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MINING & MINERALS DIVISION

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PROVIDING PERMITS for LAND USERS

37 Verano Loop, Santa Fe, NM 87508 (505) 466-8120

July 16, 2015

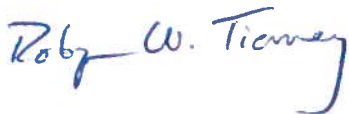
Mr. David L. Clark  
Mining and Minerals Division  
Energy, Minerals and Natural Resources Department  
1220 South St. Francis Drive, Santa Fe, New Mexico 87505

Mr. Clark:

On behalf of Southwest Resources Inc., Permits West, Inc. is pleased to submit this Work Plan to conduct a radiological survey a at the Section 11/12 Mine (Permit Application MK046RE) and complete a survey report. The plan represents an important milestone towards addressing agency comments and we look forward to receiving your approval of its implementation.

If you have any questions or need further clarification feel free to call my cell (below), email me at [robyn@permitswest.com](mailto:robyn@permitswest.com), or email Mike Deutsch at [mike@permitswest.com](mailto:mike@permitswest.com).

Sincerely,



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enclosures: Radiological Survey Plan for the Section 11/12 Mine

cc: George Lotspeich, Reed Easterwood, Domenici Law Firm, Mike Deutsch, Brian McMullen

# **Radiological Survey Plan for the Section 11/12 Mine**

**June 2015**

prepared for:

Permits West, Inc.  
37 Verano Loop  
Santa Fe, NM 87508

prepared by:

**ERG**

Environmental Restoration Group, Inc.  
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## Section 1.0 - Introduction

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On behalf of Southwest Resources, Inc., Permits West, Inc. (Permits West) retained Environmental Restoration Group, Inc. (ERG) to develop this work plan to provide a framework for a global positioning system (GPS)-based radiological survey of the Section 11/12 Mine, located in McKinley County, New Mexico. Figure 1 depicts the site location and survey boundary.

The scope of the radiological survey presented here is consistent with guidance in “Guidance for Meeting Radiation Criteria Levels and Reclamation at New Uranium Mining Operations” (New Mexico Mining and Minerals Division [NMMMD], 2014; and “Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico (NMMMD-New Mexico Environmental Department [NMED], 2014).

The scope of activities includes correlating gamma count rates to both exposure rates and radium-226 concentrations in surface soils. Soil sampling and analysis will be conducted by Permits West, the plan for which will be developed by Permits West.

### 1.1 Purpose of the characterization

The activities described in this work plan --combined with soil sampling and analysis-- will be conducted to establish the radiological condition of the permit area, in preparation for its reclamation and closure. Included in this framework is the survey of a background reference area (BRA) and determining potential on-site sources of materials that may be used as cover during reclamation, in accordance with NMMMD guidance (NMMMD, 2014).

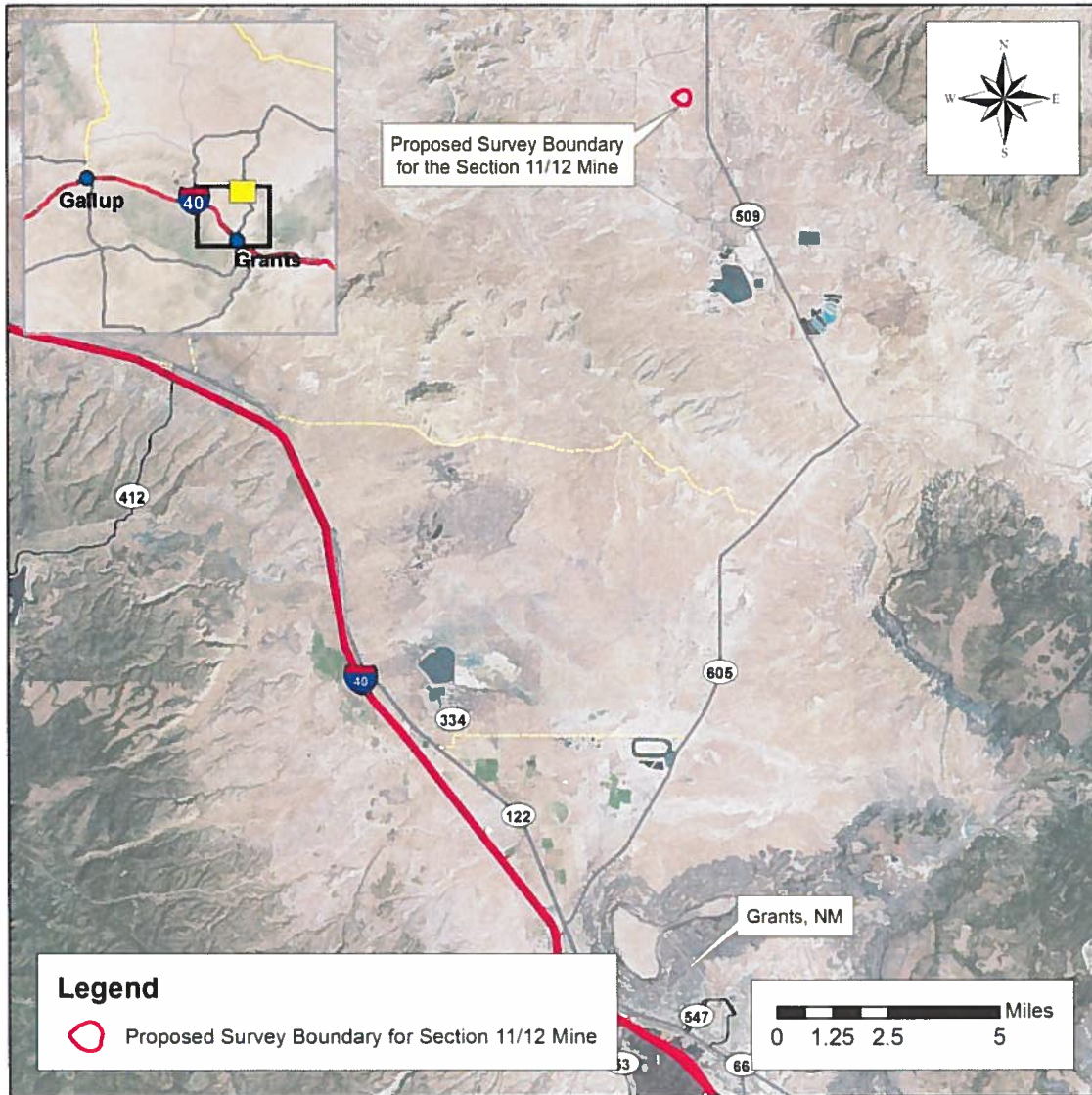
### 1.2 Areas proposed for survey

Two areas are proposed for the survey. The first is a 3-acre potential BRA, located directly north of the mine. The second is the mine area, encompassing approximately 18 acres in Township 14 North, Range 10 West, Sections 11 and 12.

The selection of the BRA will be described in the plan to be developed by Permits West.

### 1.3 Organization

The remainder of the work plan is organized as follows. Section 2 described the methods proposed for the survey. Section 3 presents the data quality objectives (DQOs). Section 4 considers quality control and quality assurance requirements for the radiation detection equipment and measurements. Sections 5 and 6 present a provisional schedule to perform the survey and references, respectively.



**Figure 1. Location of Section 11/12 Mine with Proposed Survey Boundary.**

## Section 2.0 - Methods

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### 2.1 Global Positioning System-Based Surveys

The GPS-based gamma survey will be conducted along transects spaced at 15 meters as shown on Figure 2. Transects will be added or their spacing adjusted in the field, if additional data are needed to delineate the areal extent of mine-related materials in surface soils or mineralized outcrops and access is unimpeded.

Field personnel will employ Ludlum Model 44-10 (or equivalent) 2-inch by 2-inch sodium iodide high energy gamma radiation (gamma) detectors, each coupled to a Ludlum Model 2221 ratemeter/scaler that is, in turn, coupled to a Trimble ProXH4 GPS unit and datalogger, or equivalent. Field personnel will walk transects while carrying the GPS unit and Ludlum Model 2221 in backpacks. The reference and mine areas will be surveyed at approximately 0.6 meters/second, with the detectors held at approximately 0.5 meter above the ground surface. The height of the detector may be adjusted in the field to accommodate site features; e.g., high vegetation. Gamma count rates will be recorded every second, with individual count rates tagged with associated New Mexico State Plane location coordinates.

The detection systems will be matched and calibrated to a National Institute of Standards and Technology-traceable cesium-137 check source, and function-checked daily prior to and after the work day.

### 2.2 Correlation of Gamma Count and Exposure Rates

Exposure rate measurements will be correlated to co-located, static (integrated) gamma count rates measured using the same geometry and detection systems used in the gamma survey. Selection of the number (nominally ten) and locations of the correlation measurements will be based on the range of gamma count rates observed in the GPS-based gamma survey.

The exposure rate measurements will be made using a Reuter Stokes Model RSS-131 High Pressurized Ion Chamber (HPIC), or an equivalent detector. The base of the instrument will be set a one meter above ground surface.

The HPIC responds to ionizing radiation by collecting all charges created by direct ionization within the detector gas through the application of an electric field. The HPIC measures energy deposited by gamma-rays, x-rays, and cosmic radiation without discrimination. It is highly stable, relatively energy independent, and serves as an excellent tool to calibrate (in the field) other survey equipment to measure exposure rates.

The paired gamma count and exposure rate measurements will be correlated using the regression analysis feature of JMP Statistical Software, MS Excel, or equivalent. The count rate measurements from the gamma survey will be converted to predicted exposure rates, using this correlation. A permit area-wide map of the predicted exposure rates will be produced showing exposure rates. This map will be invaluable at the time of mitigation, if any, since it will be independent of the type of gamma radiation detector that will be used to guide mitigation.

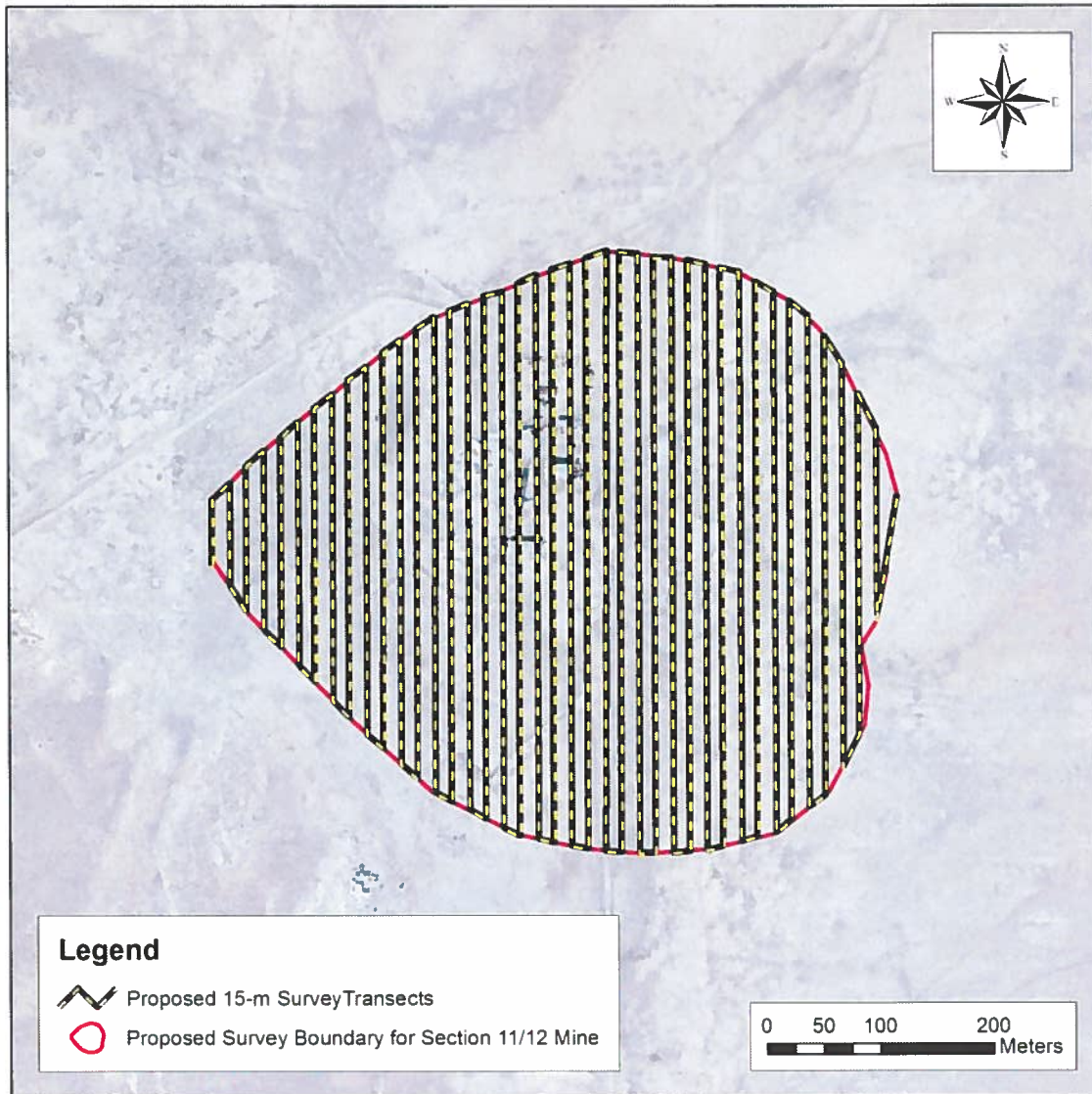


Figure 2. Proposed survey transects in the Mine Permit Area.

### 2.3 Correlation of Gamma Count Rates and Radium-226 Concentrations in Surface Soil

Radium-226 concentrations in surface soils (0 to 6 inches below ground surface) will be correlated to gamma count rates measured using the same geometry and detection systems used in the gamma survey. Co-location, in this case, is defined as a 100 square meter (m<sup>2</sup>) area in which count rates will be recorded in 1-m transects and surface soil samples are collected as a 5-point composite, as described in the plan to be developed by Permits West.

Selection of the number (nominally ten) and locations of the 100 m<sup>2</sup> areas will be based on the range of gamma count rates observed in the GPS-based gamma survey.

The paired gamma count rate and radium-226 concentrations will be correlated using the regression analysis feature of JMP Statistical Software, MS Excel, or equivalent. The count rate measurements from the gamma survey will be converted to predicted radium-226 concentrations, using this correlation. A permit area-wide map of the predicted exposure rates will be produced showing exposure rates. This map will be invaluable at the time of mitigation since it is independent of the type of gamma radiation detector that will be used to guide mitigation.



## Section 3.0 - Quality Assurance/Quality Control

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### 3.1 Data Objectives

Data quality objectives (DQO's) are statements that define the type, quality, quantity, purpose, and use of the data to be collected. The data objectives in this document are intended to ensure the collection of data in the project area to:

1. Effectively assess gamma count rates in the project area.
2. Establish the background radiation condition that is representative of the project area.

The DQO steps that are applicable to the gamma radiation survey of the permit area are:

- Problem statement: Gamma radiation emissions from the land surface will be characterized, to prepare for mitigation and closure.
- Identify the decision: The principle study question is what are the distributions of gamma count rates in the BRA and mine permit areas and their relationship? The secondary question is 1) what are the distributions of predicted exposure rates and radium-226 concentrations in surface soils in the mine permit area?
- Identify inputs to the decision: Inputs to the decision are gamma count rates and co-located exposure rate measurements and radium-226 concentrations in surface soils in the permit area.
- Define the boundaries of the study: The boundary of the study is the BRA and mine permit area. The boundary of the latter may expand to include elevated gamma count rates, if any
- Develop a decision rule: The decision rule is whether gamma count rates in the mine permit area exceed those in the BRA.
- Develop the plan for obtaining the data: The plan to obtain the data is given in Section 2.0 of this work plan.

### 3.2 Field Procedures and Instruction

Standard procedures and instructions will apply to quality-impacting activities, materials, and equipment. In general, procedures will follow ERG standard operating procedures (SOPs) and ASTM International (ASTM) standards.

These include:

SOP Number	Title
SOP 1.01	Calibration of Scaler/Ratemeter
SOP 1.04	High Energy Gamma Scintillation Calibration and Checkout
SOP 1.13	PIC Setup and Operation
SOP 1.30	Function Check of Equipment
SOP 4.10	Technical Quality Control
SOP 5.11	Setup and Operation of Trimble ProXH4 GPS Receiver with Trimble Datalogger
SOP 5.12	Download, Correction, and Export of GPS Survey Data
SOP 5.13	Performing GPS Radiological Survey by Vehicle (applies to walking surveys)

Notes:

SOP = Standard Operating Procedure

ERG SOPs are provided in Appendix A.

### 3.3 Personnel Qualifications

Project technical field personnel will meet or exceed the minimum requirements for their assignments through formal education, experience, and project-specific training. They will have the necessary training in the specific data collection, surveying, sampling, sample handling, and site-specific safety procedures required for their respective assignments on this project. A field manager will be in charge of directing the survey efforts.

### 3.4 Sample Documentation, Handling and Custody Requirements

#### 3.4.1 Field Documentation

Two forms of field documentation will be maintained: (1) field data sheets and (2) field logbook.

A three-ring binder or folder that holds field data sheets that includes but is not limited to instrumentation function and calibration sheets will be maintained onsite during the survey. Any deviations from standard protocols or notable events (e.g., rainy weather, etc.) should be entered in the section for "Notes". The field manager will sign the form when the survey is complete and all data are entered onto the forms.

Information contained in the field logbook will be recorded daily and include the following:

- Survey date
- Personnel
- Weather Conditions
- Daily start time
- Description of daily activities
- Description of deviation from SOPs
- Signature of data recorder

### 3.4.2 Record Keeping

Following completion of the project, ERG will consolidate and maintain all original log books, field data sheets, and any other information required to document and support the findings of the survey, unless otherwise directed by Permits West.

### 3.5 Instrument/Equipment Testing, Inspection and Maintenance Requirements

#### 3.5.1 Field Equipment

Field equipment planned for use during the survey will be inspected daily to ensure they remain in good working condition. Information relating to calibration, maintenance, and the daily instrument/equipment inspection will be documented on appropriate forms or in the field logbook.

### 3.6 Instrument Calibration and Frequency

Field radiation detection equipment will be calibrated prior to the start of the work and recalibrated annually, if required. Function checks will be performed each day, prior to and following the use of the instrument in accordance with procedures outlined in the respective SOPs.

### 3.7 Data Management

All data will be entered into a project-specific database by appropriately trained staff. The data entered into the database will include all relevant field information regarding the measurements made as part of the survey. All data entries will be reviewed and validated for accuracy by the project manager or his/her delegate. All original data records (both hard copy and electronic) will be cataloged and stored in their original form until otherwise directed by Permits West.

## Section 4.0 - Reporting

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A designee of Southwest Resources will prepare a report of the survey that contains the following:

- A statistical summary of the gamma count rates;
- A discussion of the regression analysis of gamma count and exposure rates;
- A discussion of the regression analysis of gamma count rates and radium-226 concentrations in surface soils;
- Statistical summaries of the predicted exposure rates and radium-226 concentrations in surface soil; and
- Maps depicting predicted exposure rates and radium-226 concentrations in surface soil.

## Section 5.0 - Proposed Schedule

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The schedule of the work will be as follows:

- Gamma Surveys: Expected to take 7 work days to complete.
- Correlation studies: Expected to take 2 work days to complete.
- Report Preparation: Expected to take 14 days following receipt of the soil analytical results from Permits West.

## Section 6.0 - References

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NMMMD, 2014. Guidance for Meeting Radiation Criteria Levels and Reclamation at New Uranium Mining Operations, Title 19, Chapter 10, Part 3 and Part 6, New Mexico Administrative Code, Draft, April.

NMMMD- NMED, 2014. Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico. March.