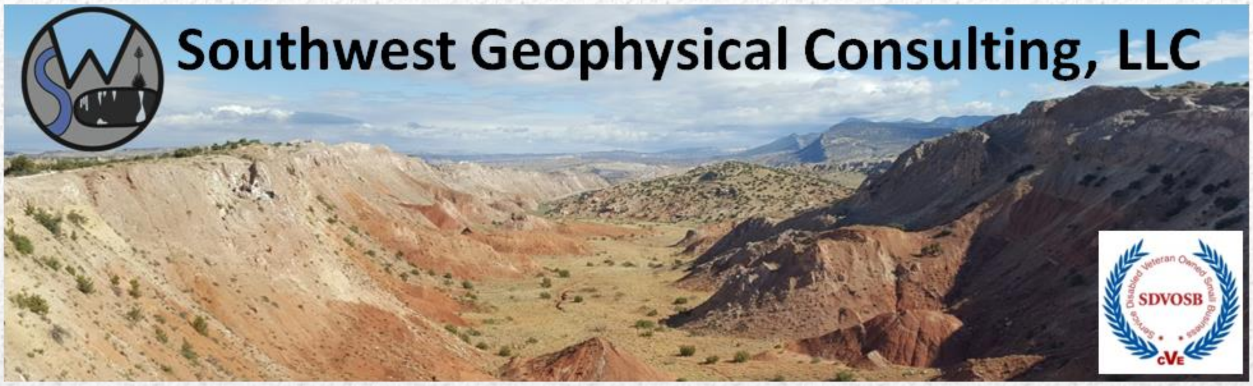


# 3D Electrical Resistivity Imaging Report

## Waterbridge Boardwalk Recycle Containment Pond

## Eddy County, New Mexico

**Prepared For:**

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

- ☐ **Positive**
    - ☐ **Avoidance Recommended**
    - ☐ **Realignment Not Required**
- ☑ **Negative**
- ☐ **Karst Monitor Recommended**

**January 17, 2024**

PW-305-20241204

**Published by:**
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**MMXXV**

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## 1.0 INTRODUCTION

This report was commissioned by Permits West, Inc. (hereinafter referred to as "the client"), on June 13, 2024, for the purpose of determining the existence of any voids within the boundaries of the Waterbridge Boardwalk Recycle Containment Pond project site (hereinafter termed “WBRC”) centered at N 32.618862° W 104.132518°using electrical resistivity imaging.

### *1.1 Goals of this Study*

To provide the client with the location and depth of any anomalies that can be interpreted as voids located within the survey boundary provided by the client on December 4, 2024 (**WaterBridge Boardwalk Recycle Footprint 12.04.kmz**), and within the parameters of the designed study using electrical resistivity imaging for the purpose of determining the feasibility of placing a pad at this location.

### *1.2 Summary of Findings*

**No shallow anomalies interpreted as possible voids or related karst features were found within the WBRC survey area**. See section **3.0 RESULTS** and **4.0 DISCUSSION** for more information.

### *1.3 Affected Environment*

The WBRC project is located in evaporite karst terrain, a landform that is characterized by underground drainage through solutionally enlarged conduits. Evaporite karst terrain may contain sinkholes, sinking streams, caves, and springs. Sinkholes leading to underground drainages and voids are common. These karst features, as well as occasional fissures and discontinuities in the bedrock, provide the primary sources for rapid recharge of the groundwater aquifers of the region. Additionally, karst may develop by hypogene processes involving dissolution by upwelling fluids from depth independent of recharge from the overlying or immediately adjacent surface. Hypogene karst systems may not be connected to the surface and can remain undiscovered unless encountered during drilling or excavation.

Karst features are delicate resources that are often of geological, hydrological, biological, and archeological importance, and should be protected. The four primary concerns that need to be considered in these types of terrain are environmental issues, worker safety, equipment damage, and infrastructure integrity.

The Bureau of Land Management (BLM) categorizes all areas within the Carlsbad Field Office (CFO) zone of responsibility as having either low, medium, high, or critical cave potential based on geology, occurrence of known caves, density of karst features, and potential impacts to freshwater aquifers[1]. The New Mexico State Land office also recognizes these categories. This project occurs within a **HIGH** karst occurrence zone [2] (HKOZ) (**Figure 1**).

A high karst occurrence zone is defined as an area in known soluble rock types that contains a high frequency of significant caves and karst features such as sinkholes, bedrock fractures that provide rapid recharge of karst aquifers, and springs that provide riparian habitat[1].

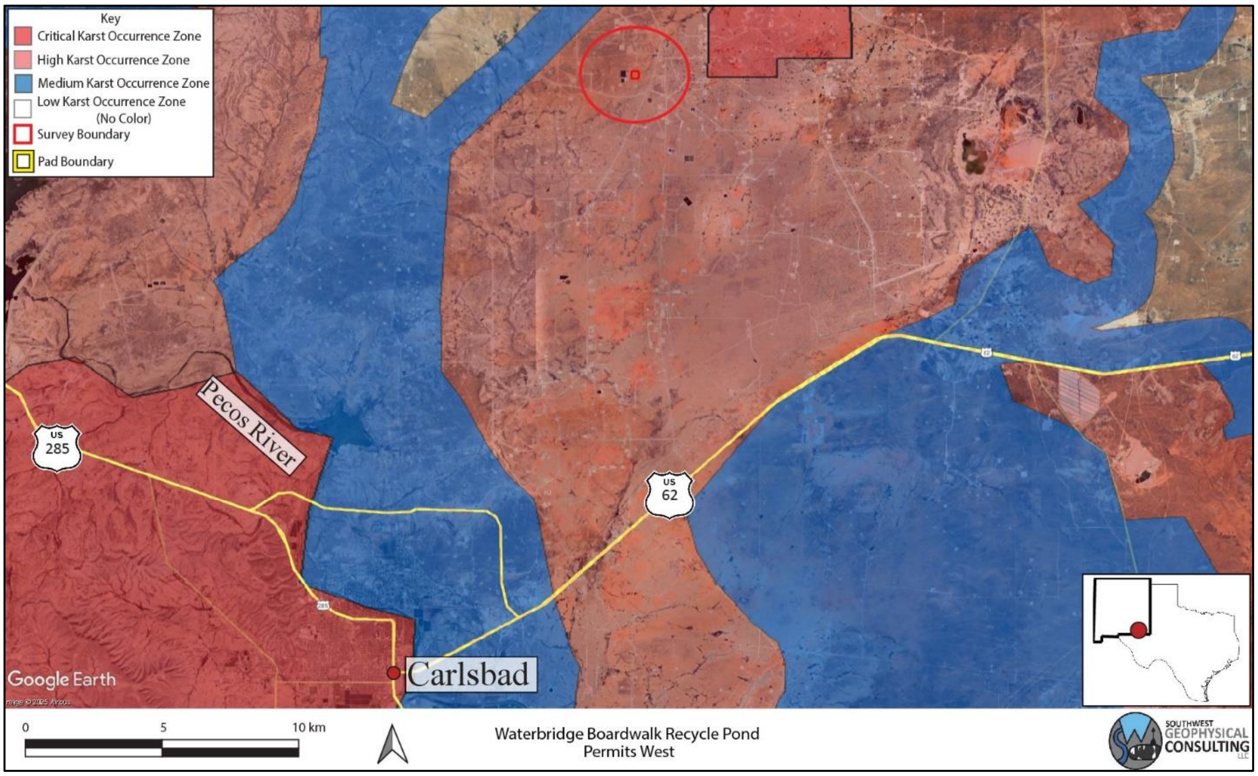


**Figure 1: Karst occurrence zone overview. Background image credit: Google Earth. Image date: July 13, 2024. Image datum: WGS-84.**

### *1.4 Limitations of Report*

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report has been prepared for the use of Permits West, Inc., in accordance with generally accepted consulting practices. Every effort has been made to ensure the information in this report is accurate as of the time of its writing. This report has not been prepared for use by parties other than the client, their contracting party, and their respective consulting advisors. It may not contain sufficient information for the purposes of other parties or for other uses.

This report was prepared upon completion of the associated fieldwork using a standard template prepared by Southwest Geophysical Consulting and is based on relevant information collected prior to fieldwork, conditions encountered on-site, and data collected during the fieldwork, all of which was reviewed at the time of preparation. Southwest Geophysical Consulting disclaims responsibility for any changes that might have occurred at the site after this time. The interpreted results, locations, and depths noted in this report (if applicable) should be taken as an interpretation only and no decision should be based solely on this information. Physical verification of geophysical results using geotechnical methods should be considered.

To the best of our knowledge, information contained in this report is accurate at the date of issue; however, conditions on the site can change in a limited time and, therefore, the information in this report shall not be used beyond three years past the date of the data collection (see section ***2.3 Description of Survey***).

## 2.0 LOCATION AND DESCRIPTION OF STUDY AREA

### *2.1 Description of Site*

The site is located 24.0 kilometers (14.0 miles) northeast of Carlsbad, New Mexico, south of the junction of Buckskin and Curry Comb Roads, west of Buckskin Road, and within the NW ¼ section of section 36, NM T19S R28E[3] (**Figure 1** and **Figure 2**). This area is locally known as Burton Flats. The region has flat terrain with heavy karstification occurring in the gypsite soils and underlying gypsum bedrock [4] (see section ***2.2 Local Geology Summary*** for further information). The region is semi-arid with an average annual precipitation of approximately 13 inches, of which about two-thirds falls as rain during summer thunderstorms from June to October. Summers are hot and sunny while winters are generally mild, with an average maximum temperature of 96°F in July and an average minimum temperature of 28°F in January[5]. There are over twenty-five documented *surface* karst features located within 2.0 kilometers (1.2 miles) of the site[6]. This area is within the Chihuahuan Desert Thornscrub as defined by the Southwestern Regional ReGAP Vegetation map[7] and the vegetation consists mostly of areas of blue grama, nine-awned pappus grass, burro grass and low scrub including yucca. The entire survey site is located within an HKOZ[2] (**Figure 1**) and within privately managed land[8] (**Figure 2**).

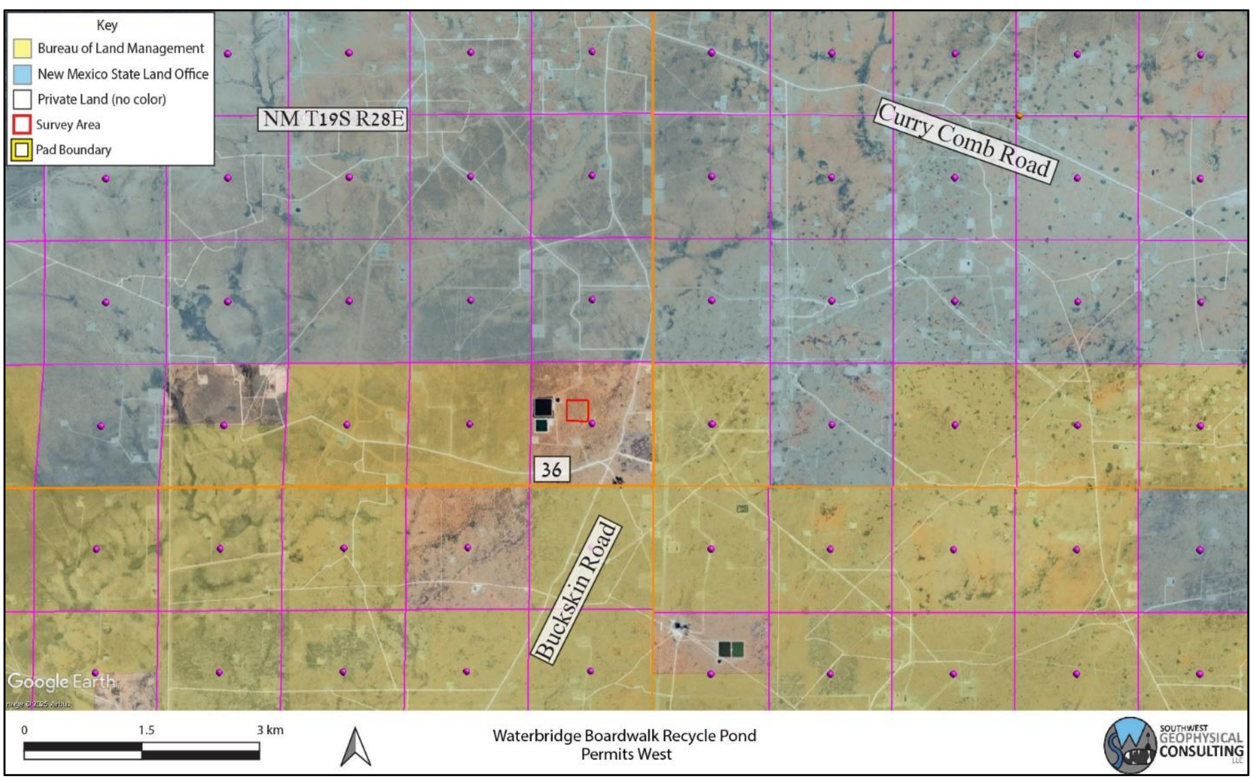


**Figure 2: Land ownership and PLSS overview. Background image credit: Google Earth. Image date: July 13, 2024. Image datum: WGS-84.**

### *2.2 Local Geology Summary*

The survey site for the WBRC project is located at an elevation of 1,005 meters (3,297 feet), ± 2 meters (6.5 feet), and is located within a region underlain by the Permian Rustler Formation (Pru). The area is mantled by thin gypsiferous soils (gypsite), Quaternary alluvium (Qal), eolian sands (Qe), and piedmont alluvial gravels (Qp)[9] up to 5 meters in depth (**Figure 3**).

The Rustler Formation is an evaporite facies and is composed mainly of thin siltstones and sandstones interbedded with claystones, dolomite and gypsum[10], and contains both karst-forming strata (the Forty-niner and Tamarisk members) and two shallow aquifers (the Magenta and Culebra Dolomite members)[11].

The Pru overlies the Permian Salado Formation (Psl – not shown), a layer of extremely soluble halite which can readily dissolve to create caves, sinkholes, and other karst features; however, due to its extremely soluble nature, only non-soluble silt and sand remain from the dissolution of this layer at the surface. The Rustler Formation may be subject to collapse if a void has developed beneath it in the Salado Formation[10].

The survey area is covered by the easily accessible Geologic Map of New Mexico (2003) at 1:500,000 scale[9] and the Digital Geologic Map of New Mexico in ARC/INFO Format[12].

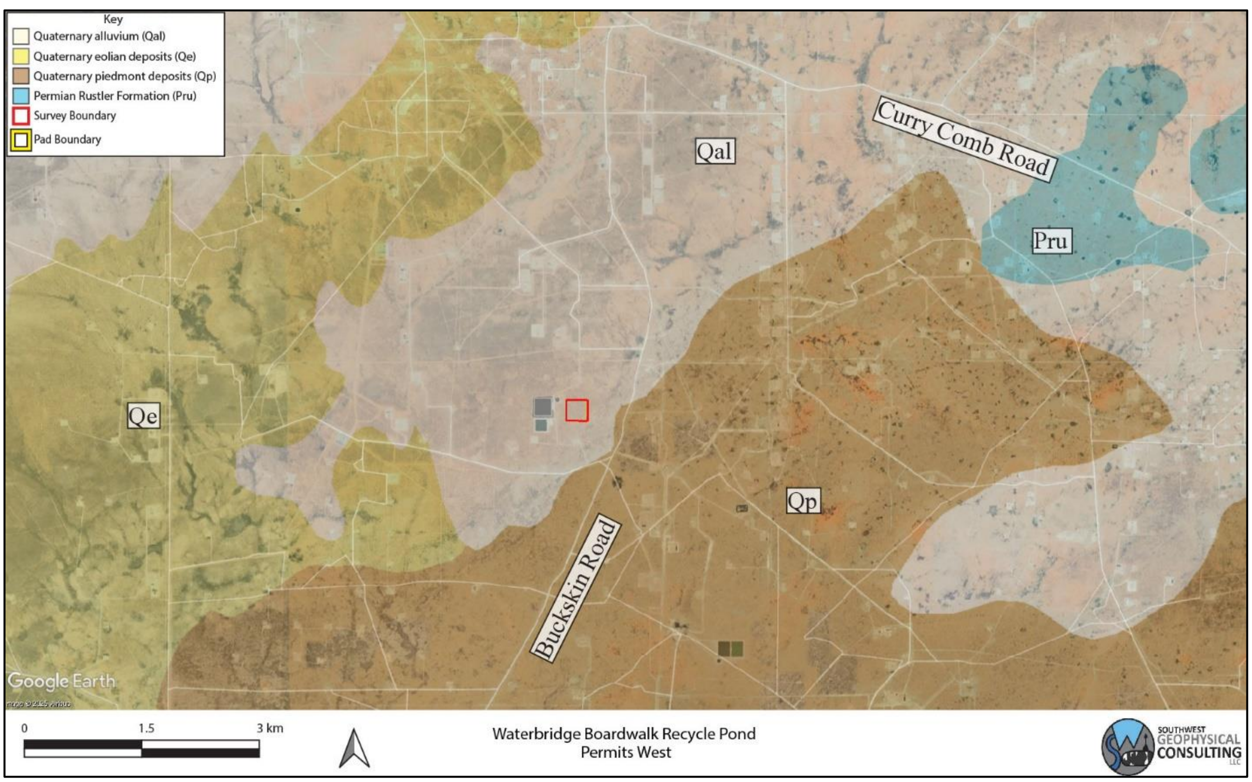


**Figure 3: Geology overview. Map credit: The Digital Geologic Map of New Mexico in ARC/INFO Format, and Google Earth. Image date: July 13, 2024. Datum: WGS-84.**

### *2.3 Description of Survey*

For this survey, an Advanced Geosciences Inc. (AGI) SuperSting™ Wifi R8 with an 8-channel switchbox, a 56-electrode array of 40-centimeter-long (1.3 feet) stainless-steel electrodes, and a tablet controller were used to image the subsurface. The pad boundaries provided by the client were used to plan the resistivity arrays and define the survey boundaries. The WBRC survey consisted of 28 resistivity lines in a dipole-dipole configuration laid out in a west-east array at 5-meter electrode spacing, with lines spaced 10 meters apart from south to north, resulting in a 270-meter-wide, 275-meter-long array. The total number of electrodes placed was 1,568. The total combined length of this survey was 7.84 kilometers (4.87 miles); the total area covered was 0.08 square kilometers (19.1 acres) (**Figure 4**, **Table 1**, and **APPENDIX 8.2**).

A preconfigured command file was used to run the data collection (DiDi56) which consisted of a dipole-dipole survey. This electrode configuration provided a depth of investigation of up to 55 meters (180 feet) in this location at a resolution of 2.5 to 3.0 meters (8.3 to 9.8 feet) near the surface. A Leica GS18 GPS was used to record electrode locations and elevations. On this survey, the estimated horizontal error mean was 7 cm (2.75 inches) and the estimated vertical error mean was 12 cm (4.7 inches).

**APPENDIX 8.2** provides a detailed list of each electrode number, location in latitude/longitude (decimal degree format), and elevation in meters. **APPENDIX 8.4** provides the 2D inverted resistivity section images for each of the survey lines. EarthImager™ 2D and EarthImager™ 3D software were used to download and process the data and to provide the model used to make our interpretations (**Table 2**). A typical starting model was used for the data processing due to the two-layer model of the geology in the area; specifically, generally high-resistivity gypsum and dolomite at the surface and low-resistivity saturated gypsum and dolomite bedrock at depth. The starting model used was "average apparent resistivity" and a default inversion setting of "surface," with a minimum apparent resistivity set to 0.1 Ohm-meters (Ohm-m or Ω-m) and a max apparent resistivity set to 100,000 Ω-m (**Table 2**).

The field work for the WBRC survey was completed over a three-day period by Garrett Jorgensen Olague, Britt Bommer, and Steven Kesler on January 6 – 9, 2025, with Monday, January 6, as a travel, set up, and survey day and Thursday, January 9, as a survey, stow, and travel day.

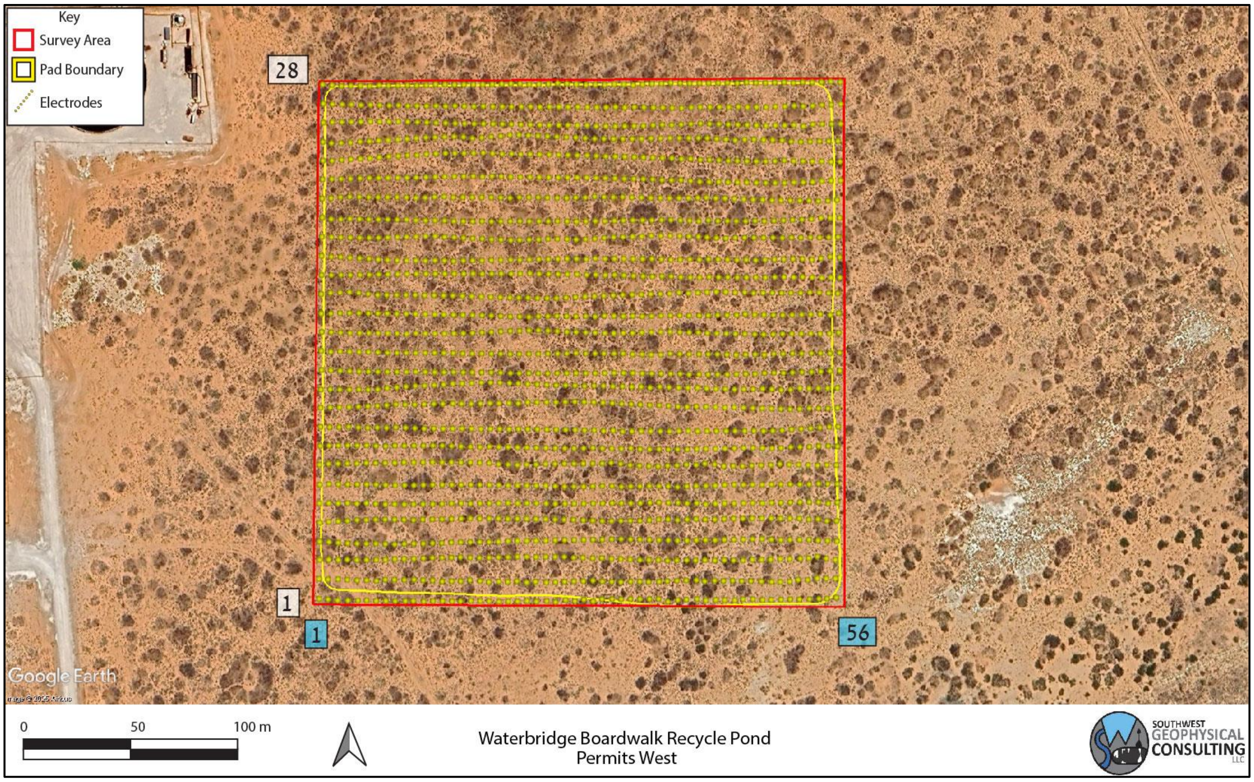


**Figure 4: Survey overview. Twenty-eight survey lines (numbered from south to north, in a white background) were conducted at 10-meter spacing, with 56 electrodes at 5-meter electrode spacing (yellow dots, numbered from west to east in a blue background). Background image credit: Google Earth. Image date: July 13, 2024. Image datum: WGS-84.**

## 3.0 RESULTS

Electrical resistivity tomography forms images of the subsurface by causing a current to flow through the rock and soil and then measuring the resistance of these materials as the current flows through them. This measurement is taken many times and the resulting data, once processed, is used to produce a model of the subsurface (**Figure 5** and **Figure 6**). This model is produced using "non-unique" solutions, which means that there are many models and interpretations which will satisfy the data. Using experience and knowledge of the local geology, a high-confidence model can be established and used to develop an accurate understanding of what lies below the surface. This survey was conducted with the express purpose of locating subsurface voids and does not purport to find paleokarst (old, non-active karst features that have been filled in with sand and sediment) or nascent karst features below the resolution limit of the survey.

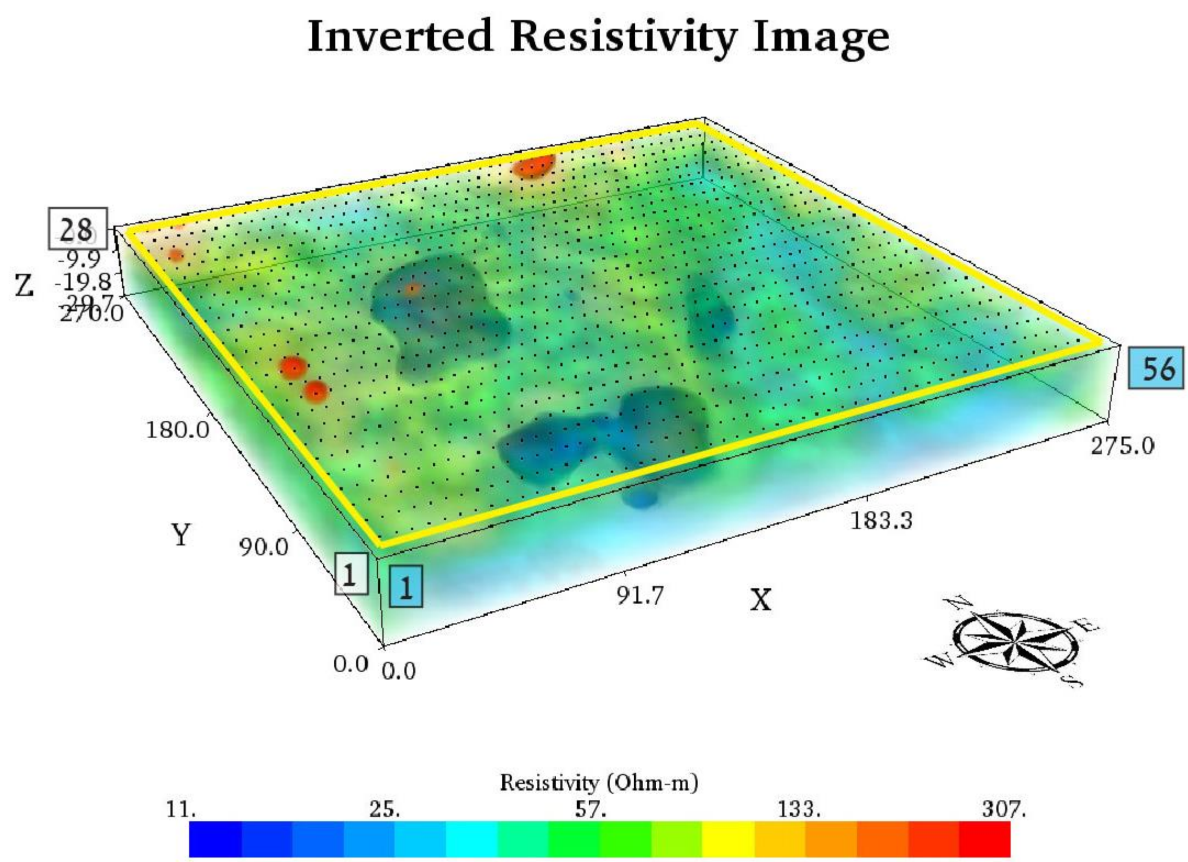


**Figure 5: WBRC lines 1 through 28 electrical resistivity oblique 3D volume view showing highest and lowest resistivities. Reds and oranges: higher resistivity. Blues: lower resistivity. Black dots are electrode locations. Red polygons highlight high-resistivity anomalies. Yellow polygon is the proposed pad boundary. Please see APPENDIX 8.3 for more details.**

The results of this study for both 3D (**Figure 5** and **APPENDIX 8.3**) and 2D (**Figure 6** and **APPENDIX 8.4**) indicate a well-layered geologic system with moderate resistivities between 5 and 800 Ohm-m with occasional areas of up to 2,850 Ohm-m.

The 2D inverted resistivity images used to produce the 3D volumes are found in **APPENDIX 8.4** and are also included as a data set (see **WBRC_2D_IRS_ images.zip**). Please keep in mind when viewing the 2D inverted resistivity sections that color maps can be widely different for each view. Always check the color map located on the right side of the image when viewing the 2D images to ensure you understand the range of resistivities presented. Distances along the top and depths along the left side are in meters. The color map along the right side is in Ohm-m. Due to the nature of the survey, shallower zones have higher resolution between electrodes than deeper zones; therefore, small features at depth will not be visible.

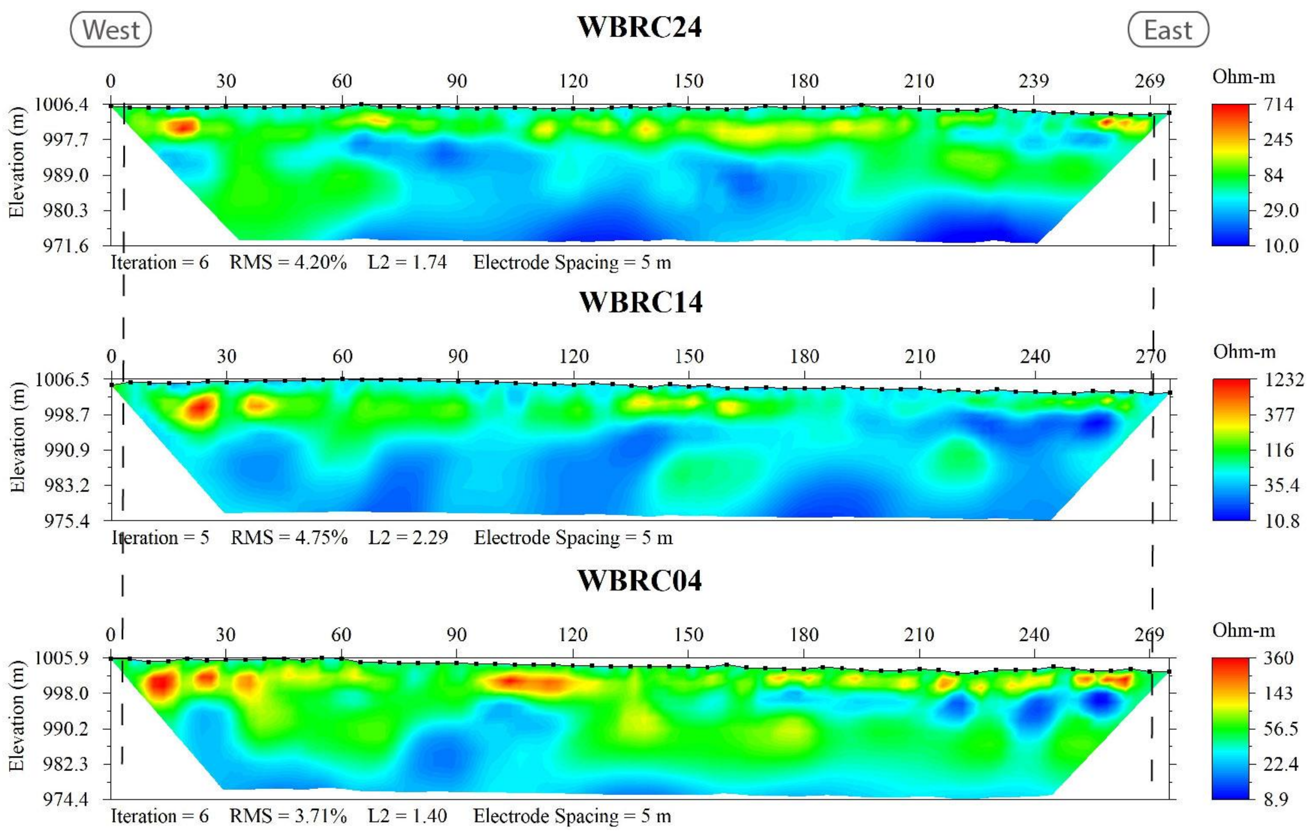


**Figure 6: 2D inverted resistivity sections (WBRC04, WBRC14, WBRC24). Reds and oranges indicate higher resistivity values. Yellows and greens are medium resistivity values. Blues are low resistivity values. The upper reds and yellows are most likely caliche and gypsite soils or dolomite. Deeper reds and oranges are likely dolomite or sandstone lenses. Blues are likely to represent clays or halite lenses, or saturated layers, in the Rustler Formation. Black dashed lines indicate the western and eastern pad boundaries. See APPENDIX 8.4 for the full set of lines collected during this survey.**

## 4.0 DISCUSSION

No anomalies interpreted as large near-surface voids are located within the survey area (**Figure 7**). Higher-than-average resistivity areas located less than 10 meters beneath the surface are interpreted as dry caliche or dolomite bedrock; however, there may be small voids at or near the resolution limit of the survey (2.5 – 3.0 meters). Due to their low resistivity values when compared with significant subsurface voids, these features should not be a concern for construction of any well pad infrastructure. Areas of moderate resistivity (yellows and greens) near the surface are interpreted as dolomite bedrock of the Rustler Formation[4] (**Figure 5** and **Figure 6**).

The overall interpretation for this location indicates that intercepting a significant void in the area of the proposed pad between the surface and 3 meters (10 feet) depth during pad construction is unlikely. Due to the resolution limit of the survey, other small voids at or near the resolution limit (2.5 – 3.0 meters) cannot be ruled out and are quite common in this area.

Resistivity of the survey area drops below 15 Ω-m at approximately 15 meters (49 feet) depth throughout the survey area, indicating a change from dry caliche/gypsite soils or dolomites of the Rustler to a clay or halite layer or a saturated medium within the Rustler.

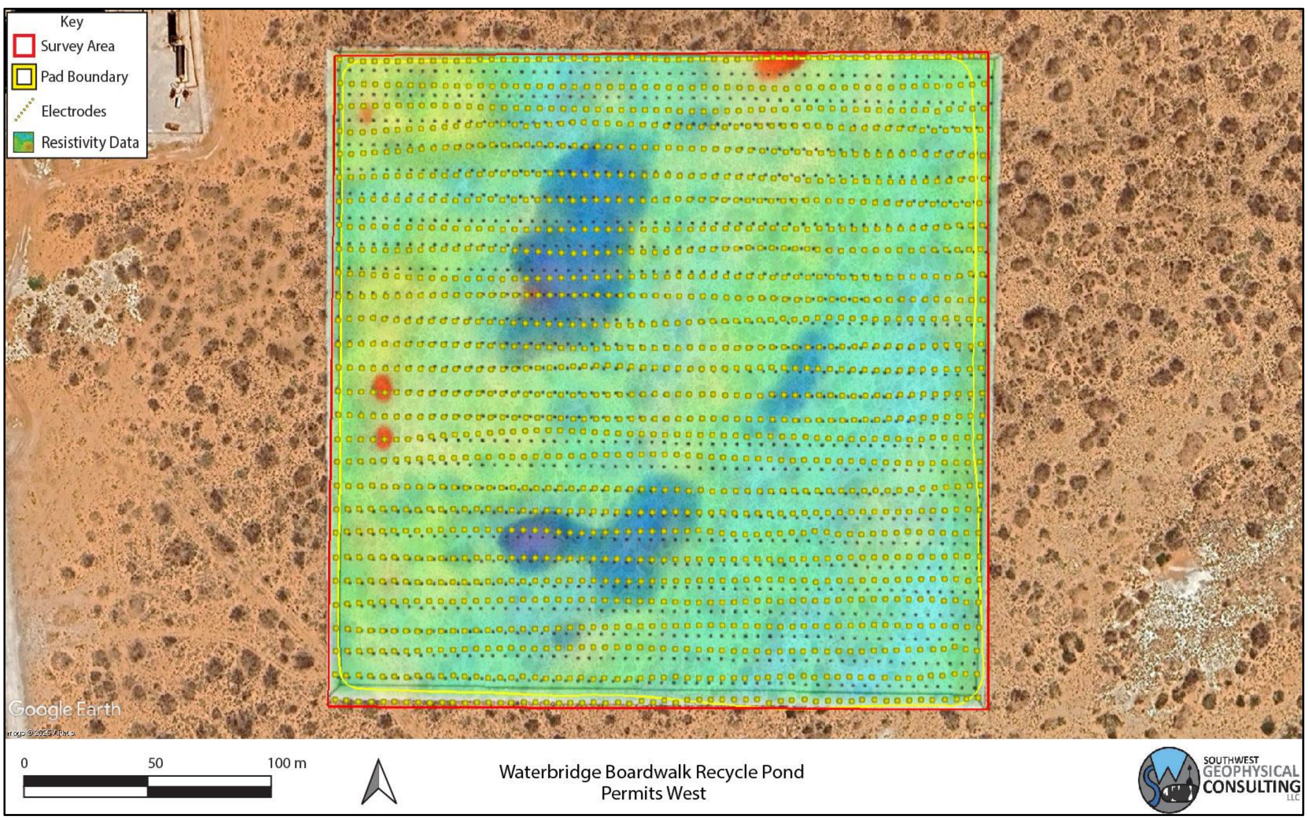


**Figure 7: WBRC map view. Background image credit: Google Earth. Image date: July 13, 2024. Image datum: WGS-84.**

Within karst terrains like the project site, small air- or sediment-filled voids and/or brecciated zones and solutionally enlarged fractures that are below the resolution limit of the survey may exist; these may be encountered during excavation and if so, should be evaluated by a karst specialist prior to continuation of the excavation. Employing a BLM-CFO approved karst monitor on site during excavation in this area should be considered.

## 5.0 SUMMARY

### *5.1 Recommendations*

- The WBRC survey area contains no shallow anomalies interpreted as large voids or related karst features.
- Intercepting a small void or solutionally enlarged fracture below the resolution limit of the survey during pad construction is unlikely, but still possible.
- Employing a BLM-CFO approved karst monitor on site to evaluate any features encountered during brush clearing and grading should be considered. Construction activities may reactivate paleo-sinkholes and small voids may appear at the surface suddenly as settling occurs or after heavy rains.

### *5.2 Best Practices*

This area is prone to rapid karst formation and warrants careful planning and engineering to mitigate karst-forming processes that could be accelerated by poor design considerations. Proper engineering of these facilities following karst guidelines should be implemented during both excavation and construction. Mitigation measures for any karst features revealed during excavation shall be approved by the BLM-CFO karst specialist and follow the Natural Resources Conservation Service Conservation Practice Standard for Karst Sinkhole Treatment, Code 527, or the Bureau of Land Management Cave and Karst Management Handbook, H-8380-1.

**Keep in mind that any flow of gypsum-undersaturated waters into a small crack or crevice can rapidly dissolve the surrounding gypsum and cause catastrophic failure of any impoundment or infrastructure within a matter of months to a few years. It is imperative that any dikes, buffers, or liners installed are checked regularly for integrity, with repairs made immediately upon discovery of failure.**

Vigilance during construction is paramount. If voids are encountered during excavation, contact the Bureau of Land Management Karst Division at (575) 234-5972, the New Mexico State Land Office Surface Resources Division at (505) 827-5768, or a BLM-CFO approved karst contractor and request an on-site investigation from a karst expert if one is not already on site. A karst consultant can generally be available in Eddy County within five hours. Monitoring services, as well as cave surveys and geophysical surveys, are available from Southwest Geophysical Consulting.

Approved karst monitors should have karst feature identification training, at least two years of supervised experience identifying karst features, wilderness first aid training, SRT training, confined space training, gas monitor training, and a minimum of SPAR cave rescue training through NCRC. They should have with them the proper gear and be prepared both physically and mentally to enter a collapse feature within minutes to perform a rescue if needed. Monitoring services with qualified karst monitors, as well as cave surveys and geophysical surveys, are available from Southwest Geophysical Consulting.

Under no circumstances should an untrained, inexperienced person enter a cave, pit, sinkhole, or collapse feature. All field employees of Southwest Geophysical Consulting have extensive caving experience and the ability to determine whether entry into a karst feature is safe or presents a hazard. In the event it is necessary to enter a karst feature, Southwest Geophysical Consulting can provide these services on request.

Cave and karst resource inventory reports, karst feature investigations, and geophysical reports commissioned at the request of the land manager should be submitted to:

BLM-CFO: blm_nm_karst@blm.gov

NMSLO: Project manager requesting the report.

## 6.0 REFERENCES


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## 7.0 ATTESTATION

**David D. Decker, PhD, PG, CPG**
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5117 Fairfax Dr. NW
Albuquerque, NM 87114
dave@swgeophys.com
(505) 585-2550

**CERTIFICATE OF AUTHOR**

I, David D. Decker, a Licensed Professional Geologist and a Certified Professional Geologist, do certify that:

- I am currently employed as a consulting geologist in the specialty of caves and karst with an office address of 5117 Fairfax Dr. NW, Albuquerque, NM, USA, 87114.
- I graduated with a Master of Science in Applied Physics with a specialization in Sensor Systems from the Naval Post Graduate School in Monterey, California, in 2003, and a Doctor of Philosophy in Earth and Planetary Sciences from the University of New Mexico, Albuquerque, New Mexico, in 2018.
- I am a Licensed Professional Geologist in the State of Texas, USA (PG-15242) and have been since 2021. I am a Certified Professional Geologist through the American Institute of Professional Geologists (CPG-12123) and have been since 2021.
- I have been employed as a geologist continuously since 2016. I was previously employed as a Fire Controlman, Naval Flight Officer, and Aerospace Engineering Duty Officer in the U.S. Navy and operated, maintained, and installed various sensor systems including magnetic, electromagnetic, radar, communications, and acoustic systems in various capacities from 1986 through 2010.
- I have been involved in various aspects of cave and karst studies continuously since 1985, including exploration, mapping, and scientific studies.
- I have read the definition of “qualified karst professional” set out in the ASTM Standard Practice for Preliminary Karst Terrain Assessment for Site Development (ASTM E-1527). I meet the definition of “qualified professional” for the purposes of this standard.
- I am responsible for the content, compilation, and editing of all sections of report number PW-305-20241204 entitled, “3D Electrical Resistivity Imaging Report, Waterbridge Boardwalk Recycle Containment Pond, Eddy County, New Mexico.” I or a duly authorized and qualified representative of Southwest Geophysical Consulting, LLC, have personally visited this site on the date or dates mentioned in section ***2.3 Description of Survey***.

- I have no prior involvement nor monetary interest in the described property or project, save for my fee for conducting this investigation and providing the report.

Dated in Albuquerque, New Mexico, January 28, 2025.

David D. Decker
PhD, CPG-12123

## 8.0 APPENDICES

### *8.1 Glossary of Terms*

| | |
|---|---|
| ACEC | Area of Critical Environmental Concern |
| AGI | Advanced Geosciences Inc. |
| BLM-CFO | Bureau of Land Management - Carlsbad Field Office |
| brecciated | Fractured rock caused by faulting or collapse. |
| caprock-collapse sinkhole | Collapse of roof-spanning rock into a cave or void. |
| cave | Natural opening at the surface large enough for a person to enter. |
| cover-collapse sinkhole | Collapse of roof-spanning soil or clay ground cover into a subsurface void. |
| ERI | Electrical Resistivity Imaging |
| GPS | Global Positioning System |
| grike | A solutionally enlarged, vertical, or sub-vertical joint or fracture. |
| HKOZ | High Karst Occurrence Zone |
| InSAR | Interferometric Synthetic Aperture Radar. A method by which radar signals from satellites are processed to determine the amount and rate of subsidence of an area as well as whether the area is actively subsiding. |
| karst | A landscape containing solutional features such as caves, sinkholes, swallets, and springs. |
| LED | Locally enclosed depression. A natural depression on the surface that collects rainwater. Some contain swallets and/or caves, others do not. |
| LKOZ | Low Karst Occurrence Zone |
| MKOZ | Medium Karst Occurrence Zone |
| NCRC | National Cave Rescue Commission |
| NKF | Non-karst feature. Used for features originally identified as PKF that have been subsequently identified in the field as non-karst related. This term may also be used for pseudokarst features. |
| NMSLO | New Mexico State Land Office |
| Ohm-m | Ohm-meter, a unit of measurement for resistivity. Also sometimes abbreviated Ω-m. |
| paleokarst | Previously formed karst features that have been filled in by erosion and/or deposition of minerals. |
| Pat | Permian Artesia Group |
| Pc | Permian Capitan Formation |
| Pcs | Permian Castile Formation |

| | |
|---|---|
| Pdl | Permian Dewey Lake Formation |
| PKF | Possible karst feature. This term is reserved for features identified in satellite or aerial imagery that have NOT been visited in the field. Further modifiers include (H) for high confidence, (M) for medium confidence, and (L) for low confidence. These confidence levels are based on field experience. |
| PLSS | Public Land Survey System |
| Pqg | Permian Queen/Greyburg Formation |
| Pru | Permian Rustler Formation |
| Psl | Permian Salado Formation |
| Psr | Permian Seven Rivers Formation |
| Pt | Permian Tansill Formation |
| Py | Permian Yates Formation |
| pseudokarst | Karst-like features (sinkholes, conduits, voids etc.) that are not formed by dissolution. These types of features include soil piping, lava tubes, and some cover-collapse and suffosion sinkholes. |
| Py | Permian Yates Formation |
| Qal | Quaternary alluvium |
| Qe | Quaternary eolian deposits |
| Qp | Quaternary piedmont deposits |
| Qpl | Quaternary playa lake deposits |
| RKF | Recognized karst feature. This term is reserved for karst features that have been physically verified in the field. |
| SKF | Surface Karst Feature |
| SPAR | Small Party Assisted Rescue |
| suffosion sinkhole | Raveling of soil into a pre-existing void or fracture. |
| swallet | A natural opening in the surface, too small for a person, that drains water to an aquifer. Some are "open," meaning a void can be seen below; some are "closed, "meaning they are full of sediment. |
| SWG | Southwest Geophysical Consulting, LLC |
| UTM | Universal Transverse Mercator (projected coordinates) |
| WGS | World Geodetic System (geographic coordinates) |

### *8.2 Electrode Data*

Please see accompanying data file **WBRC_ERI_Points.kmz** within file **PW-305-20241204_WBRC_Data_Files.kmz** for detailed information on each electrode location.

**Table 1: Survey Lines Data Table. Each .kml file contains all the points for the survey lines listed in the file name. These data are available in the accompanying file PW-305-20241204_WBRC_Data_Files.kmz.**

| File Name: | Completed By: | Date: |
|---|---|---|
| WBRC01.kmz | Garrett Jorgensen Olague – Senior Field Geologist<br>Britt Bommer – Field Geologist<br>Steven Kesler – Field Geologist | 1/06/2025 |
| WBRC02.kmz | | 1/07/2025 |
| WBRC03.kmz | | 1/07/2025 |
| WBRC04.kmz | | 1/07/2025 |
| WBRC05.kmz | | 1/07/2025 |
| WBRC06.kmz | | 1/07/2025 |
| WBRC07.kmz | | 1/07/2025 |
| WBRC08.kmz | | 1/07/2025 |
| WBRC09.kmz | | 1/07/2025 |
| WBRC10.kmz | | 1/07/2025 |
| WBRC11.kmz | | 1/08/2025 |
| WBRC12.kmz | | 1/08/2025 |
| WBRC13.kmz | | 1/08/2025 |
| WBRC14.kmz | | 1/08/2025 |
| WBRC15.kmz | | 1/08/2025 |
| WBRC16.kmz | | 1/08/2025 |
| WBRC17.kmz | | 1/08/2025 |
| WBRC18.kmz | | 1/08/2025 |
| WBRC19.kmz | | 1/08/2025 |
| WBRC20.kmz | | 1/08/2025 |
| WBRC21.kmz | | 1/09/2025 |
| WBRC22.kmz | | 1/09/2025 |
| WBRC23.kmz | | 1/09/2025 |
| WBRC24.kmz | | 1/09/2025 |
| WBRC25.kmz | | 1/09/2025 |
| WBRC26.kmz | | 1/09/2025 |
| WBRC27.kmz | | 1/09/2025 |
| WBRC28.kmz | | 1/09/2025 |

Raw data files (.stg files for EarthImager™ 2D and EarthImager™ 3D) and processed data (.trn files, terrain files for surface correction in EarthImager™ 2D and EarthImager™ 3D and .out files, the processed .stg files) are available upon request.

**Table 2: Software Information and Settings**

| | |
|---|---|
| Software Name: | EarthImager™ 2D/ EarthImager™ 3D |
| Version: | 2.4.4.649/ 1.5.5.377 |
| Starting Model: | Average Apparent Resistivity |
| Default Inversion Settings: | Surface |
| Changes to Default Inversion Settings: | Max Apparent Resistivity = 100 kΩ-m<br>Min Apparent Resistivity = 0.1 Ω-m |

### 8.3 Pseudo-3D Volume Images

These pseudo-3D volume images (also known as 2.5D since they are collected as single 2D lines and then combined into a 3D file) differ from the 2D inverted resistivity section images in that the apparent resistivity is averaged over larger areas and each line "volume" has had the color map baselined. Areas between lines are interpolated by the program. Together these processing applications smooth out the sharp contrasts between pseudo-sections (different high and low resistivities mapped to the same colors, which can be confusing) but tend to smear out the detail. For this reason, both the 3D volumes (**Figure 8**), which gives an overall picture of the area, and the 2D inverted resistivity sections (Appendix ***8.4 2D Inverted Resistivity Section Images***), which give higher resolution, are presented. Please keep in mind when viewing both the 3D and 2D images that the 3D color maps are more closely aligned with each other than the 2D color maps. Always check the color map when viewing the 2D images to ensure you understand the range of resistivities presented.

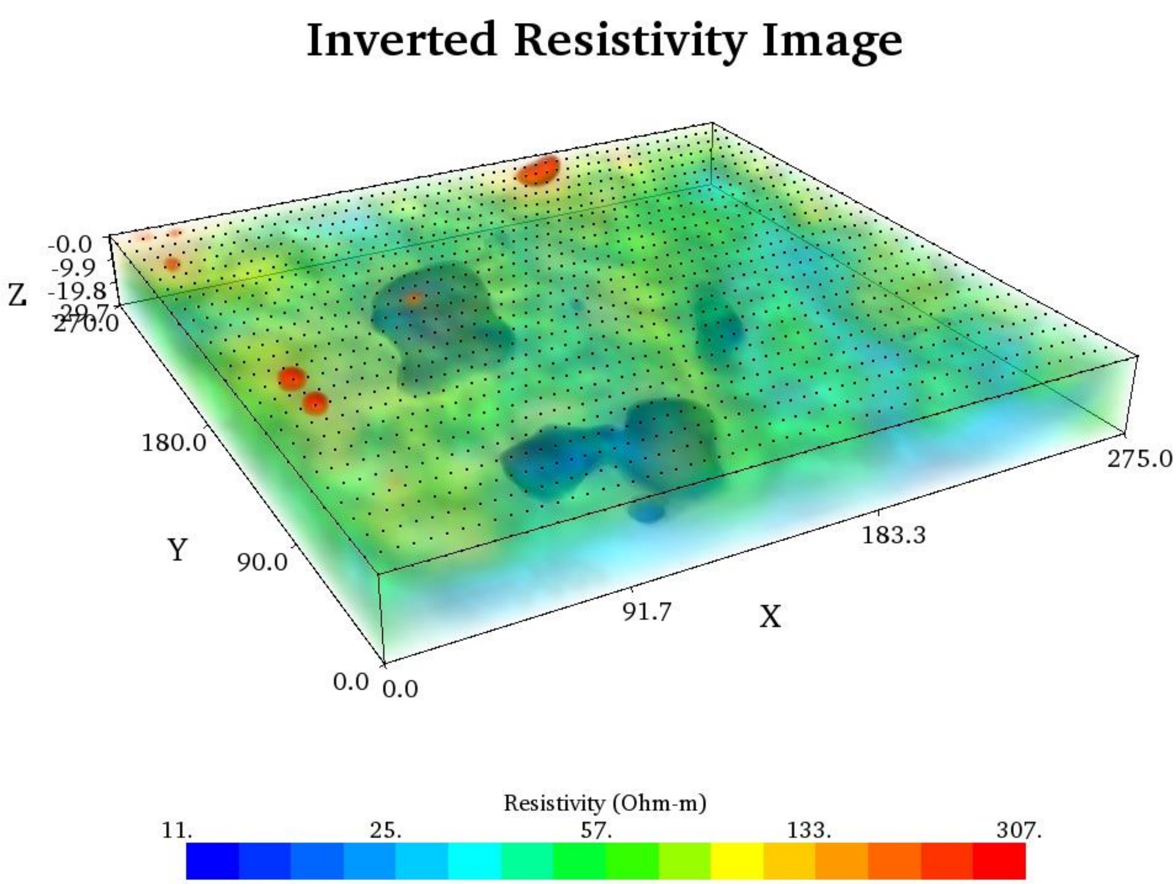


**Figure 8: 3D inverted resistivity volume of lines WBRC01 to WBRC28. Small black dots on surface are electrode locations. All axes are labeled in meters.**

### *8.4 2D Inverted Resistivity Section Images*

Please keep in mind when viewing both the 3D and 2D images that the 3D color maps are more closely aligned with each other than the 2D color maps. Always check the color map when viewing the 2D images to ensure you understand the range of resistivities presented. For example, the image for WBRC09 (**Figure 17**) appears subdued compared to WBRC11 (**Figure 19**) because there is one point with higher-than-average resistivity values. All images are presented with north to the right, looking toward the west. WBRC01 is the farthest to the south and each image/line gets progressively further north. Distances along the top (X-axis) and depths along the left (Z-axis) are in meters. Each image is approximately 275 meters (673 feet) long across the top and 50 meters (164 feet) deep. The color map along the right side is in Ohm-m. Due to the nature of the survey, shallower zones have higher resolution between electrodes than do deeper zones. All images are also available in higher resolution in the accompanying data file **WBRC_2D_IRS_images.zip**.

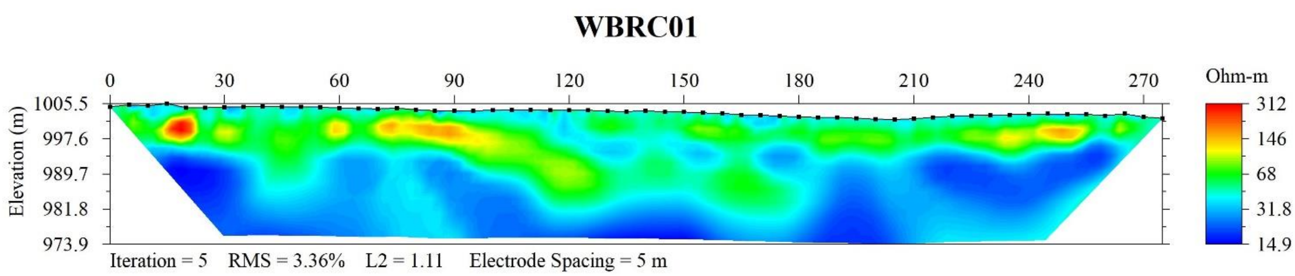


**Figure 9: WBRC01**

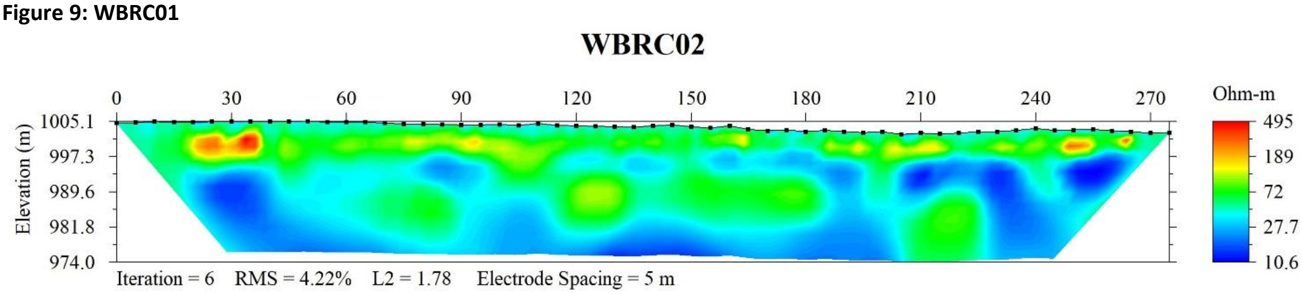


**Figure 10: WBRC02**

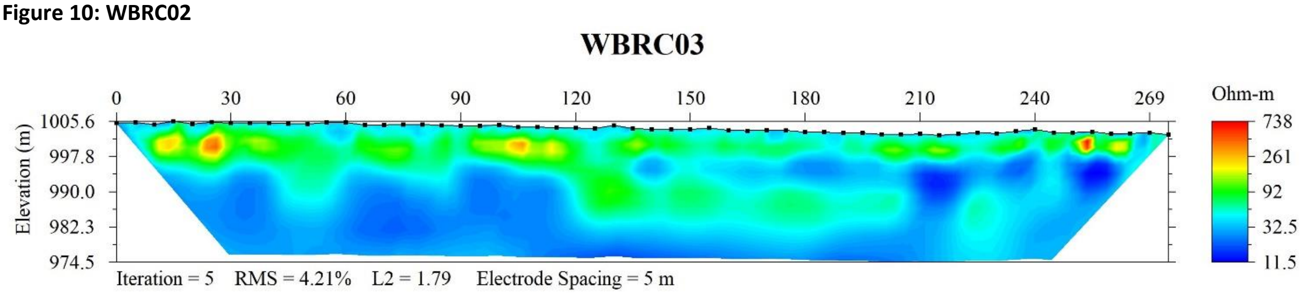


**Figure 11: WBRC03**

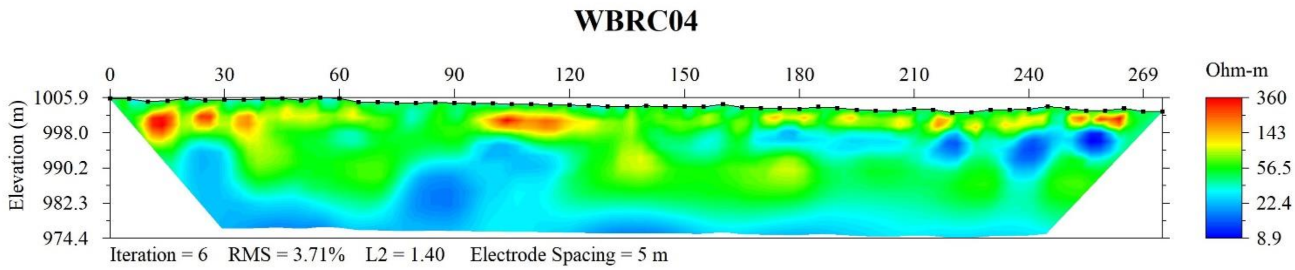


**Figure 12: WBRC04**

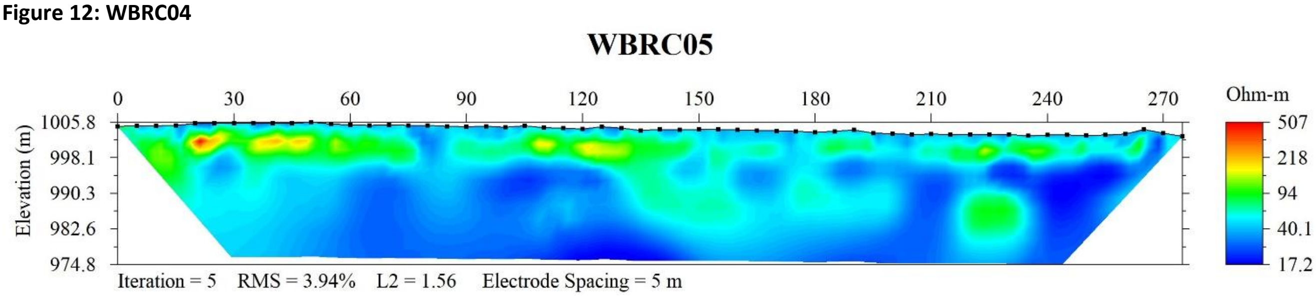


**Figure 13: WBRC05**

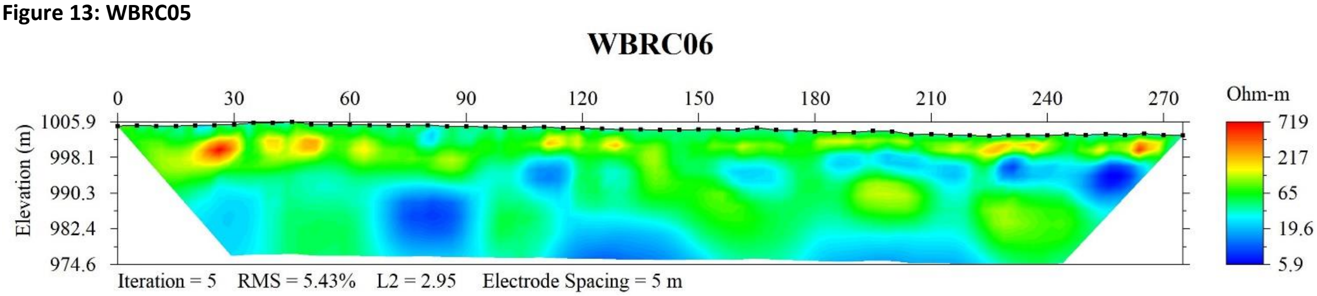


**Figure 14: WBRC06**

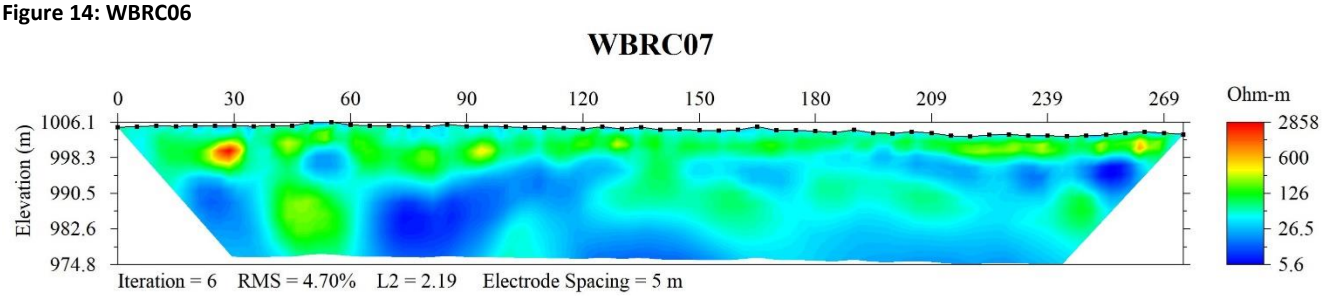


**Figure 15: WBRC07**

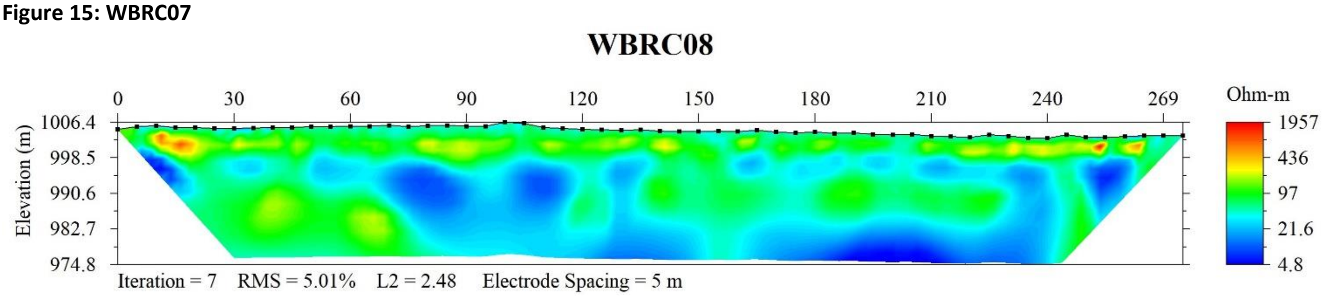


**Figure 16: WBRC08**

  

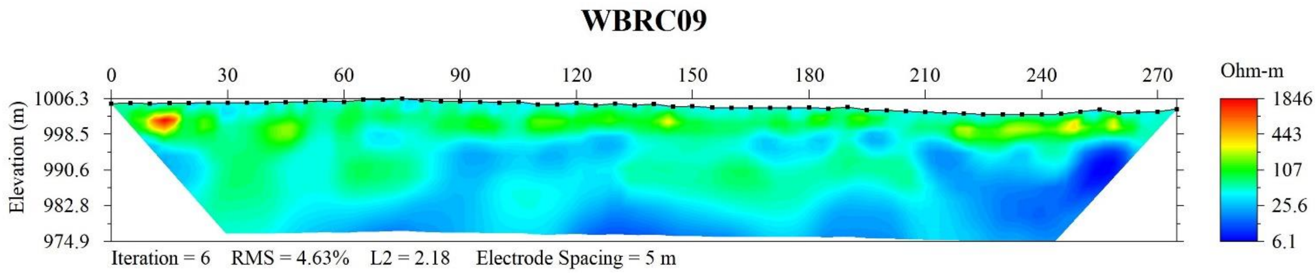


**Figure 17: WBRC09**

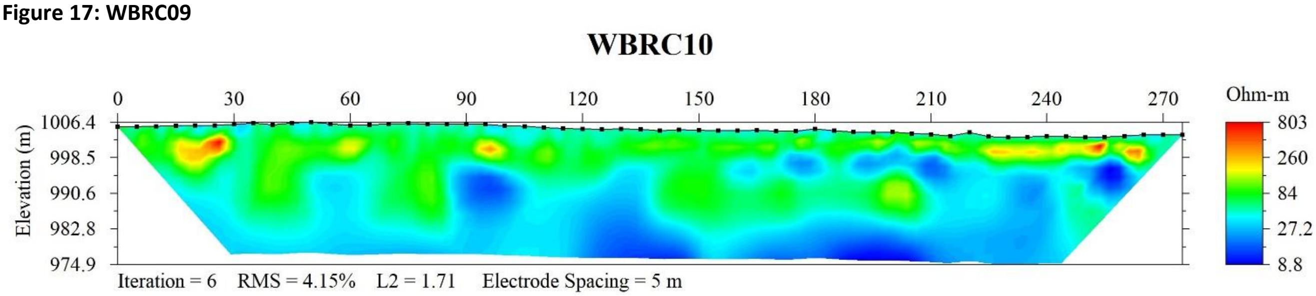


**Figure 18: WBRC10**

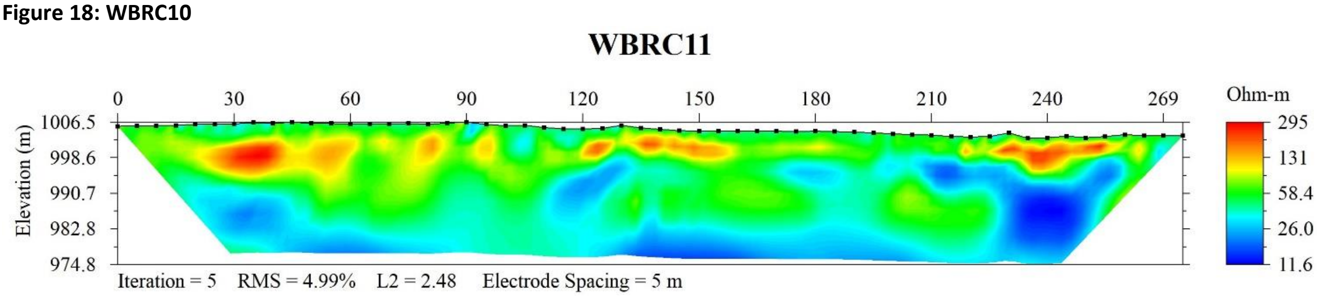


**Figure 19: WBRC11**

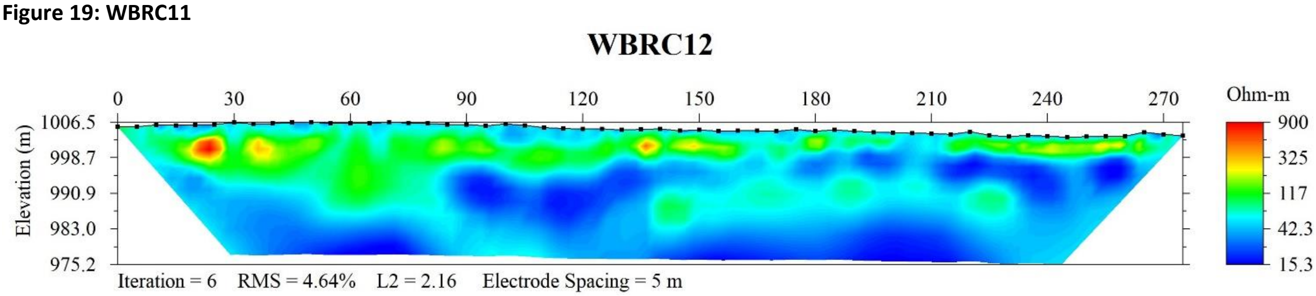


**Figure 20: WBRC12**

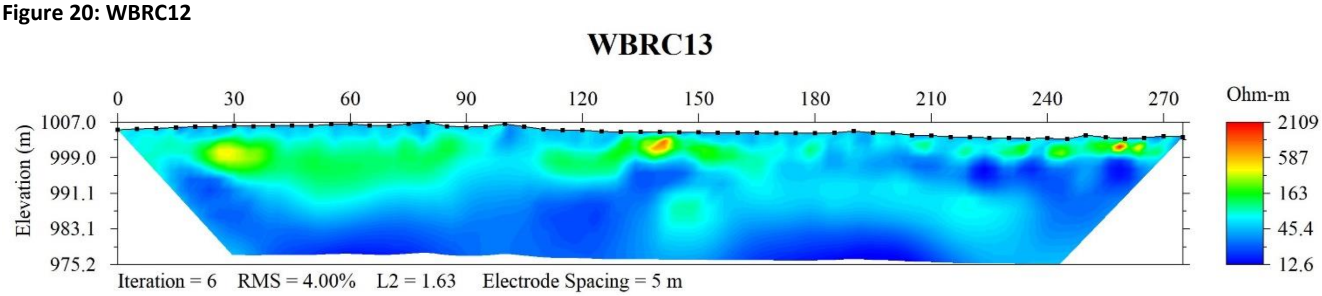


**Figure 21: WBRC13**

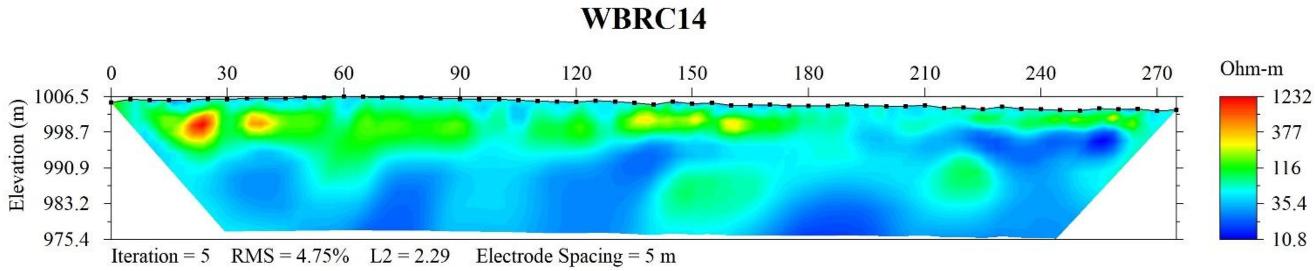


**Figure 22: WBRC14**

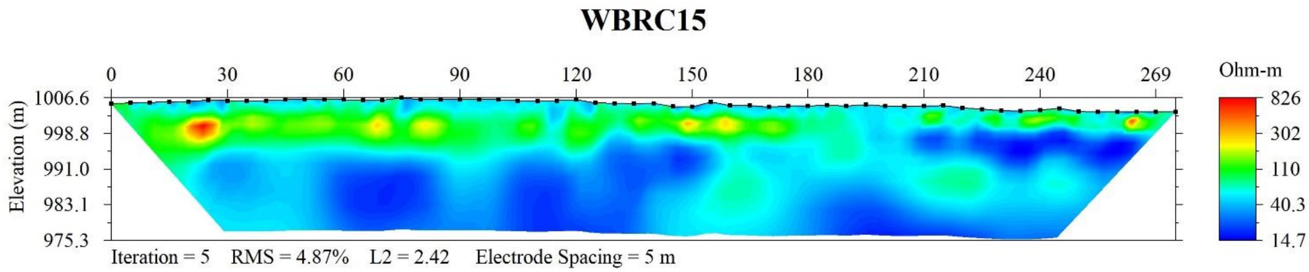


**Figure 23: WBRC15**

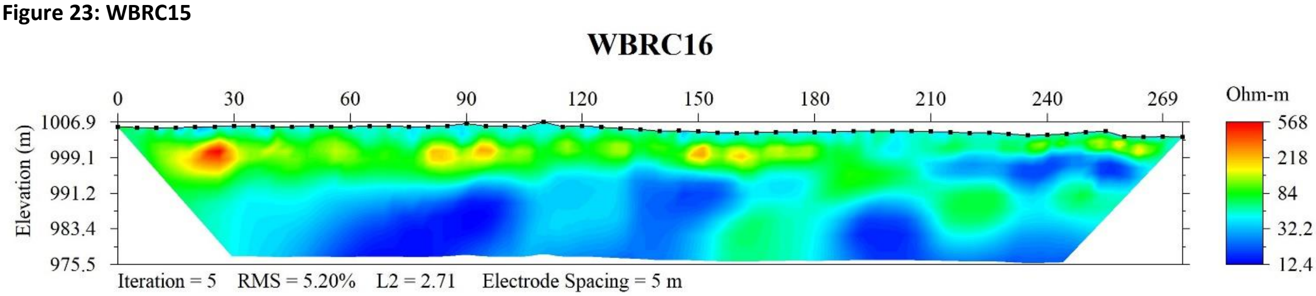


**Figure 24: WBRC16**

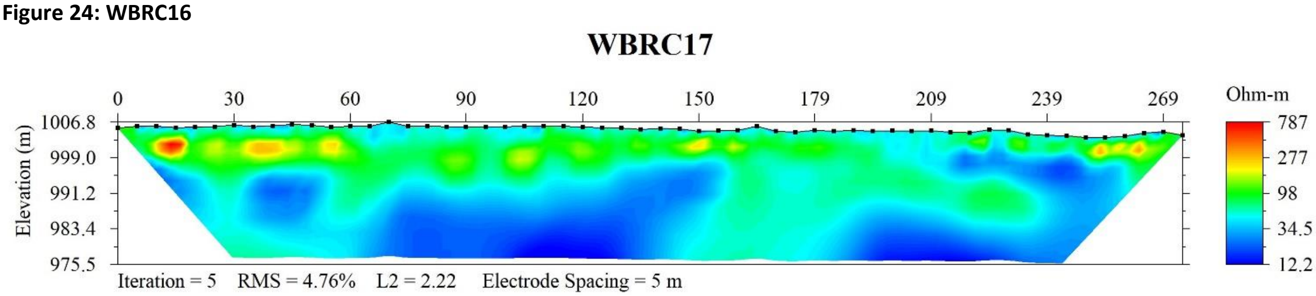


**Figure 25: WBRC17**

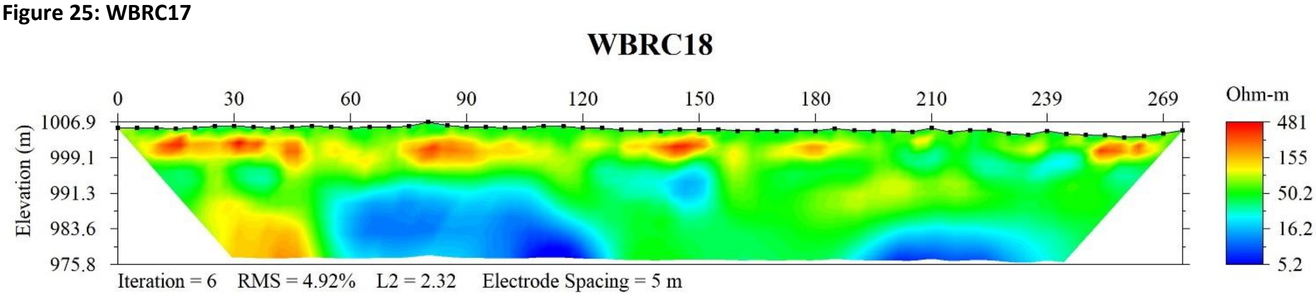


**Figure 26: WBRC18**

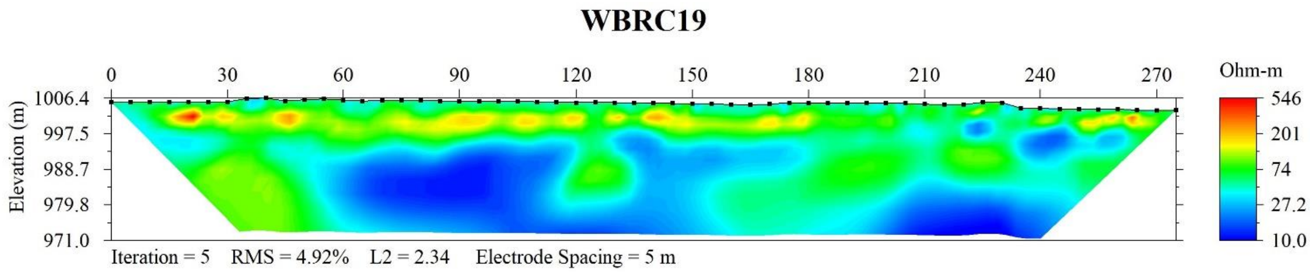


**Figure 27: WBRC19**

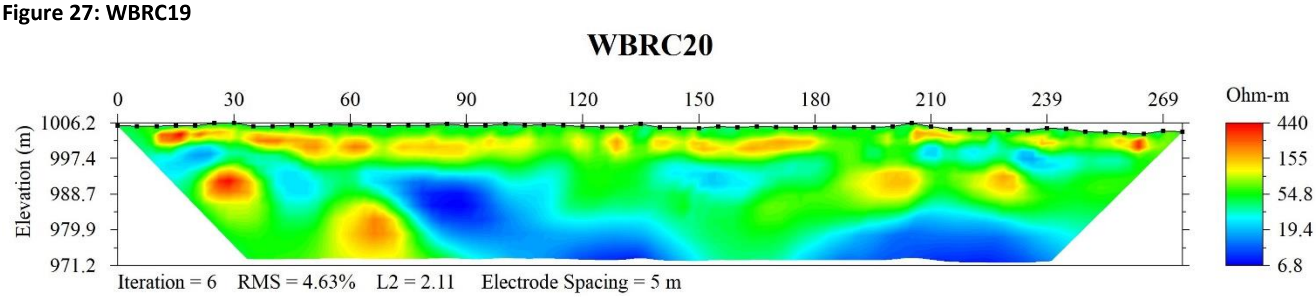


**Figure 28: WBRC20**

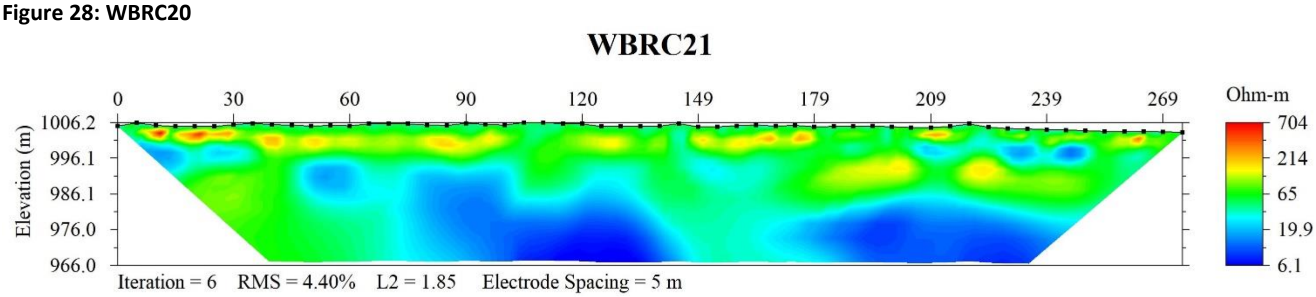


**Figure 29: WBRC21**

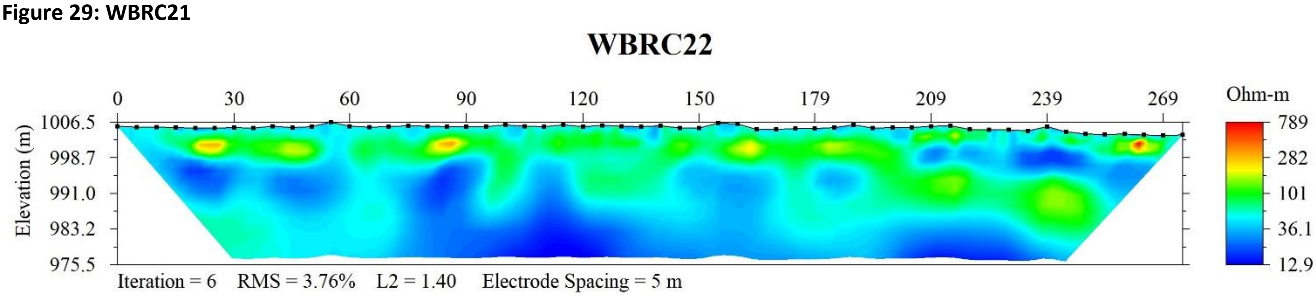


**Figure 30: WBRC22**

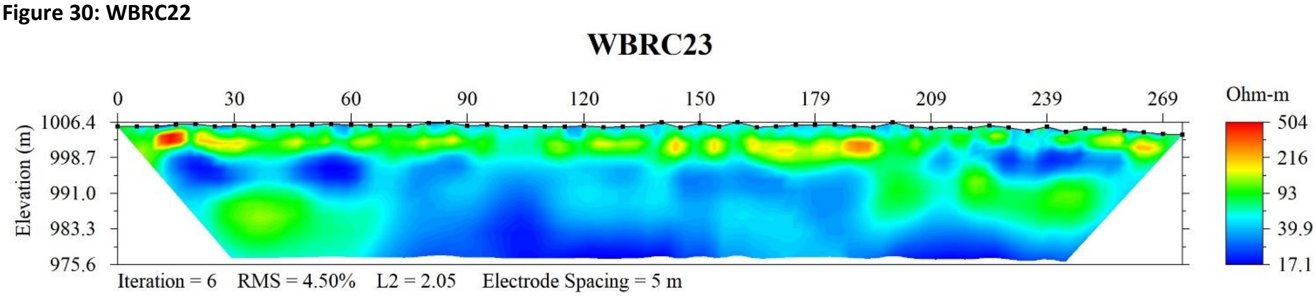


**Figure 31: WBRC23**

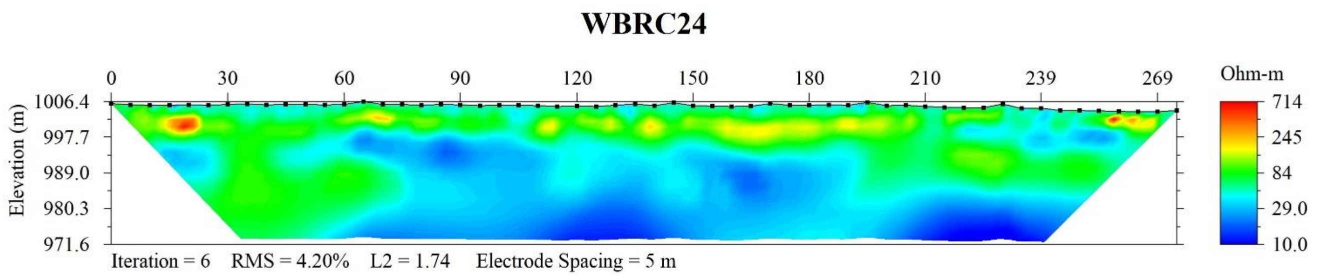

**Figure 32: WBRC24**

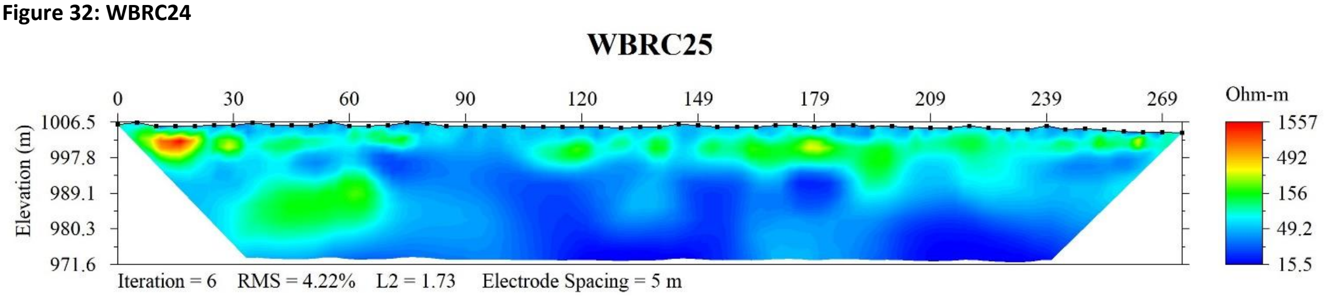

**Figure 33: WBRC25**

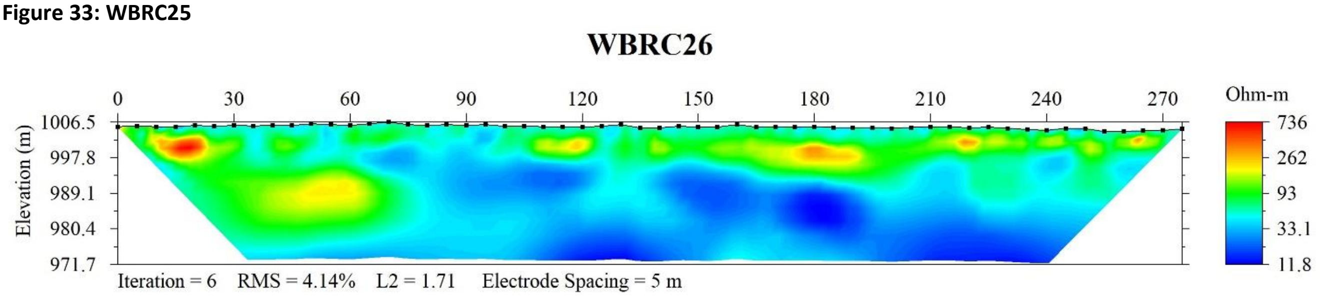

**Figure 34: WBRC26**

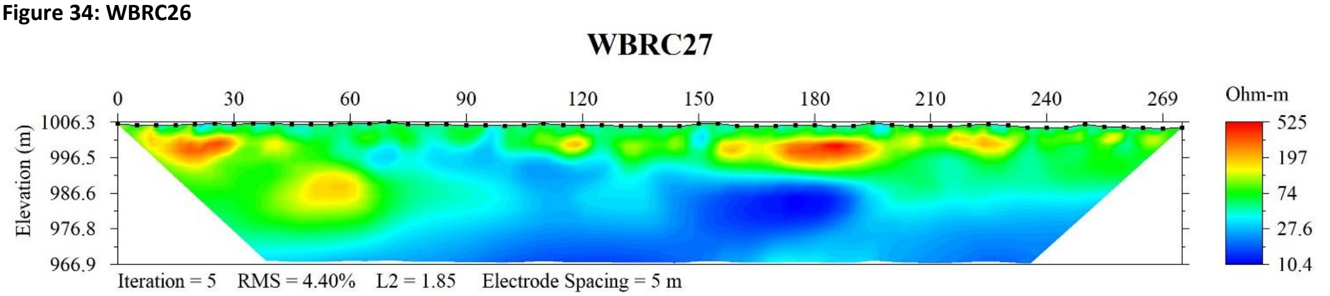

**Figure 35: WBRC27**

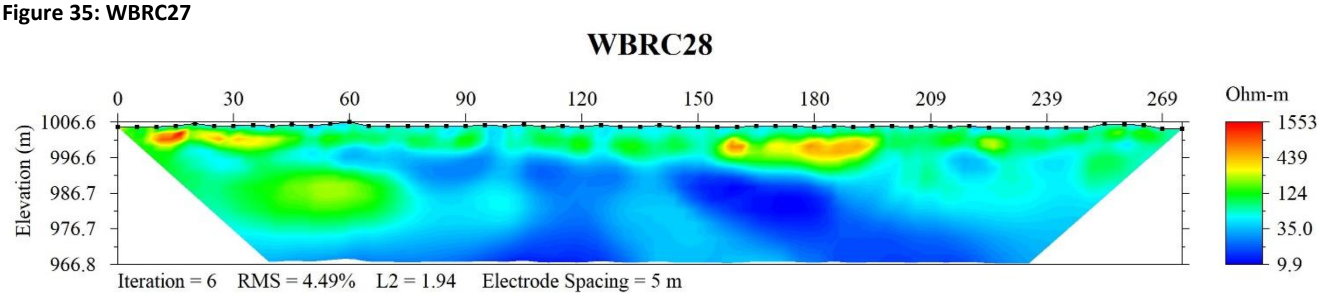

**Figure 36: WBRC28**

Sante Fe Main Office
Phone: (505) 476-3441

General Information
Phone: (505) 629-6116

Online Phone Directory
https://www.emnrd.nm.gov/ocd/contact-us

# State of New Mexico
# Energy, Minerals and Natural Resources
# Oil Conservation Division
# 1220 S. St Francis Dr.
# Santa Fe, NM 87505

CONDITIONS

Action 428565

## CONDITIONS

| Operator: | |
|---|---|
| WaterBridge Stateline LLC<br>5555 San Felipe<br>Houston, TX 77056 | OGRID:<br>330129 |
| | Action Number:<br>428565 |
| | Action Type:<br>[C-147] Water Recycle Long (C-147L) |

**CONDITIONS**

| Created By | Condition | Condition Date |
|---|---|---|
| vvenegas | None | 2/5/2025 |