresponds to the sensor that is to be installed.
- d. Apply a thin coat of o-ring lubricant to the o-rings on the connector-side of the sensor.
- e. Make sure that the probe module sensor port is free of moisture and insert the sensor into the correct port.
- f. Gently rotate the sensor until the two connectors align.
- g. With connectors aligned, screw down the sensor nut using the installation tool.
- h. Repeat these steps for the sensors.

6.1.3 Instrument/Cable Connection

- a. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the 556 instrument.
- b. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

6.2 Calibration Verification

The Field Technician must perform a calibration check of the YSI 556 MPS at a minimum, before and after sampling. In some instances, a mid-day calibration check may be warranted. The calibration check will be documented on a calibration form (as appropriate) and/or in the field notebook. Any significant issues found during the calibration check will be noted in the field notebook and the Equipment Technicians will be notified.

All of the sensors, except temperature, require daily calibration to assure high performance. The specific calibration procedures for the sensors that require calibration are noted below. Make sure that the sensors are completely submersed when calibration values are entered. For maximum accuracy, use a small amount of calibration solution to pre-rinse the probe module. Have room temperature water on hand to rinse the probes between calibration solutions. Make sure to dry the probe module between rinses and calibration solutions. Make sure that port plugs are installed in the ports where sensors are not installed.

To access the calibration screen:

- a. Press the on/off key to display the run screen.
- b. Press the escape key to display the main menu screen.
- c. Use the arrow keys to highlight the calibrate selection.
- d. Press the enter key and the calibration screen is displayed.

Note: Calibrate parameters in the order they appear in this SOP.

6.2.1 Conductivity Calibration

Ensure the conductivity sensor is clean and dry before performing a specific conductance calibration.

Always use fresh, traceable conductivity calibration solution when calibrating the conductivity sensor. The shelf life of conductivity solution is one month after being opened. This is due to potential changes in the value of the solution caused by evaporation which can occur after opening the bottle. Write the open date on the bottle so you know that you are using good calibration solution.

- a. Go to the calibrate screen as described above.
- b. Use the arrow key to highlight the conductivity selection.
- c. Press enter. The conductivity calibration screen is displayed.
- d. Select the specific conductance selection. Press enter.
- e. Place the correct volume of conductivity standard into a clean calibration cup.
- f. Carefully immerse the sensor end of the probe module into the solution. The sensor must be completely immersed past its vent hole.
- g. Gently move the probe up and down to remove any bubbles from the cell.
- h. Use the keypad to enter the calibration value of the standard you are using. Be sure to enter the value in $\mu\text{mhos}/\text{cm}@25^{\circ}\text{C}$.
- i. Press enter; the conductivity calibration screen is displayed. Allow at least one minute for temperature equilibration before proceeding. The current values for the enabled sensors will appear on the screen.
- j. Observe the reading under specific conductance. When the reading shows no significant change for 30 seconds, press enter. The screen will indicate that the calibration has been accepted and prompt you to press enter. This returns you to the conductivity calibrate selection screen.
- k. Press escape to return to the calibrate menu.
- l. Rinse the probe module and dry.

6.2.2 Dissolved Oxygen Calibration

When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8 inch (3 cm) of water is present in the cup.

Note: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating. Calibrating any one option (% or $\mu\text{g}/\text{L}$) automatically calibrates the other.

- a. Go to the calibrate screen.
- b. Use the arrow keys to highlight the dissolved oxygen selection. Press enter. The dissolved oxygen calibration screen is displayed.
- c. Use the arrow keys to highlight the DO% selection. Press enter. The DO barometric pressure entry screen is displayed.
- d. Place 1/8 inch of water in the bottom of the calibration cup and screw it on the probe module (only engage one or two threads to ensure the DO sensor is vented to the atmosphere). **Make sure that the DO and temperature sensors are not immersed in the water.**
- e. Use the keypad to enter the current local barometric pressure. (If the unit has the optional barometer, no entry is required.)

- f. Press enter and the DO% saturation calibrating screen is displayed. Allow 10 minutes for the air in the calibration cup to become water-saturated and for the temperature to equilibrate before proceeding.
- g. Observe the reading under DO%. When the reading shows no significant change for 30 seconds, press enter. The screen will indicate that the calibration has been accepted and prompt you to press enter again. This will return you to the DO calibration screen.
- h. Press escape to return to the calibrate menu.
- i. Rinse the probe and dry.

Note: A moist sponge should be kept with the probe sensor guard to prevent the dissolved oxygen membrane from drying out.

6.2.3 pH Calibration

- a. Go to the calibrate screen and select the pH selection.
- b. Press enter, and the pH calibration screen is displayed.
- c. Select the two-point (or three-point) option. Press enter. The pH entry screen is displayed.
- d. Place the correct amount of pH buffer into a clean calibration cup. (Note: for maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are sampling [e.g. pH buffers 7 then 4, buffers 7 then 10], or buffers 7, then 10, then 4.) Always begin with pH buffer 7, regardless if performing a two or three point calibration.
- e. Carefully immerse the sensor end of the probe module into the solution.
- f. Gently rotate the probe up and down to remove any air bubbles.
- g. Use the keypad to enter the calibration value of the buffer you are using. Press enter. The pH calibration screen is displayed.
- h. Allow one minute for temperature equilibrium before proceeding. The current values of the enabled sensors will appear on the screen.
- i. Observe the reading under pH. When the reading shows no significant change for 30 seconds, press enter. The screen will indicate the calibration has been accepted and prompt you to press enter again to continue.
- j. Press enter. This returns you to the specified pH calibration screen.
- k. Rinse the probe modules, calibration cup and sensors, and dry.
- l. Repeat the above steps using the second pH buffer.
- m. Press enter. This returns you to the pH calibration screen.
- n. Press escape to return to the calibrate screen.
- o. Rinse the probe and dry.

6.2.4 ORP Calibration

- a. Go to the calibrate screen and use the arrows to highlight the ORP selection.
 - b. Press enter. The calibration screen is displayed.
 - c. Place the correct amount of a known ORP solution (Zobell) into a clean calibration cup. (Note: before proceeding, make sure the sensor is dry and, ideally, rinse it with ORP solution.)
 - d. Carefully immerse the sensor end of the probe up and down to remove any air bubbles.
 - e. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature.
- Refer to the Zobell solution value chart.

Temperature (°C)	Zobell Solution Value (mV)
7	254.4
8	253.1
9	251.8
10	250.5
11	249.2
12	247.9
13	246.6
14	245.3
15	244.0
16	242.7
17	241.4
18	240.1
19	238.8
20	237.5
21	236.2
22	234.9
23	233.6
24	232.3
25	231.0
26	229.7
27	228.4
28	227.1
29	225.8
30	224.5

- Press enter. The ORP calibration screen is displayed.
- Allow at least one minute for temperature equilibration before proceeding.
- Observe the reading under ORP.
- When the reading shows no significant change for 30 seconds, press enter. The screen will indicate that the calibration has been accepted and prompt you to press enter again to continue.
- Rinse the probe and dry. The meter is now calibrated and ready for use.

If any calibrations fail, contact the Equipment Technician or manufacturer immediately or obtain a replacement instrument.

6.3 Sample Analysis

Before measuring samples you must prepare the probe module, attach the probe module to the instrument and calibrate the sensors.

To analyze samples:

- Press the on/off key or select RUN from the main menu to display the run screen.
- With the probe sensor guard installed, place the probe module in the sample making sure all the sensors are completely submerged.
- Rapidly move the probe module through the sample to provide a fresh sample to the DO sensor.
- Watch the readings on the display until they are stable.

6.3.1 Interferences

Rinse the probe sensors between instrument readings with water and dab dry to ensure accurate results.

6.4 Data Processing

To upload data to your PC, you must install EcoWatch for Windows to your PC.

- Connect the YSI 556 to a serial (COM) port of your computer using the 655173 PC interface cable.
- Open EcoWatch on your PC.
- Click on the sonde/probe icon in the upper toolbar.
- Set the Comm port number to match the port the YSI 556 MPS is connected to.
- Go to the YSI 556 MPS file screen and use the arrow keys to highlight the Upload to PC selection.
- Press Enter. The file list is displayed.
- Use the arrow keys to highlight the .DAT file you want to transfer.
- Press Enter. You will see the displays' transfer progress.
- After the file transfer is complete, close the terminal window (the smaller window on your PC) by clicking the "X" at its upper right corner.
- Press the Escape key on the YSI 556 MPS until you reach the main menu.

6.5 Data Calculations

6.5.1 Field Replicate

Field replicate results are evaluated by calculating the Relative Percent Difference (RPD) value. The RPD formula is as follows:

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

Where:

RPD	=	relative percent difference
S	=	first replicate result
D	=	second replicate result

6.5.2 Calibration Check

The percent difference is calculated using the following equation:

$$\%D = \frac{|TV - MR|}{TV} \times 100$$

Where:

%D	=	% difference
TV	=	calibration check true value
MR	=	measured result

6.6 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

QA/QC objectives (e.g., water quality parameters) are specific to each project and/or well. Discuss QA/QC procedures with the project team prior to well development.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed as written in the project scope of work and/or documentation (e.g., Work Plan, SAP, or Quality Assurance Project Plan). The following QA/QC samples are not included in the SOP reference above but should be analyzed:

- Field replicate samples

Field replicate sample measurements should be taken at a minimum of one of twenty project samples per type of measurement.

7.2 Measurement Criteria

If calibration check values fall outside of the calibration check accuracy acceptance limits in the following table, the YSI 556 MPS should be recalibrated as described in the Calibration section of this SOP.

Sensor	Calibration Solution Value	Calibration Check Acceptance Limits
Dissolved Oxygen (%)	Assumed 100% air saturation based on barometric pressure and/or stabilized reading at time of calibration	± 5% of saturation
Dissolved Oxygen (mg/L)	Solution of known value (0-20 mg/L)	± 0.5 mg/L of saturated value
Conductivity (µmhos/cm)	1409	± 3% of standard or 20 µmhos/cm, whichever is greater
pH (Standard Units)	4.00 (if used)	± 0.3 Standard Units
pH (Standard Units)	7.00	± 0.3 Standard Units
pH (Standard Units)	10.00 (if used)	± 0.3 Standard Units
ORP (mV)	Zobell Solution (231.0 mV @ 25° C	± 20 mV for temperature based calculation

8.0 Records

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Field Log Data Sheet

Field Log Data Sheets are provided to a Barr Data Management Administrator for storage on the internal Barr network. Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: collection of QC samples, decontamination of sampling equipment, and investigative derived waste.

9.0 References

YSI Model 556 MPS Water Quality System Operations Manual

Website: www.ysi.com/productsdetail.php?556MPS-21



Standard Operating Procedure

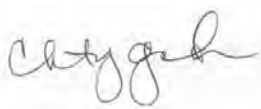
YSI ProDSS (Digital Sampling System)

Multi-parameter Water Quality Meter

Revision 1

May 9, 2023

Approved By:

Charity Gachne		05/09/23
Print	Technical Reviewer Signature	Date
Marta Nelson		05/09/23
Print	QA Manager Signature	Date

Review of the SOP has been performed and the SOP still reflects current practice.

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

Initials: _____

Date: _____

YSI ProDSS (Digital Sampling System) Multi-parameter Water Quality Meter

1.0 Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to clearly define the procedures required to accurately measure dissolved oxygen (DO), conductivity, temperature, pH, oxidation reduction potential (ORP), and turbidity in groundwater and surface water using the YSI ProDSS (digital sampling system) multi-parameter water quality meter.

The YSI ProDSS water quality meter is an easy-to-use hand-held unit. It includes a waterproof, impact-resistant case and it simultaneously measures dissolved oxygen, conductivity, temperature, pH, ORP, and turbidity.

Analysis	Conductivity	Oxidation Reduction Potential	pH	Dissolved Oxygen	Temperature	Turbidity
Analytical Method	Standard Method 2510B	Standard Method 2580A	Standard Method 4500-H ⁺ B	ASTM Method D888-09 (C)	Standard Method 2550B	Standard Method 2130B

The recommended procedures in this SOP should be followed unless conditions make it impractical or inappropriate to do so. Modifications should be noted in the applicable documentation and communicated to appropriate personnel. Significant changes may result in a revision or newly created SOP.

2.0 Limitations

- The ProDSS calibration cup and sensor guard *must* be used (and correctly installed!) when calibrating dissolved oxygen and/or turbidity. The sensor guard must be installed when taking any measurements.
- The sensor guard has a metal bottom that is painted black. Ensure the inside surface (i.e. the surface that faces the sensor tip) is not significantly scratched. This surface needs to be black to eliminate any stray light reflection. Also ensure the sensor guard and calibration cup are free of any reflective material.
- Procedures can vary by project as noted within the project scope of work and/or documentation (e.g., Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP)).
- Decontamination of reusable equipment is required to prevent cross-contamination.

3.0 Responsibilities

The Project Manager, in conjunction with the client, develops the site-specific scope of work (e.g., Work Plan, SAP, etc.).

Experienced Field Technicians are responsible for the proper field equipment calibration, measurement, quality control procedures, and documentation of dissolved oxygen, conductivity, temperature, pH, ORP, and turbidity.

Equipment Technicians are responsible for maintaining equipment in working order and aiding in troubleshooting equipment issues.

The role of the Field Safety Representative is to oversee on-site safety activities.

4.0 Safety

Barr staff is responsible for conducting aspects of the job safely. When applicable, refer to the appropriate Project Health and Safety Plan (PHASP) to understand the hazards associated with suspected contamination, symptoms of exposure, methods to minimize exposure, personal protective equipment (PPE), and personal air monitoring required when using this SOP. Minimum protection of one pair of chemical resistant gloves (e.g., nitrile) and safety glasses with side shields should be worn to prevent sample contact with the skin and eyes. When samples may be contaminated with corrosive materials, emergency eye flushing facilities should be available.

Consult the applicable Safety Data Sheet to review hazards involved with the calibration solutions and reagents listed in this SOP and to determine safe handling protocols and the appropriate PPE to minimize exposure.

5.0 Equipment, Reagents, and Supplies

- YSI ProDSS water quality meter
- O-ring lubricant
- Mild detergent
- Lint-free lab wipes
- Screwdrivers
- Calibration/Storage Cups
- Moist Sponges
- pH buffer 4
- pH buffer 7
- pH buffer 10
- Conductivity (1409 umhos/cm @25°C)
- Zobell standard
- Turbidity Standard
- Items listed in Section 8.0 Records
- Decontamination supplies (see Decon SOP)

6.0 Procedure

This section below describes the procedures and equipment used for measuring dissolved oxygen, conductivity, temperature, pH, ORP, and turbidity in groundwater and surface water.

6.1 Maintenance/Installation

6.1.1 Instrument

The YSI ProDSS has an internal battery that requires occasional charging. Battery life is shown on the display screen. When the battery gauge on the display screen is low, it is time to charge the unit.

- a. Clean the display pad with a mild detergent and water solution.
- b. Wipe the solution on and off with a soft cloth.
- c. Follow with a clean water wipe.

6.1.2 The Probe Module

To prepare the probe module for calibration and operation, the sensors need to be installed into the connectors on the probe module bulkhead. Whenever you install, remove or replace a sensor, it is important that the probe module and the sensors be dry. This will prevent water from entering the port.

Probe module maintenance should only be performed with the guidance of the Equipment Technician.

- a. Unscrew and remove the probe sensor guard.
- b. Using the sensor installation tool, unscrew and remove the sensor port plugs.
- c. Locate the port with the connector that corresponds to the sensor that is to be installed.
- d. Apply a thin coat of o-ring lubricant to the o-rings on the connector-side of the sensor.
- e. Be sure that the probe module sensor port is free of moisture and insert the sensor into the correct port.
- f. Remove the old sensor using the installation tool to loosen the stainless steel retaining nut. Once the stainless steel retaining nut has been completely unscrewed from the bulkhead, remove the old sensor from the bulkhead by pulling the sensor straight out of the bulkhead.
- g. Align the connectors of the new sensor and the port.
- h. With connectors aligned, push the sensor in towards the bulkhead until you feel the sensor seat in its port. You will experience some resistance as you push the sensor inward, this is normal.
- i. Once you feel the sensor seat into the port, gently rotate the stainless steel sensor nut clockwise with your fingers, **do not use the tool**.
- j. The nut must be screwed in by hand. If the nut is difficult to turn, STOP, as this may indicate cross threading. If you feel resistance or cross threading at any point, unscrew the nut and try again until you are able to screw the nut down completely without feeling any resistance.
Damage to the cable/sensor may occur if you force the parts together.
- k. Once completely installed, the nut will seat flat against the bulkhead. At this point, use the tool that was included with the sensor to turn the nut an additional $\frac{1}{4}$ to $\frac{1}{2}$ turn so it can't come loose. **Do not over tighten.**
- l. Repeat these steps for the rest of the sensors to be installed.

6.1.3 Instrument/Cable Connection

- a. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI ProDSS water quality meter.
- b. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place

6.2 Sensor and Unit Settings

A sensor must be enabled in the Sensor menu for it to operate. Once a sensor is enabled, the desired units for that sensor must be selected in the Display menu to determine what will be displayed.

The Equipment Technician will typically pre-prepare the instrument setup prior to being deployed to the field and sensor set up will likely not need to be completed. However, it may be necessary to reconfigure the setup in the field which can be accomplished by following the procedures below.

6.2.1 To set-up the sensors and units:

- a. Press the on/off key to display the run screen (The YSI ProDSS will automatically power on to the run screen).

- b. Press the Probe key.
- c. Highlight "Setup" and press enter.
- d. Highlight "Display" and press enter.
- e. Highlight the parameter of interest and press enter.
- f. Highlight "Sensor Type" and press enter to modify these settings.
- g. Press the left arrow key to return to the previous screen or press Esc to return to the Run screen.

Once changes to the sensor menu have been completed, you must determine which units will be reported (i.e. %, mg/L, °C, °F, etc.).

- a. Select the Probe key.
- b. Highlight "Display" and press enter.
- c. Highlight the parameter of interest and press enter.
- d. A submenu will open allowing you to select the reporting units. Some parameters can be reported in multiple units. For example, DO can be reported in DO%, DO mg/L, and DO ppm. Make selections from the submenu.
- e. Press the left arrow key to return to the Display menu or press Esc to return to the Run screen.

6.3 Calibration Verification

The Field Technician must perform a calibration check of the YSI ProDSS, at a minimum, before and after sampling. In some instances, a mid-day calibration check may be warranted. The calibration check will be documented on a calibration form (as appropriate) and/or in the field notebook. Any significant issues found during the calibration check will be noted in the field notebook and the Equipment Technicians will be notified.

All of the sensors, except temperature, require daily calibration to assure high performance. The specific calibration procedures for the sensors that require calibration are noted below. However, it is recommended the temperature sensor be compared to another thermometer periodically to insure proper operation. This will show specific calibration procedures for the sensors that require calibration. Make sure that the sensors are completely submersed when calibration values are entered. For maximum accuracy, use a small amount of calibration solution to pre-rinse the probe module. Have room temperature water on hand to rinse the probes between calibration solutions. Make sure to dry the probe module between rinses and calibration solutions. Be careful to avoid cross-contamination with other standards. Be sure that port plugs are installed in the ports where sensors are not installed.

To access the calibration screen:

The ProDSS has a menu-based interface.

Use the left arrow key to go back one screen.

- a. Press the on/off key to display the run screen (The YSI ProDSS will automatically power on to the run screen).
- b. Press the "hot keys" to access the System, Probe, Calibration, and File menus (from left to right at the top of the keypad).
- c. To navigate through the menus, use the up and down arrow keys to highlight the calibration menu option with a highlight bar, and press the Enter key to activate the selection.

- d. Use the left arrow key to go back one screen.
- e. Press the Esc key to return to the run screen or to exit an alpha/numeric entry screen.

Note: Calibrate parameters in the order they appear in this SOP.

6.3.1 Barometer Calibration (If required)

Note: If Barometer calibration is not required, proceed to conductivity calibration.

Note: The barometer is factory calibrated and should rarely need to be recalibrated.

Determine your local barometric pressure (BP) in mmHg from a mercury barometer, an independent laboratory, or from a local weather service. If the BP reading has been corrected to sea level, use the following equation to determine the true BP in mmHg for your altitude:

$$\text{True BP} = (\text{Corrected BP in mmHg}) - \{2.5 * (\text{Local Altitude in feet}/100)\}$$

- a. Go to the calibration menu as described above.
- b. Press the "Cal" (calibration) key.
- c. Highlight "Barometer" and press enter.
- d. Highlight "Calibration Value" and press enter to adjust.
- e. Use the alpha/numeric screen to enter the True BP value then highlight "Enter" and press enter.
- f. Highlight "Accept Calibration" and press enter to finish the barometric pressure calibration.
- g. "Calibration successful!" will be displayed in the message area.

6.3.2 Conductivity Calibration

Note: Calibrating any one option (specific conductance, conductivity or salinity) automatically calibrates the other.

- a. Go to the calibration menu as described above.
- b. Press the "Cal" (calibration) key.
- c. Use the arrow keys to highlight the conductivity selection and press enter.
- d. A second menu will offer the option of specific conductance, conductivity or salinity.
- e. Select the specific conductance selection. Press enter.
- f. Press enter. The conductivity calibration screen is displayed.
- g. Place the correct volume of conductivity standard into the calibration cup (225 mL).
- h. Carefully immerse the sensors making sure the solution is above the vent holes on the side of the conductivity sensor.
- i. Gently rotate and move the probe up and down to remove any bubbles from the cell and allow at least one minute for temperature to stabilize.
- j. To enter the calibration value of the standard you are using, highlight "Calibration Value".
- k. Press the enter button then use the keypad to enter the calibration value. Be sure to enter the value in umhos/cm@25°C.
- l. Press enter; the conductivity calibration screen is displayed.
- m. Once you have entered the value, highlight "ENTER" and press enter.
- n. Observe the reading under specific conductance. When the reading shows no significant change for 40 seconds, highlight "Accept Calibration" and press enter to calibrate.
- o. "Calibration successful!" will be displayed in the message area.
- p. Rinse the probe module in clean water and dry.

6.3.3 pH Calibration

Note: Typical working life for pH sensors is approximately 12-24 months depending on usage, storage and maintenance. Proper storage and maintenance generally extends the sensor's working life.

Note: If performing a 2 or 3 point calibration, one point should be in buffer 7. Calibration points can be in any order.

- a. Fill the calibration cup with pH 7 buffer solution (170mL).
- b. Carefully immerse the probe end of the sensors into the buffer solution.
- c. Press the "Cal" (calibration) key.
- d. Use the arrow keys to highlight the pH/ORP selection press enter.
- e. Select pH and press enter.
- f. Allow at least one minute for temperature stabilization, then select Calibration value.
- g. Enter the pH buffer value and press enter.
- h. Observe the reading under pH. Once the pH is stable with no significant change for 40 seconds, highlight "Accept Calibration" and press enter.
- i. "Ready for cal point 2" will be displayed in the message area.
- j. Rinse the sensor 2-3 times with a small amount of the pH buffer solution.
- k. Rinse, then fill the calibration cup with the same buffer solution (170mL) used to rinse the sensor.
- l. Carefully immerse the sensors in the buffer solution.
- m. Allow at least one minute for temperature stabilization.
- n. Select Calibration value and enter the pH buffer value and press enter.
- o. Observe the reading under pH. Once the pH is stable with no significant change for 40 seconds, highlight "Accept Calibration" and press enter.
- p. Highlight "Finish Calibration" for a 2-point calibration or repeat the procedure for the third buffer solution.

6.3.4 ORP Calibration

Note: Typical working life for ORP sensors is approximately 12-24 months depending on usage, storage and maintenance. Proper storage and maintenance generally extends the sensor's working life.

- a. Press the "Cal" (calibration) key.
- b. Use the arrow keys to highlight the pH/ORP selection.
- c. Select ORP and press enter.
- d. Place the correct volume of a known ORP solution (Zobell) standard into the calibration cup.
- e. Carefully immerse the sensor and allow the temperature of the standard to stabilize.
- f. Highlight "Calibration Value" and enter the ORP calibration value that corresponds to the measured temperature.
- g. Refer to the Zobell solution value chart.

Temperature (°C)	Zobell Solution Value (mV)
7	254.4
8	253.1
9	251.8
10	250.5
11	249.2
12	247.9
13	246.6
14	245.3
15	244.0
16	242.7
17	241.4
18	240.1
19	238.8
20	237.5
21	236.2
22	234.9
23	233.6
24	232.3
25	231.0
26	229.7
27	228.4
28	227.1
29	225.8
30	224.5

- h. Once you have entered the value, highlight "ENTER" and press enter; the ORP calibration screen will be displayed.
- i. Observe the reading under ORP. When the reading shows no significant change for 40 seconds, highlight "Accept Calibration" and press enter to calibrate.
- j. "Calibration successful!" will be displayed in the message area.
- k. Rinse the probe module and dry.

6.3.5 Dissolved Oxygen Calibration

Note: The instrument must be on for at least 10 minutes to allow the DO sensor to stabilize before calibrating. Calibrating any one option (% , mg/L, or ppm) automatically calibrates the other. It is recommended to calibrate DO% or DO% Local and not mg/L

- a. Using the sensor guard, place a small amount of water (1/8 inch) in the calibration/storage cup and screw it on the probe.
Only engage one or two threads to ensure the DO sensor is vented to the atmosphere. **Make sure that the DO and temperature sensors are not immersed in the water and there are no water droplets on the ODO sensor cap or temperature sensor.**
- b. Go to the calibration menu as described above.
- c. Press the "Cal" (calibration) key.
- d. Use the arrow keys to highlight the ODO selection.
- e. Select DO% press enter.
- f. Verify the barometric pressure displayed is accurate.

- g. Once DO% and temperature are stable with no significant change for 40 seconds, highlight "Accept Calibration" and press enter.
- h. "Calibration successful!" will be displayed in the message area.

Note: A moist sponge should be kept with the probe sensor guard to prevent the dissolved oxygen membrane from drying out.

6.3.6 Turbidity Calibration

NOTE: The sensor guard must be installed for the turbidity sensor calibration.

NOTE: When performing a turbidity calibration, the first point must be zero.

- a. Rinse the sensor 2-3 times with a small amount of DI water. Ultra-filtered DI water is included with the turbidity standards.
- b. Fill the calibration cup with DI water and immerse the sensors into the water.
- c. Press the "Cal" (calibration) key.
- d. Select Calibration Value and enter 0.00. Press enter
- e. Observe the readings for stability and after no significant change after 40 seconds, highlight Accept Calibration and press enter.
- f. "Ready for cal point 2" will be displayed in the message area.
- g. Rinse the sensors, calibration cup, and sensor guard 2-3 times with a small amount of the second standard (124 FNU). Discard the standard after each rinse.
- h. Fill the calibration cup with the second standard (124 FNU).
- i. Select Calibration Value and enter the value of the second standard.
- j. Observe the readings for stability for no significant change after 40 seconds.
- k. Select "Finish Calibration" to complete the 2-point calibration.
- l. Rinse the sensors in clean water and dry.

The meter is now calibrated and ready for use.

If any calibrations fail, contact the Equipment Technician or manufacturer immediately or obtain a replacement instrument.

6.4 Sampling

- a. Install the sensor guard.
- b. Carefully immerse the sensors in the sample making sure the sensors are complete submerged.
- c. Gently move the module up and down and rotate to release any air bubbles.
- d. Wait for the sensors to stabilize.

6.4.1 Interferences

Rinse the probe sensors between instrument readings with water and dab dry to ensure accurate results.

6.5 Data Processing

- a. Open the KorDSS software.
- b. Use the micro USB cable to connect the handheld to the PC.

- c. Power on the handheld; there may be a short delay before it shows up in the software.
- d. Select the handheld under the Instrument Connection Panel and press "Connect".
- e. Press "Start Download" from Device.
- f. After data download, press "View Logged Data" to view, print, and export data files from the KorDSS software program.

6.6 Data Calculations

6.6.1 Field Replicate

Field replicate results are evaluated by calculating the Relative Percent Difference (RPD) value. The RPD formula is as follows:

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

Where:

RPD	=	relative percent difference
S	=	first replicate result
D	=	second replicate result

6.6.2 Calibration Check

The percent difference is calculated using the following equation:

$$\%D = \frac{|TV - MR|}{TV} \times 100$$

Where:

%D	=	% difference
TV	=	calibration check true value
MR	=	measured result

6.7 Disposal

Waste generated by this process will be disposed of in accordance with Federal, State and Local regulations and Barr's SOP 'Investigative Derived Waste'. Where reasonably feasible, technological changes have been implemented to minimize the potential for environmental pollution.

7.0 Quality Control and Quality Assurance (QA/QC)

QA/QC objectives (e.g., water quality parameters) are specific to each project and/or well. Discuss QA/QC procedures with the project team prior to well development.

7.1 QA/QC Samples

QA/QC samples are defined in Barr's SOP 'Collection of Quality Control Samples'. The sampling frequency should be performed as written in the project scope of work and/or documentation (e.g., Work Plan, SAP, or Quality Assurance Project Plan). The following QA/QC samples are not included in the SOP reference above but should be analyzed:

- Field replicate samples

Field replicate sample measurements should be taken at a minimum of one of twenty project samples per type of measurement.

7.2 Measurement Criteria

If calibration check values fall outside of the calibration check accuracy acceptance limits in the following table, the YSI ProDSS should be recalibrated as described in the Calibration section of this SOP.

Sensor	Calibration Solution Value	Calibration Limits
Dissolved Oxygen (%)	Assumed 100% air saturation based on barometric pressure and/or stabilized reading at time of calibration	± 5% of saturation
Dissolved Oxygen (mg/L)	Solution of known value (0-50 mg/L)	± 0.5 mg/L of saturated value
Conductivity (µmhos/cm)	1409	± 3% of standard or 20 µmhos/cm, whichever is greater
pH (Standard Units)	4.00 (if used)	± 0.3 Standard Units
pH (Standard Units)	7.00	± 0.3 Standard Units
pH (Standard Units)	10.00 (if used)	± 0.3 Standard Units
ORP (mV)	Zobell Solution (231.0 mV @ 25° C	± 20 mV for temperature based calculation
Turbidity	0 FNU and 124 FNU	± 5% of standard value

8.0 Records

Examples of common field documentation are available in Barr's "Compendium of Field Documentation". Field documentation specific to this SOP are listed below:

- Field Log Data Sheet

Field Log Data Sheets are provided to a Barr Data Management Administrator for storage on the internal Barr network. Additional records information can be found in Barr's "Records Management System Manual".

Other Barr SOP subjects referenced within this SOP: collection of QC samples, decontamination of sampling equipment, and investigative derived waste.

9.0 References

Website: <https://www.ysi.com/ProDSS>

YSI ProDSS Multiparameter Water Quality Field Instrument Catalog

YSI ProDSS User Manual Document #626973-01REF



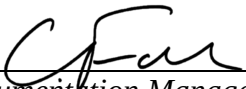
Environmental Restoration Group, Inc.

ITC.101 Rev. 2

Calibration of a Radiological Survey Meter

Standard Operating Procedure

Approvals



Instrumentation Manager

Sept, 12, 2024

Date

Quality Assurance Manager

Date

REVISION LOG		
Revision Number	Description of Changes	Pages Affected
0	Initial Release	All
1	Minor text edits and footer revision	All
2	Add recording of environmental conditions requirements, revise footer	All

1. PURPOSE

To provide a method for the calibration of general-purpose radiological survey meters in a manner that meets the applicable sections of the ANSI N323A-1997 American National Standard Radiation Protection Instrumentation Test and Calibration.

2. DISCUSSION

A general-purpose radiological survey meter (meter) is used with a compatible detector to measure radiation in integrated scaler count and/or rate modes. A meter is calibrated using a pulse generator (pulser). The pulser allows for the high voltage, threshold, window setting, and analog/digital count rates to be tested. During the calibration process the meter is also inspected for damaged buttons, switches, etc., or any physical damage that might affect functionality. Calibration of any survey meter is required at least annually, and after any scheduled or unscheduled maintenance or repair that may affect instrument operation. To calibrate a radiological survey meter the Instrument Technician must show proficiency on the meter and be recognized on their ERG Training Qualification Form as qualified to perform this procedure.

3. PROCEDURE

3.1 Equipment – The necessary components to calibrate a radiological survey meter.

- 3.1.1 Radiological survey meter – Ludlum Model 12, 177, 2221, 2224, 2241, 2360, 2929, or similar.
- 3.1.2 Calibrated pulse generator – Ludlum Model 500 pulser, or similar.
- 3.1.3 Calibrated Fluke multimeter, or similar.
- 3.1.4 Cable to connect meter and pulser.
- 3.1.5 Flathead precision screwdriver.
- 3.1.6 ERG Certificate of Calibration form, or access to ERG Equipment Rental database.

3.2 Documentation – A meter calibration is documented using the appropriate meter/detector specific Certificate of Calibration form (form) found in the ERG Equipment Rental database. If access to the database is not available, then a blank Certificate of Calibration form for the appropriate meter/detector specific calibration may be manually completed. *NOTE: blank forms are included in this SOP as attachments.* When a calibration is completed the Certificate of Calibration form must be printed, protected, and retained per the ERG Document Retention Schedule and ANSI N323A-1997.

- 3.3 Calibration** – Below is the general meter calibration process. Not all meters have the same features or calibration needs. When unsure check the manufacturer's Technical Manual for confirmation and/or assistance. *NOTE: If any equipment is found to be in non-compliance, then immediately repair or red-tag and remove from service until issue is resolved.*
- 3.3.1 Open the ERG Equipment Rental database and locate the appropriate meter/detector specific form. If access to the database is not possible then record calibration data on a printed form.
 - 3.3.2 Input the Manufacturer, Model Number, and Serial Number for the meter and/or detector being calibrated on the form.
 - 3.3.3 Input the atmospheric conditions of the calibration location. ERG personnel will record barometric pressure, temperature, and relative humidity using a NIST-traceable desktop weather station during calibration. *NOTE: There is no requirement for these parameters to be within a specific range, they only need to be recorded.*
 - 3.3.4 **PHYSICAL INSPECTION CHECK** – Check meter for broken components that may affect operation (e.g., broken parts including latches, knobs, buttons, switches; misaligned knobs; and loose screws). If everything is found to be in proper working order check the Mechanical Check box on the form.
 - 3.3.5 **AUDIO CHECK** – Check that the meter audio feature is in proper working order. If so, then check the Audio Check box on the form.
 - 3.3.6 **RESET CHECK** – Check that the Reset button is in proper working order. If so, then check the Reset Check box on the form.
 - 3.3.7 **BATTERY CHECK** – Note condition of battery as indicated by display. If the indicated battery power is not within BATT OK range on analog meter, not greater than 5.0 (volts) in digital LCD display for Model 2221, or not greater than 4.5 (volts) on Model 3000, then replace.
 - 3.3.8 Connect the pulser to the meter being calibrated.
 - 3.3.9 **HV CHECK** – Check the high voltage level at 500, 1000, 1500 volts to see if the meter readings match the pulser readings ($\pm 2.5\%$). If so, then check the 500 V, 1000 V, and 1500 V boxes on the calibration form. If the readings do not match, then refer to the Technical Manual on how to adjust the meter HV to match the pulser output and recheck.
 - 3.3.10 **THR/WIN OPERATION** – If applicable to the meter being calibrated, determine if the input sensitivity, or threshold (THR), and window (WIN) features are operating correctly. Not all meters will have an adjustable THR or a WIN feature. Determine what the THR

- and WIN settings are on the meter. Use the THR and WIN buttons that display these settings when pressed. The THR setting is typically detector specific, and the WIN setting is use/project specific. By adjusting the amplitude on the pulser, check to see if the displayed THR and WIN settings correspond to actual. If so, then check the THR/WIN Operation box on the form. If the readings do not match, then refer to the Technical Manual on how to adjust the meter THR and WIN to match the pulser output and recheck. For dual channel alpha/beta meters repeat the THR check for both channels. Only the beta channel (lower channel) will have a WIN.
- 3.3.11 FAST/SLOW RESPONSE CHECK – With the pulser providing a count rate of less than 500 counts per minute (CPM) and the pulse multiplier in the X1 position switch the pulser multiplier to the X100 or X1000 range. With the RESP switch in the F (fast) position the meter should indicate a count rate in the set range within 4 ± 1 seconds. With the RESP switch in the S (slow) position the meter should indicate a count rate in the set range in 22 ± 2 seconds. If so, then check the F/S Response Check box on the form. If not, then red-tag meter and remove from service until issue is resolved.
- 3.3.12 GEOTROPISM – If applicable to the meter being calibrated, determine if the unit is experiencing geotropism, or a change in the analog meter reading due to gravity. Check the needle position by holding the meter in three different orientations (meter face flat, meter face up, and meter face on its side). If the meter reads the same in all three orientations, then the meter successfully passes the geotropism check, check the Geotropism box on the form. If not, then red-tag meter and remove from service until issue is resolved.
- 3.3.13 METER ZEROED – Press the ZERO button or RESET Switch and release. The meter should zero out. If so, then check the Meter Zeroed box on the form. If not, then red-tag meter and remove from service until issue is resolved.
- 3.3.14 RANGE TEST – Set the scale multiplier on the meter and check the ranges indicated on the appropriate calibration sheet. Set the count rate on the pulse generator to its highest reference setting indicated on the calibration sheet. Set the meter to the proper ratemeter range scale, observe, and record the instrument analog reading. Record this value in the “As Found Reading” column on form. If the reading is not $\pm 10\%$ of what the pulser reads, then use a precision flathead screwdriver to adjust the appropriate internal meter potentiometer so the meter reading matches the pulser output. If not familiar with this process, then refer to Technical Manual. If /when the reading is within $\pm 10\%$ then record in the Meter Reading column on form. If applicable to the meter being calibrated, switch

the ratemeter range scale to LOG and record value in the Log Scale Count column on form. Repeat this for the remaining reference settings. *NOTE: As the count rate and range setting are changed on the pulser, allow time for the analog meter movement to respond, as this may take several seconds to happen if in slow response mode.*

- 3.3.15 INTEGRATED COUNT – If applicable to the meter being calibrated check the integrated counts feature (i.e., check the ability to collect counts for a set time span), for example: one minute; then perform a one-minute integrated count. For dual channel alpha/beta meters repeat the integrated count process for both channels. Do this for each scale range of counts specified on form.
- 3.3.16 INSTRUMENT WITHIN TOLERANCE – If the instrument passes all checks above then check the Instrument found within tolerance check box.
- 3.3.17 At the bottom of the form check the appropriate pulser serial number box, and Fluke multimeter box if used.
- 3.3.18 If no detector is to be calibrated with the meter, then print out form, sign and date form, enter a calibration due on form (no more than one year from calibration date), and submit for review to someone qualified to perform a radiological survey meter calibration. If a detector is to be calibrated with the meter, then continue to that procedure.

4. REFERENCES

- 4.1 Manufacturer's Technical Manual for the meter to be calibrated. *NOTE: Ludlum Technical manuals are also available on their webpage; <http://www.ludlums.com>*
- 4.2 ANSI N323A-1997, American National Standard Radiation Protection Instrumentation Test and Calibration
- 4.3 ERG Training Qualification Form

5. ATTACHMENTS

- 5.1 Blank Form ITC.101.A – Single Channel Calibration Form
- 5.2 Blank Form ITC.101.B – Single Channel Calibration Form (G-M Pancake Specific)
- 5.3 Blank Form ITC.101.C – Dual Channel Calibration Form
- 5.4 Blank Form ITC.101.D – Tray Counter Calibration Form

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ATTACHMENTS

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Environmental Restoration Group, Inc.

ITC.107.B Rev. 0

Setup of a Ludlum Model 3000 Survey Meter for RadScout Use

Standard Operating Procedure

Approvals

A handwritten signature in black ink, appearing to be "J. J. [unclear]", is written over a horizontal line.

Instrumentation Manager

22 FEB 24

Date

A handwritten signature in black ink, appearing to be "Stephen J. Cook", is written over a horizontal line.

Quality Assurance Manager

02/22/2024

Date

REVISION LOG		
Revision Number	Description of Changes	Pages Affected
0	Initial Release	All

1. PURPOSE

To provide a method for the setup of a Ludlum Model 3000 to further ensure that it functions properly with ERG RadScout software and hardware.

2. DISCUSSION

A Ludlum Model 3000 is used with a compatible detector to measure radiation integrated scaler count and/or rate modes. This standard operation procedure (SOP) is specific to a Model 3000. During the setup process the detector is also inspected for any physical damage that might affect functionality, such as cracked housing. Calibration of any survey detector is required prior to initial use, at least annually, and after any scheduled or unscheduled maintenance or repair that may affect instrument operation.

3. PROCEDURE

3.1 Equipment – The necessary components to set up a Ludlum Model 3000.

- 3.1.1 Radiological survey meter – Ludlum Model 3000.
- 3.1.2 USB (male to male) cable to connect meter and computer.
- 3.1.3 Flathead screwdriver.
- 3.1.4 Access to Lumic Firmware Updater 1.2.1.6 & Lumic Calibration 2 software.

3.2 Updating the Model 3000 Firmware

- 3.2.1 Identify printed circuit board version:
 - 3.2.1.1 Remove the battery cover of the Model 3000 and make note of the handwritten circuit board version number written on the inside of the battery compartment. If there is not aboard version number visible replace the battery compartment door and remove the six screws on the bottom of the Model 3000 housing, and then make note of the board version number. *NOTE: Board version number should be 5498-440, 5519-042, or 5519-773.*
 - 3.2.1.2 Record the last three numbers.
- 3.2.2 Reassemble the battery compartment door or housing screws, as needed.
- 3.2.3 Connect Model 3000 to a computer and open Lumic Firmware Updater version 1.2.1.6.
- 3.2.4 Under **Connected Instruments** highlight the **Model 3000 Series** option and then select **Browse**.

- 3.2.5 Navigate to the SharePoint folder \Environmental Restoration Group\Survey Systems - General\Non-ERG Systems\Ludlum Model 3000\Firmware.
- 3.2.6 Choose the folder that corresponds with the printed circuit board version number identified previously and click on the **Open** button. *NOTE: When the file is opened two .pdf files will open. You may close the .pdf files.*
- 3.2.7 When the Lumic Firmware Updater window opens up click on the **Update** button.
- 3.2.8 When the update is complete you may close the window.
- 3.3 Update the Model 3000 Internal Settings**
- 3.3.1 Open Ludlum Lumic Calibration 2 and click on the **Connect to Instrument** button. If you are prompted to use a username and password Username: Admin; Password: password.
- 3.3.2 When connected select the **Det/Mem**
Select **Load from File** (located in the top right corner of the window), and navigate to General – Survey systems, Non-ERG systems, Ludlum Model 3000, Ludlum3000_DefaultSettings
- 3.3.3 When the file is open click on the select **Save to Instrument** button (located in the bottom right corner of the window).
- 3.3.4 Select **Disconnect from Instrument** & disconnect Model 3000 from computer.

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Environmental Restoration Group, Inc.

PWT.102 Rev. 0
Field Logbook Use

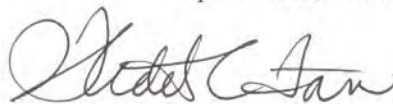
Standard Operating Procedure

Approvals



Operations Manager

1/25/18
Date



Quality Assurance Manager

1/25/18
Date

REVISION LOG		
Revision Number	Description of Changes	Pages Affected
0	Initial Release	All

1. PURPOSE

The purpose of this procedure is to provide a method for using a field logbook to record relevant project activities and information.

2. Discussion

Logbooks are used to record information about project field activities, tasks, measurements made, and/or samples collected.

Field logbooks may be used in place of standard operating procedure (SOP) log forms; for recording information such as sampling dates and times, personnel present, equipment make/model/serial numbers, measurement results, weather/terrain/other site observations, etc.

A field logbook may be considered a legal document, and the information recorded within it be of a professional and relevant nature. Neat and legible handwriting is as important as the information recorded. If the information recorded is not legible, then the use of a logbook may be of no benefit.

3. Procedure

3.1 Equipment – The necessary equipment and supplies to complete a field logbook:

- 3.1.1 Logbook – Various types are available, but ERG typically provides/uses *Rite in the Rain All-Weather* Field Notebook No. 353
- 3.1.2 A black or blue permanent ink pen or marker, typically a Sharpie. NOTE: Do not use pencil.
- 3.1.3 A time recording device such as a watch or cell phone.

3.2 Logbook Entries –

- 3.2.1 General Logbook Entries:
 - Record the name, location, and work order number of the project on the logbook front cover.
 - Record your name, phone number, e-mail address, and ERG address on the first page of the logbook. This is useful in case the logbook is misplaced.
 - Record important contact information of project staff, including phone numbers, e-mail addresses, and mailing addresses. Business cards may be taped in the logbook.
 - Record any pertinent details about safety concerns, site requirements, directions to

the site, gate/lock codes, etc.

3.2.2 Information Required for Sample Collection – In addition to the general logbook entries, the following information may be included in all logbooks when samples are collected, if not already recorded on a procedure log form:

- The date and time of collection.
- Sample name/identification.
- Method of collection.
- Sample collection equipment.
- Matrix sampled.
- Site and/or weather conditions that may adversely impact quality of samples.
- Sample location coordinates, including coordinate system, or note that the sample location(s) were logged using a GPS unit.
- Description of any deviation(s) from Work Plan or SOPs, and notes on why.
- Any other information deemed important enough to record in the field logbook.

3.2.3 Quality assurance relevant information related to data collection – In addition to the general logbook entries, the following information may be included in all logbooks when not already recorded on a procedure log form:

- Date and time of function check.
- Make, model, serial number, and calibration due date of instrumentation used.
- Instrumentation battery level, operating high voltage, threshold, window use, as necessary.
- Radiological check source identification; including radionuclide, serial number, activity, date of known activity, and distance between instrument and source.
- Instrument background counts and source counts.
- Any notable details including weather, topography, other ongoing site work that might affect function check results.

3.2.4 Information required for field data integrity and accountability:

- Data or other information that has been entered incorrectly will be corrected by drawing a single line through the incorrect entry and initialing the lined entry. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.
- Field personnel will date and number each page, as necessary. Pages may never be removed.

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- Observations, data, and calculations will be recorded at the time they are made, when practical.
- Where practical, begin each new day of notes on their own page.
- At the end of each day, the logbook entry may be closed out by making a diagonal line across the unfinished portion of the last page. The diagonal line may be signed and dated by the individual using the logbook.

4. REFERENCES

- 4.1 U.S. Environmental Protection Agency, SESD Operating Procedure: Logbooks. May 2013. <https://www.epa.gov/sites/production/files/2015-06/documents/Logbooks.pdf>

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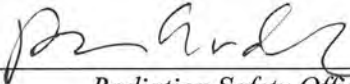
Environmental Restoration Group, Inc.

PWT.105 Rev. 1

Performing a GPS-Based Gamma Radiation Survey

Standard Operating Procedure

Approvals



Radiation Safety Officer

1/11/2021
Date



Quality Assurance Manager

1/11/2021
Date

REVISION LOG		
Revision Number	Description of Changes	Pages Affected
0	Initial Release	All
1	Updates to procedure wording and removal of Trimble related info.	All

1. PURPOSE

The purpose of this procedure is to provide a method for performing a gamma radiation survey using a survey meter and gamma radiation detector coupled to a global positioning system (GPS) unit.

2. DISCUSSION

A radiation survey is often performed to provide a spatially representative radiological condition of an area. By combining the radiological survey instruments to a GPS receiver, the survey data and associated positions can be logged in electronic format for use in GIS. Depending upon the goals of the survey and the terrain or the survey area a GPS-based radiological survey may be performed with the system setup carried by the surveyor (backpack) or setup for use on a vehicle (push cart, utility terrain vehicle (UTV), or truck).

To perform a project related GPS-based radiological survey personnel must be recognized on their ERG Training Qualification Form as qualified to perform this procedure

3. PROCEDURE

- 3.1 Equipment** – The necessary components to perform a GPS-based radiological survey.
- 3.1.1 GPS survey system of mapping grade or better (sub-meter accuracy) – Juniper Systems Mesa² and Geode, or similar with data logger/controller.
 - 3.1.2 Gamma radiological survey instruments with RS-232 data output or Bluetooth output – Ludlum Model 3000 survey meter, Ludlum Model 2221 ratemeter/scaler, or Ludlum Model 4612 counter matched with a Ludlum Model 44-10 (2-inch by 2-inch NaI), Model 44-20 (3-inch by 3-inch NaI), Field Instrument for Detection of Low Energy Radiation (FIDLER) detector, or similar radiation detector.
 - 3.1.3 Radiological check source – For typical function check of a high-energy gamma detector use a cesium 137 (Cs-137) source, or for low-energy gamma detector such as a FIDLER use an americium 241 (Am-241) source. Check sources used are dependent upon the goal of the survey. While the sources listed above are for typical function checks, they are not required to be NIST traceable. *NOTE: Select check sources that will provide a minimum accumulation of 1,000 gross counts during the counting interval, typically one minute.*
 - 3.1.4 All appropriate cables, including GPS antenna cable as necessary, RS-232 cable from meter to GPS datalogger, C-cables from meter to detector, and others, as necessary.

- 3.1.5 Detector rack to hold multiple detectors at set height above ground surface, as necessary when performing a pushcart, UTV, or truck survey.
- 3.2 Setup** – Setup the survey system hardware by assembling the GPS backpack or detector rack (pushcart, UTV, and truck), as appropriate. Connect cabling and/or Bluetooth connection(s) between GPS unit, antenna, ratemeter/scaler/counter, detector, and datalogger or controller, as necessary. Use sufficient cabling such that it will be safe and secure from damage or unintended disconnection. If performing a vehicle survey, mount rack to vehicle and attach detectors to rack. The GPS datalogger(s) or controller(s) are typically setup to record the external sensor (ratemeter/scaler/counter) output with associated position every one second.
- 3.3 Function Check** – Perform function check of the radiological survey instrument(s) before each day of use per ERG SOP ITC.201 Operational Checkout of Single-Channel Detector with Meter, ITC.207 Operational Checkout of a Single-Channel Detector with Ludlum Model 3000, or ITC.204 Operational Checkout of a Single-Channel Detector Array with Ludlum Model 4612, whichever is applicable.
- 3.4 Survey** –
 - 3.4.1 **SURVEY FILE NAME** – Open a new survey file and give it a unique file name indicative of the survey. The file name could include the survey date and/or time, the surveyor initials, and/or the site name.
 - 3.4.2 **WHEN SURVEYING** –
 - 3.4.2.1 Turn the ratemeter/scaler/counter on prior to beginning a survey file. *NOTE: If the unit is not turned on prior to opening a survey file the initial recorded gamma count rate records may be low.*
 - 3.4.2.2 Begin and end a survey data file at a point/location where it is desirable to collect data. Do not start a survey file when near the function check source.
 - 3.4.2.3 If pausing movement during the survey for a period greater than 30 seconds, then pause the data collection. Remember to restart data collection upon resuming the survey.
 - 3.4.2.4 Close the survey file upon completion of the survey. If taking a break create a new survey file upon resuming the survey.
 - 3.4.3 **SURVEY DESIGN** – Perform the survey by either walking (backpack), pushing (pushcart), or driving (UTV or truck) the survey equipment following the survey design, typically provided in a work plan. The survey design is dependent upon the goal of the survey and the equipment being used to conduct the survey and should take into account

the radiation detector type and model choice, survey scan speed, detector spacing, and height of detector above ground during the survey. Some of these design parameters may be dependent upon the survey area terrain.

3.4.3.1 DETECTOR – Choose a detector that is appropriate to meet the goals and/or requirements of the survey. For middle to high-energy gamma emitting radiation it is common to use the Model 44-10, Model 44-20, or similar detector. For low-energy emitting radiation a FIDLER detector may be more suitable. If surveying in an area where gamma shine is an issue, then use of a detector shield may be appropriate. The project work plan will typically prescribe the detector type to be used.

3.4.3.2 SURVEY SCAN SPEED – Use the designed survey scan speed or choose a survey scan speed range that is appropriate to meet the goals and/or requirements of the survey. A survey scan speed that is too fast may not allow for a detector to physically be present over a localized area of elevated gamma count rates long enough to adequately represent the conditions. For an area believed to have homogenous gamma count rates a slower survey scan speed may be unnecessary and inefficient. The project work plan will typically prescribe the survey scan speed.

3.4.3.3 DETECTOR SPACING – Attempt to adequately cover the survey area with an appropriate detector spacing to meet the goals and/or requirements of the survey. If surveying over an area known to have homogenous gamma count rates, then a wider/farther apart detector spacing may be appropriate. When surveying over an area where radiological conditions are unknown or known to have small, localized areas of elevated readings, then a tighter/closer detector spacing may be called for to better define extents. A combination of detector spacing may also be appropriate; tighter detector spacing in areas of elevated readings and wider spacing in areas of homogenous readings. The project work plan will typically prescribe the detector spacing.

3.4.3.4 DETECTOR HEIGHT – The detector height above ground should be chosen to meet the goals and/or requirements of the survey. Attempt to maintain the same detector height throughout the survey. The project work plan will typically prescribe the detector height.

3.5 Data Processing and Review – Upon completion of a GPS-based radiological survey download the data from the datalogger(s) or controller and convert into usable format,

typically a GIS shapefile format. Visually inspect the processed data for possible errors and/or missing data. Resurvey areas where data is unexplainably missing, corrupt, or there is reason to believe the results are in error.

4. REFERENCES

- 4.1 ERG Training Qualification Form
- 4.2 USER GUIDE Setup and Operation of the ERG Model 104G (GPS Array System)
- 4.3 USER GUIDE Setup and Operation of the ERG Model 105G RadScout (GPS Handheld System)

5. ATTACHMENTS

None



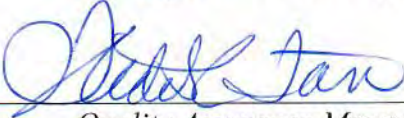
Environmental Restoration Group, Inc.

PWT.106 Rev. 1

**Making Exposure Rate Measurements Using a
High Pressure Ionization Chamber (HPIC)**

Standard Operating Procedure

Approvals

 _____ Operations Manager	<u>3/14/18</u> _____ Date
 _____ Quality Assurance Manager	<u>3/14/18</u> _____ Date

REVISION LOG		
Revision Number	Description of Changes	Pages Affected
0	Initial Release	All
1	Updates for new model RSDetection and software	All

1. PURPOSE

The purpose of this procedure is to provide a method for making exposure rate measurements using the GE Reuter-Stokes RSDetection (RS-S131-200) High Pressure Ionization Chamber (HPIC), or similar.



Figure 1: GE RSDetection Environmental Radiation Monitor HPIC

2. DISCUSSION

NOTE: For shipping purposes the HPIC is considered dangerous goods and must be shipped as such (see *ERG Standard Operating Procedure EQR.101 Shipping of Hazardous Materials*). An HPIC is a highly sensitive and stable detector for measuring gamma radiation exposure rates in air, in the unit microroentgen per hour ($\mu\text{R/hr}$). These measurements are often made for comparison to, and/or correlation with, other gamma radiation detectors such as the Ludlum Model 44-10 or Model 44-20 gamma scintillators.

To make project related exposure rate measurements using an HPIC personnel must be recognized on their ERG Training Qualification Form as qualified to perform this procedure.

3. PROCEDURE

- 3.1 Equipment** – The necessary components to make exposure rate measurements using the HPIC.
 - 3.1.1 A calibrated RSDetection Environmental Radiation Monitor HPIC. *NOTE: A fully charged battery should provide for approximately 48 hours of use.*
 - 3.1.2 Tripod.

- 3.1.3 Computer with RS Detection Configuration Utility installed, necessary to communicate with HPIC.
- 3.1.4 Cables – USB Type-A to USB Type-B cable, HPIC charging cable, and others as necessary.



Figure 2: USB Type-A (left) and a USB Type-B (right)

3.2 Communication and Setup –

3.2.1 COMMUNICATION –

- 3.2.1.1 Install the RS Detection Configuration Utility on to the computer to be used with the HPIC. The installation file may be found on the ERG server at:

<X:\SurveySystems\PIC\RSDetection\>

or on the internet at:

<https://www.gemeasurement.com/download/rsdetection-configuration-utility-software-v165260-latest>

NOTE: This should be an initial one-time step. After installation on the computer it should not be necessary to perform this step again.

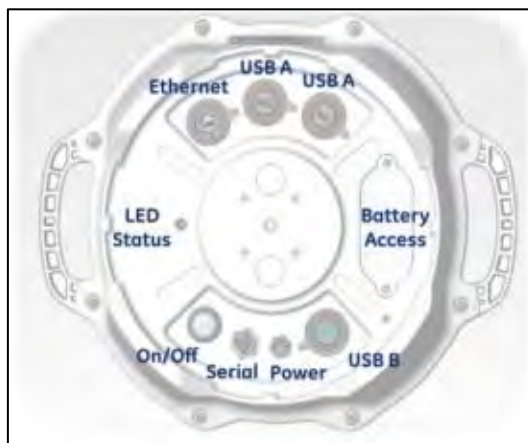


Figure 3: RSDetection Connector Diagram

- 3.2.1.2 Plug the USB Type-A cable end in to USB port on the computer and connect the USB Type-B cable end into the HPIC USB B port.
- 3.2.1.3 Power on the HPIC using the ON/OFF toggle switch.
- 3.2.1.4 Open the RSDetection Configuration Utility on the computer. When the Discovery window opens, choose the connected HPIC and click the **Connect** button.
- 3.2.1.5 Refer to the RSDetection User's Manual for additional communication information.
- 3.2.2 GENERAL SETTINGS – To change the HPIC general use settings select the **Utilities** menu, then the **Get/Set Unit Time** tab. Here you can set the clock on the HPIC.
- 3.2.3 SENSOR CONFIGURATION – If there is a need to change the HPIC sensor settings select the **Configuration** menu, then select the **DoseRate** tab. Here you can change the **LoggingIntervalSpan**. NOTE: The electrometer is sampled every 5-seconds. The recorded dose rate, in units of $\mu\text{R/hr}$, is the average of the sampled dose rates logged on the specified logging interval. For example: If the logging interval is 60 seconds, then the recorded dose rate for the interval is an average of 12 samples, or 60-second log interval divided by 5-second sample interval equals 12 samples.
- 3.3 Operation** – The HPIC will log readings when powered on, regardless of being connected to a computer or not. You may power the detector on/off as needed between locations.
- 3.3.1 MAKE MEASUREMENT – Power on the HPIC using the ON/OFF toggle switch. *NOTE: When the HPIC is powered on the initial exposure rate readings will be inaccurately low. After approximately one minute the exposure rate readings will stabilize. The HPIC will continue to log exposure rate readings according to the logging settings as set in the Configuration menu. The project work plan may prescribe the measurement duration and/or logging interval, but if not then 5-minutes per location and an interval of 5-seconds is typically acceptable.* At each location where an HPIC measurement is made record the date, collection time, approximate measurement duration, and comments (any other pertinent information) on Form PWT.106.A HPIC Measurement Log, included in this SOP as an attachment. When finished with making the measurement power off the HPIC.
- 3.3.2 MONITORING HPIC STATUS – The HPIC operating status may be monitored by viewing the LED status light identified in Figure 3 and comparing it to Table 1.

Table 1: LED Operations

Color	Pattern	Indication
Red	Solid	Loading Operating System
Yellow	Solid	Loading Application
Green/Yellow	Alternating colors every 2-sec	No Ethernet connection
Green/Red	One blink each per second	Alarm condition exists
Green	Single blink every 2-sec	Powered from battery, no errors
Green	Double blink every 2-sec	Powered from external, no errors

3.3.3 VIEWING DATA IN REAL TIME – If the user chooses to view exposure rate readings in real time this may be done through the RSDetection Configuration Utility application.

NOTE: The exposure rate in $\mu\text{R/hr}$ will be updated at the interval set in the Sensor Configuration.

3.3.4 DOWNLOAD DATA – Upon completion of making measurements the data may be downloaded to the computer. In the **History** tab, select the start and end date that you want the data from. Select the **Get Data** tab, to display the data, then select the **Save To File** tab. A **Save As** dialog window will open allowing the user to navigate to the location where the file is to be saved.

4. REFERENCES

-
- 4.1 GE Measurement & Control RSDetection User's Manual
 - 4.2 ERG Training Qualification Form
 - 4.3 ERG Standard Operating Procedure EQR.101.R1 Shipping of Hazardous Materials

5. ATTACHMENTS

-
- 5.1 Blank Form PWT.106.A – HPIC Measurement Log

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ATTACHMENTS

HPIC Measurement Log

• Name(s) of personnel making HPIC measurements:

• Project:

• HPIC Serial Number:

• Date:

• HPIC Calibration Date:

• Weather/Field Conditions:

Number	Location	Time (24:00)	Duration (minutes)	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
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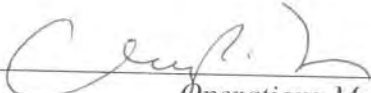
Environmental Restoration Group, Inc.

PWT.108 Rev. 0

Soil Sampling for Analytical Purposes

Standard Operating Procedure

Approvals


Operations Manager

4/10/15
Date


Quality Assurance Manager

4/10/15
Date

REVISION LOG		
Revision Number	Description of Changes	Pages Affected
0	Initial Release	All

1. PURPOSE

The purpose of this procedure is to provide a method for collection of soil samples suitable for radionuclide and/or heavy metal analyses.

2. DISCUSSION

Soil samples are used to assess the distribution and intensity of constituent(s) of concern (COC) for a wide variety of applications ranging from characterization of project areas and undisturbed areas to verification that remediation goals have been attained. Soil samples may be collected at discrete or random locations to assess the impacts of unplanned releases, spills, or other contamination events; or at systematic locations on a routine frequency. The analytical requirements placed on soil samples depend on the type of sample and the desired reporting radiological, chemical, and geochemical characteristics. This information is typically described in a project sampling plan.

Surface soil samples are defined as samples from an interval of ground surface to a depth of 15 centimeters (cm) below ground surface (BGS). Shallow subsurface samples are defined as samples from an interval ranging from 15 cm BGS to 1.5 meter (m) BGS. Hand sampling methods are typically adequate to sample surface and shallow subsurface intervals. Samples taken below 1.5 m (~ 5 feet) BGS typically require mechanized methods of soil collection; including mechanized direct-push technology, motorized augers, and drill rigs.

To collect project related soil samples for laboratory analysis personnel must be recognized on their ERG Training Qualification Form as qualified to perform this procedure

3. PROCEDURE

3.1 Equipment – The necessary equipment and supplies to collect soil sample(s) per this procedure.

3.1.1 Sampler – Various sampler technologies are listed below:

- Surface: shovel, hand trowel, or soil core sampler
- Shallow Subsurface: soil auger or direct-push with slide-hammer
- Subsurface: mechanized direct-push, drill rig, or motorized auger

3.1.2 Sample container

3.1.3 Bucket and mixing trowel

3.1.4 Screwdriver, or other method of removing soil from sampler

3.2 Procedure –

- 3.2.1 Clear debris, loose brush, and any excess vegetation or rock from sample locations.
- 3.2.2 If making a radiological measurement of the sample location, do so prior to collecting soil sample and record on Form PWT.108.A – Soil Sample Collection Log, or in the sampler's field log book. Form PWT.108.A – Soil Sample Collection Log is included in this procedure as an attachment. *NOTE: If making down-hole gamma measurement then take care to not knock any surface or side-wall soils into hole.*
- 3.2.3 Using a decontaminated sampler collect the soil sample to the prescribed depth for the sample. If sampler encounters refusal (i.e.: cannot advance sampler to full sample depth) then adjust the sample location to another location as near as practical to achieve successful sample collection. If a sample cannot be collected at the location then note "Refusal" on Form PWT.108.A.
- 3.2.4 Make sure the sample provided is equally representative of the range of depth. If multiple soil samples are collected from the same location and depth interval to achieve sufficient sample mass for analysis then either submit all of the collected soil for analysis, or using a mixing bucket or bowl homogenize the collected soil into a single representative sample of sufficient mass for laboratory analysis.
- 3.2.5 Place the sample into a properly labeled and decontaminated sample container and record sample collection information on Form PWT.108.A. At a minimum the label information should include the sample location or sample number, sample depth, date and time, and sampler(s) name or initials.
- 3.2.6 Prior to collecting any additional samples or leaving a sample location sufficiently decontaminate the sampling and mixing equipment. If using rinse water to decontaminate equipment, release rinse water to the ground unless the work plan or project manager specifies that it be retained.
- 3.2.7 Repeat steps above as necessary to collect all samples and depths at a location. *NOTE: If collecting soil sample(s) at greater depths take care not to knock any surface or side-wall soils into hole.*
- 3.2.8 Prior to leaving the sample location record position using GPS or pin flags, and close off the sample opening(s) with excess sample material and/or surrounding materials.

4. REFERENCES

4.1 ERG Training Qualification Form

5. ATTACHMENTS

5.1 Blank Form PWT.108.A – Soil Sample Collection Log

UNCONTROLLED COPY IF PRINTED

ATTACHMENTS

ERG Soil Sample Collection Log

• Name(s) of personnel collecting soil samples:

• Project:

• Date:

• Survey Instrument(s) with Serial Number(s):

• Weather/Field Conditions:

• Calibration Due Date(s):

Number	Sample ID	Depth (cm)	Gamma Reading (cpm) (μR/hr)	Time (24:00)	GPS Position Recorded	Comments	Initials
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Review: _____

Appendix B

Vegetation and Wildlife Supporting Information

IPaC Official Species List
NMERT Output
Plants Likely to Occur in the Permit Area



United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna Road Ne
Albuquerque, NM 87113-1001
Phone: (505) 346-2525 Fax: (505) 346-2542



In Reply Refer To:
Project Code: 2025-0139200
Project Name: La Jara Mesa Mine Project

03/06/2026 16:24:33 UTC

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Thank you for your recent request for information on federally listed species and important wildlife habitats that may occur in your project area. The U.S. Fish and Wildlife Service (Service) has responsibility for certain species of New Mexico wildlife under the Endangered Species Act (ESA) of 1973 as amended (16 USC 1531 *et seq.*), the Migratory Bird Treaty Act as amended (16 USC 701-715), and the Bald and Golden Eagle Protection Act as amended (16 USC 668-668(c)). We are providing the following guidance to assist you in determining which federally imperiled species may or may not occur within your project area, and to recommend some conservation measures that can be included in your project design.

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the ESA is to provide a means whereby threatened and endangered species and

the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the ESA and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (NEPA; 42 USC 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at <https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf>.

Candidate Species and Other Sensitive Species

A list of candidate and other sensitive species in your area is also attached. Candidate species and other sensitive species are species that have no legal protection under the ESA, although we recommend that candidate and other sensitive species be included in your surveys and considered for planning purposes. The Service monitors the status of these species. If significant declines occur, these species could potentially be listed. Therefore, actions that may contribute to their decline should be avoided.

Lists of sensitive species including State-listed endangered and threatened species are compiled by New Mexico State agencies. These lists, along with species information, can be found at the following websites.

Biota Information System of New Mexico (BISON-M): www.bison-m.org

New Mexico State Forestry. The New Mexico Endangered Plant Program:
<https://www.emnrd.nm.gov/sfd/rare-plants/>

New Mexico Rare Plant Technical Council, New Mexico Rare Plants: nmrareplants.unm.edu

Natural Heritage New Mexico, online species database: nhnm.unm.edu

WETLANDS AND FLOODPLAINS

Under Executive Orders 11988 and 11990, Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and floodplains, and preserve and enhance their natural and beneficial values. These habitats should be conserved through avoidance, or mitigated to ensure that there would be no net loss of wetlands function and value.

We encourage you to use the National Wetland Inventory (NWI) maps in conjunction with ground-truthing to identify wetlands occurring in your project area. The Service's NWI program website, www.fws.gov/wetlands/Data/Mapper.html, integrates digital map data with other resource information. We also recommend you contact the U.S. Army Corps of Engineers for permitting requirements under section 404 of the Clean Water Act if your proposed action could impact floodplains or wetlands.

MIGRATORY BIRDS

In addition to responsibilities to protect threatened and endangered species under the ESA, there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the Service (50 CFR 10.12 and 16 USC 668(a)). For more information regarding these Acts, see <https://www.fws.gov/program/migratory-bird-permit/what-we-do>.

It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a Federal nexus) or a Bird/Eagle Conservation Plan (when there is no Federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see <https://www.fws.gov/library/collections/threats-birds>. We also recommend review of the Birds of Conservation Concern list (<https://www.fws.gov/media/birds-conservation-concern-2021>) to fully evaluate the effects to the birds at your site. This list identifies migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent top conservation priorities for the Service, and are potentially threatened by disturbance, habitat impacts, or other project development activities.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 thereby provides additional protection for both migratory birds and migratory bird habitat. Please visit <https://www.fws.gov/partner/council-conservation-migratory-birds> for information regarding the implementation of Executive Order 13186.

We suggest you contact the New Mexico Department of Game and Fish, and the New Mexico

Energy, Minerals, and Natural Resources Department, Forestry Division for information regarding State protected and at-risk species fish, wildlife, and plants.

For further consultation with the Service we recommend submitting inquiries or assessments electronically to our incoming email box at nmesfo@fws.gov, where it will be more promptly routed to the appropriate biologist for review.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New Mexico Ecological Services Field Office

2105 Osuna Road Ne

Albuquerque, NM 87113-1001

(505) 346-2525

PROJECT SUMMARY

Project Code: 2025-0139200

Project Name: La Jara Mesa Mine Project

Project Type: Department of Energy Operations

Project Description: The project is a proposed 96 acre underground uranium mine which is about to begin baseline studies.

Project Location:

The approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/@35.283453050000006,-107.74892309252806,14z>



Counties: Cibola County, New Mexico

ENDANGERED SPECIES ACT SPECIES

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries¹, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

-
1. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Mexican Wolf <i>Canis lupus baileyi</i> Population: Wherever found, except where listed as an experimental population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3916 General project design guidelines: https://ipac.ecosphere.fws.gov/project/NWYV4KFZARAVXHXH4L7GHE3PGY/documents/generated/9162.pdf	Endangered

BIRDS

NAME	STATUS
Mexican Spotted Owl <i>Strix occidentalis lucida</i> There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8196 General project design guidelines: https://ipac.ecosphere.fws.gov/project/NWYV4KFZARAVXHXH4L7GHE3PGY/documents/generated/9489.pdf	Threatened
Southwestern Willow Flycatcher <i>Empidonax traillii extimus</i> There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6749 General project design guidelines: https://ipac.ecosphere.fws.gov/project/NWYV4KFZARAVXHXH4L7GHE3PGY/documents/generated/9177.pdf	Endangered
Yellow-billed Cuckoo <i>Coccyzus americanus</i> Population: Western U.S. DPS There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911 General project design guidelines: https://ipac.ecosphere.fws.gov/project/NWYV4KFZARAVXHXH4L7GHE3PGY/documents/generated/9183.pdf	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly <i>Danaus plexippus</i> There is proposed critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743	Proposed Threatened
Suckley's Cuckoo Bumble Bee <i>Bombus suckleyi</i> Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10885	Proposed Endangered

FLOWERING PLANTS

NAME	STATUS
Pecos (=puzzle, =paradox) Sunflower <i>Helianthus paradoxus</i> There is final critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7211 General project design guidelines: https://ipac.ecosphere.fws.gov/project/NWYV4KFZARAVXHXH4L7GHE3PGY/documents/generated/9168.pdf	Threatened

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Private Entity

Name: Jesse Dillon

Address: 9401 N County Road 19

City: Fort Collins

State: CO

Zip: 80524-9784

Email: jdillon@cedarcreekassociatesinc.com

Phone: 9709883106

LEAD AGENCY CONTACT INFORMATION

Lead Agency: New Mexico Energy, Minerals, and Natural Resources Department



PROJECT INFORMATION

Project Title: La Jara Proposed Uranium Mine
Project Type: MINING, BASELINE WILDLIFE SURVEYS
Latitude/Longitude (DMS): 35.246374 / -107.784819
County(s): CIBOLA
Project Description: This is a preliminary evaluation to determine which wildlife surveys may be needed to support mine permitting. The surveys have not been completed to date are intended to start this fall and extend into spring/summer 2026. The permitting has been ongoing with the Mining and Minerals Division. The proposed mine will have an access road, portal, vent shaft, and ancillary mine facilities to support underground mining of uranium. Mitigation measures, if necessary, will be developed following the baseline assessment. It is anticipated that disturbance during the nesting season will need clearance surveys to ensure compliance with the Migratory Bird Treaty Act.

REQUESTOR INFORMATION

Project Organization:
Contact Name: Jesse Dillon
Email Address: jdillon@cedarcreek.app
Organization: Cedar Creek Asssociates Inc
Address: 9401 N County Road 19, Fort Collins CO 80524-9784
Phone: 9709883106

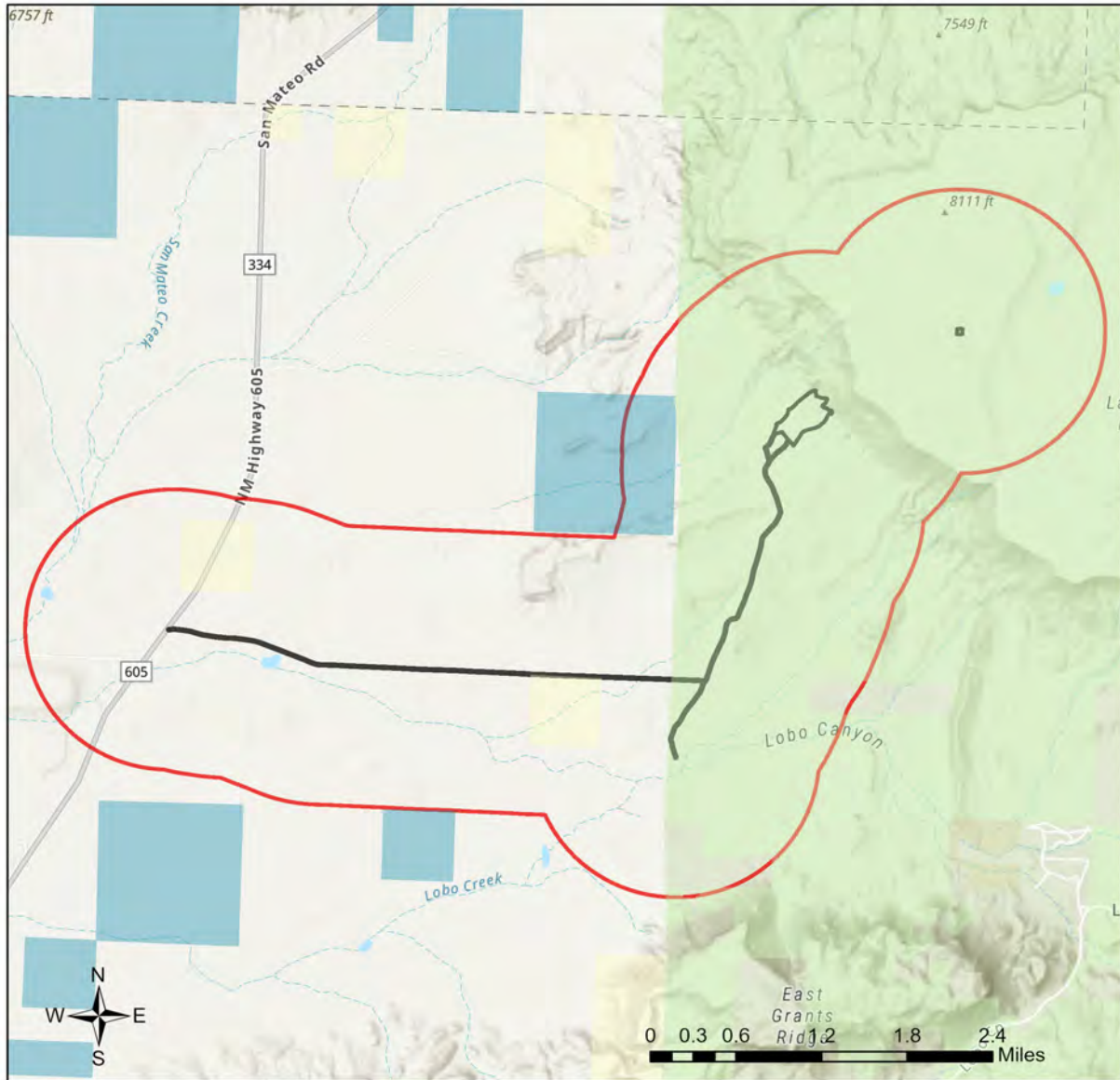
OVERALL STATUS

This report contains an initial list of recommendations regarding potential impacts to wildlife or wildlife habitats from the proposed project; see the Project Recommendations section below for further details. Your project proposal is being forwarded to a New Mexico Department of Game and Fish (Department) biologist for review to determine whether there are any additional recommendations regarding the proposed actions. A Department biologist will be in touch within 30 days if there are further recommendations regarding this project proposal.

About this report:

- This environmental review is based on the project description and location that was entered. The report must be updated if the project type, area, or operational components are modified.
- This is a preliminary environmental screening assessment and report. It is not a substitute for the potential wildlife knowledge gained by having a biologist conduct a field survey of the project area. Federal status and plant data are provided as a courtesy to users. The review is also not intended to replace consultation required under the federal Endangered Species Act (ESA), including impact analyses for federal resources from the U.S. Fish and Wildlife Service (USFWS) using their [Information for Planning and Consultation tool](#).
- This report contains information on wildlife species protected under the ESA and the [Wildlife Conservation Act \(WCA\)](#), [Species of Greatest Conservation Need \(SGCN\)](#), and Species of Economic and Recreational Importance (SERI). Species listed under the ESA are protected from take at the federal level and under the WCA are protected from take at the state level. SGCN are identified in the [State Wildlife Action Plan \(SWAP\) for New Mexico](#); all of these species are considered to be of conservation concern but not all of them are protected from take at the state or federal level. The harvest of all SERI is regulated at the state level. The Department has no authority to designate critical habitat for species listed under the WCA; only the USFWS can designate critical habitat for species listed under the ESA.
- The New Mexico Environmental Review Tool (ERT) utilizes species observation locations and species habitat suitability models, both of which are subject to ongoing change and refinement. Inclusion or omission of a species within a report cannot guarantee species presence or absence within your project area. To determine occurrence of any species listed in this report, or other wildlife that may be present within your project area, onsite surveys conducted by a qualified biologist during appropriate, species-specific survey timelines may be necessary.
- The Department encourages use of the ERT to modify proposed projects for avoidance, minimization, or mitigation of wildlife impacts. However, the ERT is not intended to be used in a repeatedly iterative fashion to adjust project attributes until a previously determined recommendation is generated. The ERT serves to assess impacts once project details are developed. The [New Mexico Crucial Habitat Assessment Tool](#), the data layers from which are included in the ERT, is the appropriate system for advising early-stage project planning and design to avoid areas of anticipated wildlife concerns and associated regulatory requirements.

La Jara Proposed Uranium Mine



NHNM, USGS, USFS, US Census Bureau, NMDGF
Esri, NASA, NGA, USGS
Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS

Special Status Animal Species Potentially within 1 Miles of Project Area

Common Name	Scientific Name	USFWS (ESA)	NMDGF (WCA)	NMDGF SGCN/SERI	USFS	USFS SCC	BLM
Mountain Treefrog	Hyla wrightorum			SGCN			
Boreal Chorus Frog	Pseudacris maculata			SGCN			
Bald Eagle	Haliaeetus leucocephalus		T	SGCN	Sensitive Species		BLM SENSITIVE
Peregrine Falcon	Falco peregrinus		T	SGCN			BLM WATCH
Mountain Plover	Charadrius montanus			SGCN	Sensitive Species		BLM WATCH
Flammulated Owl	Otus flammeolus			SGCN			BLM WATCH
Western Burrowing Owl	Athene cunicularia hypugaea			SGCN	Sensitive Species	USFS R3 SCC	BLM SENSITIVE
Mexican Spotted Owl	Strix occidentalis lucida	LT		SGCN			
Common Nighthawk	Chordeiles minor			SGCN			
Lewis's Woodpecker	Melanerpes lewis			SGCN		USFS R3 SCC	BLM WATCH
Williamson's Sapsucker	Sphyrapicus thyroideus			SGCN			
Olive-Sided Flycatcher	Contopus cooperi			SGCN			
Bank Swallow	Riparia riparia			SGCN			
Pinyon Jay	Gymnorhinus cyanocephalus			SGCN		USFS R3 SCC	BLM SENSITIVE
Clark's Nutcracker	Nucifraga columbiana			SGCN			
Juniper Titmouse	Baeolophus ridgwayi			SGCN		USFS R3 SCC	BLM WATCH
Pygmy Nuthatch	Sitta pygmaea			SGCN			
Western Bluebird	Sialia mexicana			SGCN			
Mountain Bluebird	Sialia currucoides			SGCN			
Loggerhead Shrike	Lanius ludovicianus			SGCN		USFS R3 SCC	BLM WATCH
Gray Vireo	Vireo vicinior		T	SGCN	Sensitive Species	USFS R3 SCC	BLM WATCH
Virginia's Warbler	Leiothlypis virginiae			SGCN			BLM SENSITIVE
Black-Throated Gray Warbler	Setophaga nigrescens			SGCN			BLM WATCH

Special Status Animal Species Potentially within 1 Miles of Project Area

Common Name	Scientific Name	USFWS (ESA)	NMDGF (WCA)	NMDGF SGCN/SERI	USFS	USFS SCC	BLM
Grace's Warbler	Setophaga graciae			SGCN		USFS R3 SCC	BLM WATCH
Black-Chinned Sparrow	Spizella atrogularis			SGCN			BLM WATCH
Vesper Sparrow	Pooecetes gramineus			SGCN			
Chestnut-Collared Longspur	Calcarius ornatus			SGCN			BLM SENSITIVE
Cassin's Finch	Haemorhous cassinii			SGCN			BLM WATCH
Evening Grosbeak	Coccothraustes vespertinus			SGCN			
Spotted Bat	Euderma maculatum		T	SGCN	Sensitive Species	USFS R3 SCC	BLM SENSITIVE
Pale Townsend's Big-Eared Bat	Corynorhinus townsendii pallescens			SGCN	Sensitive Species	USFS R3 SCC	BLM SENSITIVE
Gunnison's Prairie Dog	Cynomys gunnisoni			SGCN	Sensitive Species		BLM SENSITIVE
Black Bear	Ursus americanus			SERI			
Mountain Lion	Puma concolor			SERI			
Elk	Cervus canadensis			SERI			
Mule Deer	Odocoileus hemionus			SERI			

Common Name hyperlink takes you to species account in [bison-m.org](https://www.bison-m.org/); Scientific Name hyperlink takes you to information in [NatureServe Explorer](#); ESA = Endangered Species Act, C = Candidate, LE = Listed Endangered, LT = Listed Threatened, XN = Non-essential Experimental Population, for other ESA codes see this [website](#); WCA = Wildlife Conservation Act, E = Endangered, T = Threatened; SERI = Species of Economic and Recreational Importance; SGCN = Species of Greatest Conservation Need; USFS = U.S. Forest Service, Sensitive Species = A species likely to occur on USFS lands that is of concern for a potential reduction in population viability; SCC = Species of Conservation Concern; BLM = Bureau of Land Management, BLM SENSITIVE = A species that occurs on BLM lands and whose viability is at risk, BLM WATCH = Species that may be added to the sensitive species list in future pending new information regarding species status.

Project Recommendations

Baseline surveys should grow out of a clear and concise statement of the ultimate objectives of the investigation. Different objectives require different sampling designs. A clear and concise statement of objectives is essential to select appropriate study sites, take relevant and meaningful measurements at these locations, and perform analyses that will provide a basis for the conclusions necessary for meeting the stated objectives.

- Studies associated with specific proposed actions should be designed to gather information on key wildlife species and important wildlife habitats based on anticipated project-specific effects.
- Sampling design, including determination of sample size, replication, stratification, and statistical analysis, is as important to a baseline study as survey or inventory method. If sufficient resources are available, sampling design should be reviewed by a biological statistician prior to expenditure of money and effort on field surveys.
- Investigations of wildlife likely present in the project area and area of potential effects should begin by accessing existing information. Wildlife and habitat information is available from a variety of sources, including online searchable databases. Much information on the distribution, status, habitat affinities, and natural history of New Mexico's wildlife is housed in the Biota Information System of New Mexico ([BISON-M](#)) database, which contains species accounts for all New Mexico vertebrates and many invertebrates.
- Special attention should be given to documenting the presence or potential occurrence of state and federally listed species, candidates for federal listing, and sensitive species. Consultation with agency biologists and/or permits may be required from USFWS and the Department to conduct surveys for certain species, particularly if these species are listed, or if trapping, handling, callback surveys, and/or collecting of wildlife is necessary.

Additional information is available from the Department's [Baseline Wildlife Study Guidelines](#). Once these initial guidelines have been followed, baseline study proposals may be submitted directly to the Department for review.

Burrowing owl (*Athene cunicularia*) may occur within your project area. Burrowing owls are protected from take by the Migratory Bird Treaty Act and under New Mexico state statute. Before any ground disturbing activities occur, the Department recommends that a preliminary burrowing owl survey be conducted by a qualified biologist using the Department's [Burrowing Owl Survey Protocol](#). Should burrowing owls be documented in the project area, please contact the Department or USFWS for further recommendations regarding relocation or avoidance of impacts.

Prairie dog colonies may occur within the vicinity of your project area. Both black-tailed prairie dogs (*Cynomys ludovicianus*) and Gunnison's prairie dogs (*Cynomys gunnisoni*) are designated as New Mexico SGCN, and their colonies provide important habitat for other grassland wildlife. Wherever possible, occupied prairie dog colonies should be left undisturbed, and all project activities should be directed off the colony. Any burrows that are located on the project site should be surveyed by a qualified biologist to determine whether burrows are active or inactive and whether burrowing owls may be utilizing the site. Colonies within the range of the black-tailed prairie dog can be surveyed by a qualified biologist diurnally, year-round using binoculars. Colonies within the range of the Gunnison's prairie dog can be surveyed by a qualified biologist diurnally, using binoculars during the warmer months from April through October and by searching for fairly fresh scat and lack of cobwebs or debris at the mouths of burrows during the cold months (November through March). If ground-disturbing activities cannot be relocated off the prairie dog colony, or if project activities involve control of prairie dogs, the Department recommends live-trapping and relocation of prairie dogs. The Department can provide recommendations regarding suitability of potential translocation areas and procedures.

The proposed project occurs within or near a riparian area. Because riparian areas are important wildlife habitats, the project footprint should avoid removing any riparian vegetation or creating ground disturbance either directly within or affecting the riparian area, unless the project is intended to restore riparian habitat through non-native plant removal and replanting with native species. If your project involves removal of non-native riparian trees or planting of native riparian vegetation, please refer to the Department's habitat handbook guideline for [Restoration and Management of Native and Non-native Trees in Southwestern Riparian Ecosystems](#). The [New Mexico Riparian Habitat Map \(NMRipMap\)](#) may also provide useful information on local riparian habitat composition and structure.

Disclaimers regarding recommendations:

- The Department provides technical guidance to support the persistence of all protected species of native fish and wildlife, including game and nongame wildlife species. Species listed within this report include those that have been documented to occur within the project area, and others that may not have been documented but are projected to occur within the project vicinity.
- Recommendations are provided by the Department under the authority of § 17-1-5.1 New Mexico Statutes Annotated 1978, to provide "communication and consultation with federal and other state agencies, local governments and communities, private organizations and affected interests responsible for habitat, wilderness, recreation, water quality and environmental protection to ensure comprehensive conservation services for hunters, anglers and nonconsumptive wildlife users".
- The Department has no authority for management of plants or Important Plant Areas. The [New Mexico Endangered Plant Program](#), under the Energy, Minerals, and Natural Resources Department's Forestry Division, identifies and develops conservation measures necessary to ensure the survival of plant species within New Mexico. Plant status information is provided within this report as a courtesy to users. Recommendations provided within the ERT may not be sufficient to preclude impacts to rare or sensitive plants, unless conservation measures are identified in coordination with the Endangered Plant Program.
- Additional coordination and/or consultation may also be necessary under the federal ESA or National Environmental Policy Act (NEPA). Further site-specific mitigation recommendations may be proposed during ESA consultation and/or NEPA analyses or through coordination with affected federal agencies.

TABLE B-1 PLANT SPECIES LIST FOR THE LA JARA MESA PROJECT AREA

Common Name	Scientific Name
Grasses	
Spike Dropseed	<i>Sporobolus contractus</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Bluegrass	<i>Poa</i>
Sand Dropseed	<i>Sporobolus cryptandrus</i>
Prairie Junegrass	<i>Koeleria macrantha</i>
James' Galleta	<i>Pleuraphis jamesii</i>
Pinyon Ricegrass	<i>Piptochaetium fimbriatum</i>
Western Wheatgrass	<i>Pascopyrum smithii</i>
Spike Muhly	<i>Muhlenbergia wrightii</i>
Ring Muhly	<i>Muhlenbergia torreyi</i>
Common Wolfstail	<i>Lycurus phleoides</i>
Muttongrass	<i>Poa fendleriana</i>
Sleepygrass	<i>Achnatherum robustum</i>
Cutleaf Coneflower	<i>Rudbeckia laciniata</i>
New Mexico Feathergrass	<i>Hesperostipa neomexicana</i>
Indian Ricegrass	<i>Achnatherum hymenoides</i>
Threeawn	<i>Aristida</i>
Poverty Threeawn	<i>Aristida divaricata</i>
Purple Threeawn	<i>Aristida purpurea</i>
Cane Bluestem	<i>Bothriochloa barbinodis</i>
Sideoats Grama	<i>Bouteloua curtipendula</i>
Blue Grama	<i>Bouteloua gracilis</i>
Sedge	<i>Carex</i>
Pine Dropseed	<i>Blepharoneuron tricholepis</i>
Needle And Thread	<i>Hesperostipa comata</i>
Squirreltail	<i>Elymus elymoides</i>
Forbes	
Rough Menodora	<i>Menodora scabra</i>
Sunflower	<i>Helianthus</i>
Hoary False Goldenaster	<i>Heterotheca canescens</i>
Red Bluet	<i>Houstonia rubra</i>
Fineleaf Hymenopappus	<i>Hymenopappus filifolius</i>
Pingue Rubberweed	<i>Hymenoxys richardsonii</i>
Flaxflowered Ipomopsis	<i>Ipomopsis longiflora</i>
Flatspine Stickseed	<i>Lappula occidentalis</i>
Gordon'S Bladderpod	<i>Lesquerella gordonii</i>
Plains Flax	<i>Linum puberulum</i>
Hoary Tansyaster	<i>Machaeranthera canescens</i>

Common Name	Scientific Name
Rockcress	<i>Arabis</i>
Lacy Tansyaster	<i>Machaeranthera pinnatifida</i>
Spurge	<i>Euphorbia</i>
Four O'Clock	<i>Mirabilis</i>
Colorado Four O'Clock	<i>Mirabilis multiflora</i>
Pony Beebalm	<i>Monarda pectinata</i>
Bristly Nama	<i>Nama hispidum</i>
Clustered Broomrape	<i>Orobanche fasciculata</i>
Lemonscent	<i>Pectis angustifolia</i>
Beardtongue	<i>Penstemon</i>
Beardlip Penstemon	<i>Penstemon barbatus</i>
Toadflax Penstemon	<i>Penstemon linarioides</i>
Upright Blue Beardtongue	<i>Penstemon virgatus</i>
Varileaf Phacelia	<i>Phacelia heterophylla</i>
Slender Goldenweed	<i>Machaeranthera gracilis</i>
Woolly Prairie Clover	<i>Dalea lanata</i> var. <i>terminalis</i>
Carruth'S Sagewort	<i>Artemisia carruthii</i>
Tarragon	<i>Artemisia dracunculus</i>
White Sagebrush	<i>Artemisia ludoviciana</i>
Milkvetch	<i>Astragalus</i>
Ragleaf Bahia	<i>Bahia dissecta</i>
Mustard	<i>Brassica</i>
Wholeleaf Indian Paintbrush	<i>Castilleja integra</i>
Rose Heath	<i>Chaetopappa ericoides</i>
Goosefoot	<i>Chenopodium</i>
Fetid Goosefoot	<i>Chenopodium graveolens</i>
Birdbill Dayflower	<i>Commelina dianthifolia</i>
Dakota Mock Vervain	<i>Glandularia bipinnatifida</i>
Thicksepal Cryptantha	<i>Cryptantha crassisejala</i>
Firewheel	<i>Gaillardia pulchella</i>
Purple Prairie Clover	<i>Dalea purpurea</i>
Tansymustard	<i>Descurainia</i>
Touristplant	<i>Dimorphocarpa wislizeni</i>
Shieldpod	<i>Dithyrea</i>
Fleabane	<i>Erigeron</i>
Spreading Fleabane	<i>Erigeron divergens</i>
Trailing Fleabane	<i>Erigeron flagellaris</i>
Annual Buckwheat	<i>Eriogonum annuum</i>
James' Buckwheat	<i>Eriogonum jamesii</i>

Common Name	Scientific Name
Sanddune Wallflower	<i>Erysimum capitatum</i>
Slimleaf Plainsmustard	<i>Schoenocrambe linearifolia</i>
Canadian Horseweed	<i>Conyza canadensis</i>
White Milkwort	<i>Polygala alba</i>
Prickly Russian Thistle	<i>Salsola tragus</i>
Rocky Mountain Zinnia	<i>Zinnia grandiflora</i>
Juniper Globemallow	<i>Sphaeralcea digitata</i>
Globemallow	<i>Sphaeralcea</i>
Ragwort	<i>Senecio</i>
Shrubs	
Banana Yucca	<i>Yucca baccata</i>
Pricklypear	<i>Opuntia</i>
Tree Cholla	<i>Opuntia imbricata</i>
Plains Pricklypear	<i>Opuntia polyacantha</i>
Wavyleaf Oak	<i>Quercus pauciloba</i>
Soapweed Yucca	<i>Yucca glauca</i>
Spineless Horsebrush	<i>Tetradymia canescens</i>
Red Barberry	<i>Mahonia haematocarpa</i>
Alderleaf Mountain Mahogany	<i>Cercocarpus montanus</i>
Skunkbush Sumac	<i>Rhus trilobata</i>
Pale Desert-Thorn	<i>Lycium pallidum</i>
Winterfat	<i>Krascheninnikovia lanata</i>
Pingue Rubberweed	<i>Hymenoxys richardsonii</i>
Broom Snakeweed	<i>Gutierrezia sarothrae</i>
Spinystar	<i>Escobaria vivipara</i>
Echinocactus	<i>Echinocactus</i>
Fourwing Saltbush	<i>Atriplex canescens</i>
Prairie Sagewort	<i>Artemisia frigid</i>
Sand Sagebrush	<i>Artemisia filifolia</i>
Trees	
Rubber Rabbitbrush	<i>Ericameria nauseosa</i>
Twoneedle Pinyon	<i>Pinus edulis</i>
Oneseed Juniper	<i>Juniperus monosperma</i>

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