TT0561 – Olive Avenue Roadway Improvements

Geotechnical and Pavement Design Report

MCDOT Project No.:TT0561; Contract No.: CY 2023-014

November 3, 2025 | Terracon Project No. CP255023

MARICOPA
COUNTY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
43838
RAMON
PADILLA
Date Signed 11/3/25
ARIZONA, U.S.A.
Expires 3-31-2027

Prepared for:

Maricopa County Department of Transportation
2901 West Durango Street
Phoenix, Arizona 85009

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November 3, 2025

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Attn: Mr. Jorge Cossio Duran, PhD, A.M.ASCE
Materials Technology Branch Manager
Phone: (602) 506-8367
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Re: Geotechnical and Pavement Design Report
TT0561 – Olive Avenue Roadway Improvements
Between State Route (SR) 303L and Reems Road
Waddell/Glendale, Maricopa County, Arizona
Terracon Project No. CP255023

Terracon Consultants, Inc. (Terracon) has completed the Geotechnical and Pavement Design Services for the above referenced project in general accordance with the Terracon Proposal No. PCP255023 – Revision 1 dated June 10, 2025. This geotechnical and pavement engineering report presents the findings of the subsurface exploration and provides geotechnical and pavement engineering recommendations for the project concerning the design of pavements, culvert structures, stormwater retention areas, earth fissures, and earthwork.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon

Registered Professional Engineer (Civil)
CERTIFICATE NO.
43838
RAMON
PADILLA
Date Signed 11/3/25
ARIZONA, U.S.A.
Expires 3-31-2027

Ramon Padilla, P.E.
Geotechnical Services Manager

Donald R. Clark, P.E.
Senior Consultant / Senior Principal

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Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

List of Abbreviations

AASHTO	American Association of State Highway and Transportation
ABC	Aggregate Base Course
AC	Asphalt Concrete
ACI	American Concrete Institute
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
ASTM	American Society for Testing and Materials
AR	Asphalt Rubber
AZGS	Arizona Geological Survey
ASTM	American Society for Testing and Materials
CMP	Corrugated Metal Pipe (culvert)
DDF	Directional Distribution Factor
ESALs	Equivalent 18-kip Single Axle Loads
GI	AASHTO Group Index
GF	Growth Factor
MAG	Maricopa Association of Governments
MCDOT	Maricopa County Department of Transportation
M_R	Resilient Modulus
MSL or AMSL	Mean Sea Level or Above Mean Sea Level
OGF	Overall Growth Factor
OSHA	Occupational Safety and Health Administration
PI	Plasticity Index
PCCP	Portland cement concrete pavement
pcf	Pounds per cubic foot
PMTR AC	Polymer and tire rubber modified asphalt concrete
ppm	Parts per million
psf	Pounds per square foot
psi	Pounds per square inch
SPT	Standard Penetration Test
SN	Structural Number
TEF	Traffic Equivalency Factor

Introduction

This report presents the results of our subsurface exploration and Geotechnical and Pavement Design Services performed for the proposed Olive Avenue Roadway Improvements planned between State Route (SR) 303L and Reems Road in Waddell/Glendale, Maricopa County, Arizona. The purpose of these services was to provide information and geotechnical and pavement engineering recommendations relative to the following:

- Subsurface Soil Conditions
- Groundwater Conditions
- Pavement Design and Construction
- Earth Fissures
- Culvert Structures
- Stormwater Retention
- Earthwork
- Pavement Materials Specifications

Our geotechnical field exploration for this project included performing the following:

- 6 Roadway Borings
- 6 Culvert Structure borings (with 1 structure boring pending BNSF permit approval)
- 4 Drainage Basin borings
- 4 Double Ring Infiltration Tests
- 2 Earth Fissure Exploratory Test Pits
- Geophysical Seismic Refraction Surveys
- Ground Penetrating Radar Surveys

The test borings were generally advanced to depths ranging from approximately 10 to 25 feet below the existing ground surface (bgs). As an exception, 2 Roadway Borings were manually excavated with a hand auger to depths ranging from approximately 1 to 5 feet bgs due to overhead utility conflicts for the truck mounted drill rig tower. The double ring infiltration tests were performed in test pit areas excavated to depths of approximately 3 to 4 feet bgs in proposed stormwater retention areas. The exploratory test pits to evaluate for the presence of earth fissures were excavated with a backhoe parallel to the roadway to depths of approximately 4 to 5 feet bgs.

Our geotechnical engineering scope of work for this project also included performing laboratory testing, geotechnical and pavement engineering analysis, and preparation of this report. Maps showing the site and boring/infiltration testing locations are shown on the Site Location and Exploration Plan, respectively. The boring logs and the results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included in the Exploration Results section.

Project Description

Item	Description
Information Provided	Terracon received a Request for Services (RFS) from MCDOT for the referenced project dated April 10th, 2025. In addition, MCDOT provided Terracon with the following documents: ■ Geotechnical Investigation, Olive Avenue Widening, Olive Avenue from Citrus Road to El Mirage Road, MCDOT Job No.: TT404, MCDOT Contract No.: 2010-042; report prepared by AMEC, AMEC Project No. 17-2012-4015, report dated May 23, 2012. ■ Fissure Mitigation Report, Olive Avenue – Loop 303 to Sarival Avenue, MCDOT Project No.: TT0561, MCDOT Contract No.: 2016-023, Maricopa County, Arizona; report prepared by AMEC Foster Wheeler (AMEC), AMEC Project No. 17-2017-4026, report dated June 15, 2017. ■ Geotechnical Investigation Report (Percolation/Infiltration Testing), Olive Avenue, State Route 303L to Sarival Avenue, MCDOT Project No.: TT0561, MCDOT Contract No.: 2016-023; report prepared by AMEC, AMEC Project No. 17-2017-4083, report dated February 22, 2018. ■ Geotechnical Investigation Report (Percolation/Infiltration Testing), Olive Avenue, Sarival Avenue to Reems Road, MCDOT Project No.: TT0562, MCDOT Contract No.: 2018-031; report prepared by AMEC, AMEC Project No. 17-2018-4056, report dated November 20, 2018. ■ Plans for the Construction of Olive Avenue – SR303L to Reems Road, 100% Plans, Preliminary, Not for Construction, MCDOT Project No. TT0561. Note: Based on the information provided and discussions with MCDOT, we understand Terracon can rely on the previous geotechnical engineering information presented in the reports listed above. Therefore, selected data from the reports outlined above was used to supplement this geotechnical engineering report.
Project Description	Based on the information provided, we understand the proposed roadway improvements include the widening of Olive Avenue (from approx. SR303L to Reems Road) to a 5-lane roadway with a center turn lane. Intersection improvements and signalization are also planned at Sarival Avenue and Reems Road, with additional improvements extending approximately ¼-mile north and south on each intersecting roadway. The total project length is approximately 2 to 2½ miles, with portions of the proposed roadway improvements covered by the previous geotechnical investigation reports.

Item	Description
Planned Roadway Improvements	■ Olive Avenue widening (SR303L to Reems Road) to a 5-lane roadway (generally consisting of 2 lanes in each direction and 1 center turn lane). ■ Intersection improvements at Sarival Avenue ¼-mile north and south (of Olive Avenue) including various lane configurations and generally consisting of 2 lanes in each direction with additional median and/or turn lanes. ■ Intersection improvements at Reems Road ¼-mile north and south (of Olive Avenue) including various lane configurations and generally consisting of 1 lane in each direction with additional thru, median, and/or turn lanes.
Earth Fissure Mitigation	■ Possible Earth Fissure Mitigation for a mapped earth fissure across Olive Avenue at approx. 400 feet east of SR303L (approx. Sta. 195+00 to Sta. 196+00).
Planned Structures	■ Reinforced Concrete Box Culvert (RCBC) crossing Olive Avenue diagonally at approx. 100 feet east of Sarival Avenue (approx. Sta. 218+00). ■ RCBC adjacent to the south of Olive Avenue at approx. 2,300 feet east of Sarival Avenue (approx. Sta. 240+00). ■ RCBC adjacent to the south of Olive Avenue at approx. 800 feet west of Reems Road (approx. Sta. 257+00). ■ RCBC adjacent to the south of Olive Avenue at approx. 200 feet west of Reems Road (approx. Sta. 263+00). ■ Two RCBCs near crossings with the BNSF Railroad at approx. Sta. (215+00 and 215+50)
Planned Storm Water Basins	■ First Flush Basin, South side of Olive Avenue, approx. 3-foot deep, approx. 450-foot long from approx. Sta. 189+00 to 193+50. ■ Retention Basin, North side of Olive Avenue, approx. 6-foot deep, approx. 500-foot long from approx. Sta. 197+50 to 202+50. ■ Retention Basin, South side of Olive Avenue, approx. 5-foot deep, approx. 250-foot long from approx. Sta. 202+00 to 204+50. ■ Retention Basin, South side of Olive Avenue, approx. 8-foot deep, approx. 500-foot long from approx. Sta. 206+00 to 211+00. ■ Retention Basin, South side of Olive Avenue, approx. 5-foot deep, approx. 400-foot long from approx. Sta. 211+50 to 215+50. ■ Approx. 4,400-foot long Linear Drainage Canal parallel to the South edge Olive Avenue from Sarival Avenue to Reems Road (approx. Sta. 219+00 to 263+00).

Item	Description
Grading /Slopes	The site is relatively flat and grading operations across the site for pavement areas are anticipated to include relatively minor cuts and fills. Cuts of up to approximately 8 feet are anticipated in proposed storm-water retention areas and RCBC structure areas.
Free-Standing Retaining Walls	None are planned.
Traffic	We understand Olive Avenue, Sarival Avenue and Reems Road are classified as Arterial Roadways. Traffic data for Terracon to perform the pavement structure design for project was provided by MCDOT. The following summarizes the traffic data provided for the project: ▪ Olive Avenue – Principal Arterial Roadway Classification – From Cotton Lane to Sarival Avenue - 2023 Average Daily Traffic (ADT) Volume (Two way): 4,856; with a Percent Trucks of 1.86%. ▪ Olive Avenue – Principal Arterial Roadway Classification – From Sarival Avenue to Reems Road - 2023 ADT Volume (Two way): 4,205; with a Percent Trucks of 2.4%. ▪ Sarival Avenue – Minor Arterial Roadway Classification – At Olive Avenue - 2023 ADT Volume (Two way): 2,258; with a Percent Trucks of 1.38%. ▪ Reems Road – Major Collector Roadway Classification – At Olive Avenue - 2023 ADT Volume (Two way): 6,513; with a Percent Trucks of 4.09%. ▪ Estimated yearly average growth rate for the project: 5%. ▪ Estimated percent truck traffic for the project: 5%.

Site Conditions

Item	Description
Project Location	The project consists of Olive Avenue from approximately SR303L to Reems Road in Waddell/Glendale, Maricopa County, Arizona. See Site Location and Exploration Plan for additional site location information.
Existing Improvements	Olive Avenue, Sarival Avenue, and Reems Road generally consist of asphalt paved roadways with 2 travel lanes (1 lane in each direction). As an exception, Sarival Avenue extending from Olive Avenue towards the south consists of 3 southbound lanes and 1 northbound lane. An existing BNSF railroad parallels Olive Avenue to the north.

Item	Description
Current Ground Cover	The ground cover across the site generally consists of asphalt concrete paved roadways followed by graded shoulders and generally followed by agricultural land or industrial/commercial developments.
Existing Topography	The project site is relatively flat. Based on the roadway elevations outlined in the Plans (and review of Google Earth Pro imagery), the west end of the Olive Avenue project (at approx. SR303L) has an elevation of approximately 1,167 feet above mean sea level (amsl), and the east end of the Olive Avenue project (at approx. Reems Road) has an elevation of approximately 1,127 feet amsl. This elevation change generally takes place gradually across the project site.
Photography Log	A photography log of selected photographs from the site is included in this report and shows typical site conditions.
Geological Hazards	The alignment of Olive Avenue crosses a confirmed continuous and discontinuous earth fissure mapped by the Arizona Geological Survey (AZGS) at approximately 425 feet (according to measurements obtained from Google Earth Pro) east of SR303L. Terracon previously evaluated this earth fissure further south as part of a previous project for SR303L improvements for the Arizona Department of Transportation (ADOT). The approximate location of the mapped confirmed and discontinuous earth fissure is shown in the image below (red and orange line). 

Geology

The project area is located in the Basin and Range physiographic province ([1]Cooley, 1967) of the North American Cordillera ([2]Stern, et al, 1979) of the southwestern United States. The southern portion of the Basin and Range province is situated along the southwestern flank of the Colorado Plateau and is bounded by the Sierra Nevada Mountains to the west. Formed during middle and late Tertiary time (100 to 15 million years ago), the Basin and Range province is dominated by fault-controlled topography. The topography consists of mountain ranges and relatively flat alluviated valleys. These mountain ranges and valleys have evolved from generally complex movements and associated erosional and depositional processes. Drainage flows to the Gila River during late Tertiary time, coupled with structural activity discussed above, are generally responsible for the present-day topography within the basin.

Typically, the ranges in this area are of small areal extent but protrude significantly above adjacent wide alluviated plains and valleys. The basin rims are formed by the mountain ranges which consist of sedimentary, igneous and metamorphic materials which have been subjected to recurrent faulting and tilting, and in some places volcanic and intrusive events. As a result of erosion, the valleys have experienced partial infilling with sedimentary material which has been deposited as alluvial fans. Occasionally, the valleys may become interlocking as a result of coalescing alluvial fans which are referred to as bajadas.

Based on review of U.S. Geological Survey (USGS) geological maps, surficial geologic conditions mapped at the site consist of Holocene surficial deposits. These deposits are described as unconsolidated deposits associated with modern fluvial systems. This unit consists primarily of fine-grained, well-sorted sediment on alluvial plains, but also includes gravelly channel, terrace, and alluvial fan deposits on middle and upper piedmonts.

The project area is located within the western portion of the Phoenix Basin. The Basin and Range Province is characterized by alternating northwest-southeast trending mountainous terrain of igneous, metamorphic and consolidated sedimentary rocks and broad alluvial valleys or basins, most formed by block faulting and folding. The mountains and hills west of the current segment of the project, the White Tank Mountains, are aligned north-south, and are composed, in part, of Tertiary age rocks common in the Basin and Range. The range also contains Proterozoic metamorphic and igneous rocks closely

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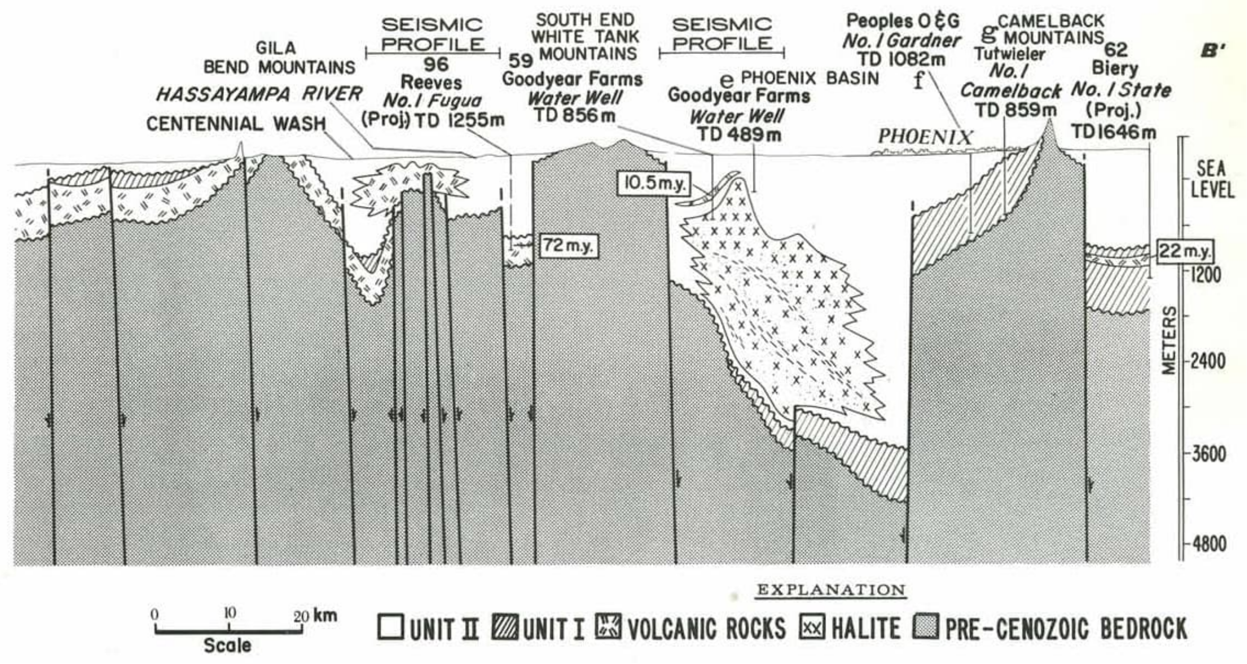
[1] Cooley, M.E., 1967, Arizona Highway Geologic Map, Arizona Geological Society.

[2] Stern, C.W., et al, 1979, Geological Evolution of North America, John Wiley & Sons, Santa Barbara, California.

related to the Arizona Transition Zone which is located between the Basin and Range Province and the Colorado Plateau Province. The western portion of the Phoenix Basin is underlain by unconsolidated to semi-consolidated basin-fill alluvial sediments extending down over 12,000 feet below the ground surface, see the following figure ([3]Eberly and Stanley, 1978).



GEOLOGIC CROSS SECTION THROUGH S.W. ARIZONA INCLUDING THE PHOENIX BASIN

The White Tank Mountain Range was brought up to the surface in mid-Tertiary time as part of the lower plate of a detachment fault system. This extension event is documented by a mid-Tertiary foliation, lineation, and mylonites in the eastern part of the range and by exposure of the detachment fault itself on the western edge of the range. The exposed bedrock along the eastern side of the range closest to the project does not exhibit high angle normal fault scarps associated with eastward movement of the upper plate. A remnant section of the low angle detachment fault has been interpreted to extend eastward beneath Luke Air Force Base and the Morton Salt Body centered at the intersection of Dysart Road and Glendale Avenue ([4]Spencer, J.E. and Rauzi, S.L., 2005). Based on well borehole data, it dips 12 degrees at N64E with chloritic breccia below the

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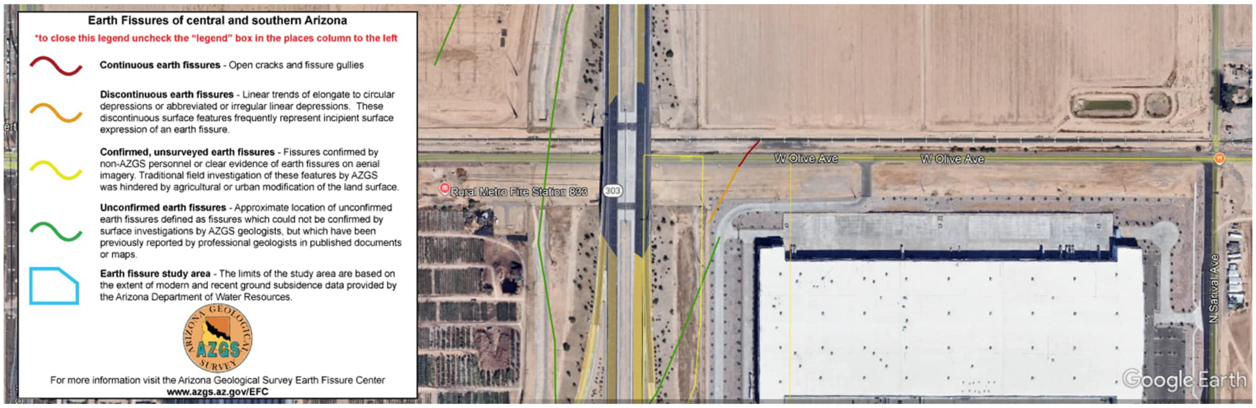
[3] Eberly, L. D., Stanley, T. B. *Cenozoic stratigraphy and geologic history of southwestern Arizona,* Geological Society of America Bulletin, v. 89, p. 921-940, June 1978.
[4] Spencer, J.E. and Rauzi, S.L., *Drill Holes in the Luke Salt Body Penetrate Underlying Fault*, Arizona Geological Society, Vol. 35, No.3, 2005.

fault. In the White Tank Mountains, erosion has removed sedimentary and Tertiary age volcanic rock of the upper plate and left the lower plate metamorphic core complex exposed in the upper portion of the range facing the western margins of the basin.

Significant geologic features within and adjacent to the project corridor include the Luke Salt Body, which is a large body of halite and anhydrite, that occurs to the south and east of Luke Air Force Base. In addition, another significant geologic feature is earth fissures that have resulted from compression of deep alluvial deposits due to years of groundwater withdrawal associated with the farming activities in the west valley.

Land Subsidence and Earth Fissures

Portions of the Western Metropolitan Phoenix area have experienced historic and documented groundwater decline. The depletion of the groundwater table has resulted in compression of the aquifer material and the phenomenon known as areal subsidence. Earth fissures are fractures or cracks that form in alluvial basins due to substantial groundwater overdrafts that produce local subsidence. Earth fissures develop within land subsidence areas where a significant thickness of compressible alluvium overlies shallow irregular bedrock surfaces such as ridges and fault scarps or other subsurface features. As previously mentioned, the project alignment of Olive Avenue crosses a confirmed continuous and discontinuous earth fissure mapped by the AZGS at approximately 425 feet east of SR303L. The approximate location of the mapped confirmed and discontinuous earth fissure is shown in the image below (red and orange line)([5]AZGS, 2019):



Terracon previously performed the geotechnical engineering services for the design and construction of the SR303L from approximately Glendale Avenue to Peoria Avenue, including a comprehensive earth fissure evaluation. The earth fissure evaluation

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[5] Arizona Geological Survey (AZGS), 2019, Earth Fissure Map of the Luke Study Area: Maricopa County Arizona, Digital Map Series – Earth Fissure Map 8, DM-EF-8 version 4.0.

performed on the neighboring SR303L project was presented to the Arizona Department of Transportation (ADOT) in a report titled: *Geotechnical Engineering Report, SR303L, Glendale Avenue to Peoria Avenue, MP 109.68 to MP 112.68, Maricopa County, Arizona, ADOT TRACS No. 303 MA 109 H7874 01C* (Terracon Project No. 65095060, report dated July 28, 2011). Relevant information from this previous project/report is included in this report.

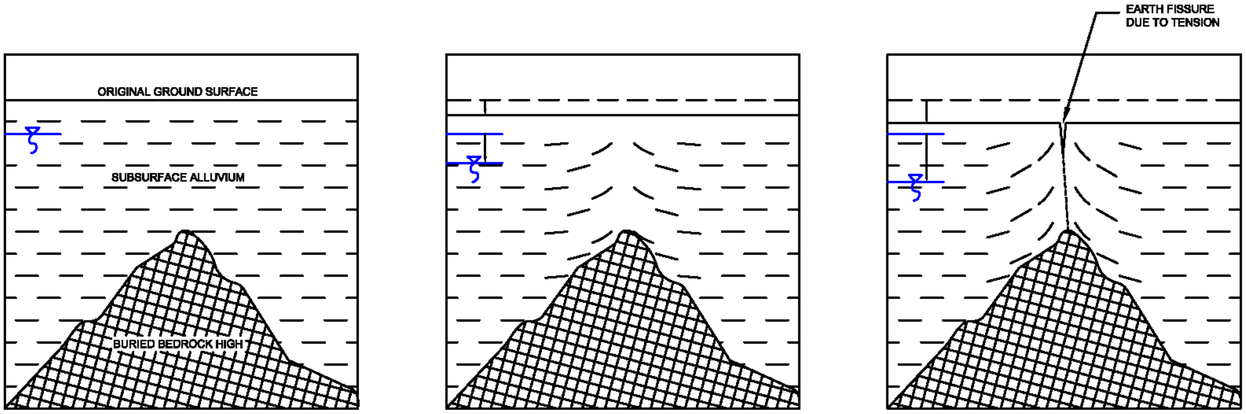
There are several earth fissures in the vicinity that have been mapped by the AZGS, which include various earth fissures previously identified by Terracon. A methodical approach was performed in an effort to locate the confirmed earth fissure mapped across the Olive Avenue project alignment. Our earth fissure evaluation included the following:

- Literature review of:
    - Geologic maps showing subsurface stratigraphy
    - Earth fissure maps
    - Review of historical aerial photographs for lineament evaluation
- Review of Arizona Department of Water Resources (ADWR) Interferometric Synthetic Aperture Radar (InSAR) historical subsidence maps
- Site reconnaissance
- Geophysical surveys including:
    - Seismic p-wave and multi-channel analysis of surface waves (MASW) surveys
    - Ground penetrating radar (GPR) surveys
- An earth fissure trench field exploration

Background

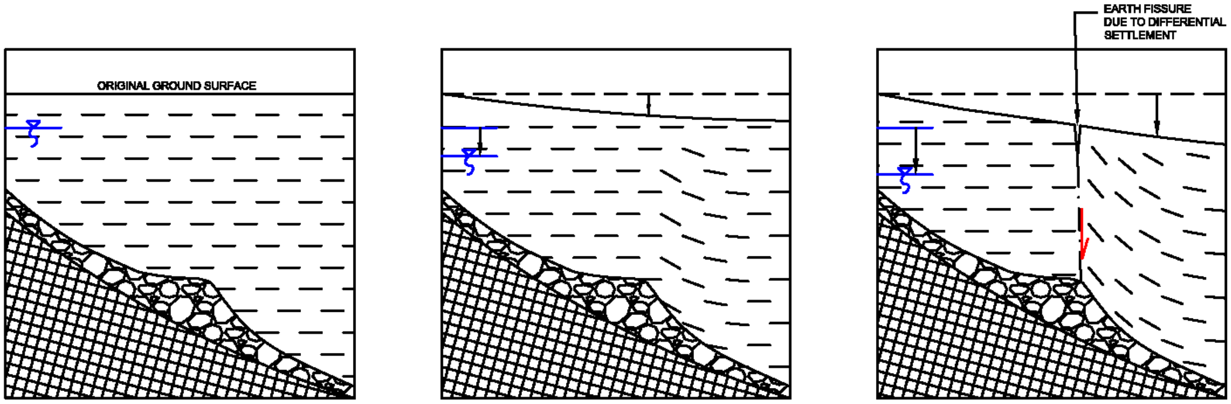
Earth fissures in Arizona have resulted from ground subsidence generally associated with groundwater withdrawal from aquifers in sediment filled basins. Based on historic groundwater information, the groundwater elevation has been lowered by as much as 224 feet between 1945 and 1996 in the vicinity of the project. The withdrawal of groundwater causes consolidation by the effective stress of the soils increasing from the buoyant unit weight of about 65 pounds per cubic foot (pcf), to a moist unit weight of about 130 pcf; an increase of about 100% as groundwater declines in elevation in the area. As an example of this phenomenon, when the groundwater is drawn down 224 feet, the subsurface soils beneath the elevation of groundwater withdrawal are subjected to an increase in pressure of about 224 feet times 65 pcf, or about 14,560 pounds per square foot (psf) of additional in-situ pressure. Since the area being affected is on the order of square miles in plan area, the entire depth of subsurface soils down to bedrock, over 12,000 feet, undergoes a stress increase of 14,560 psf under this scenario. This stress increase causes the underlying materials to compress causing ground subsidence to occur. For the subsurface soils comprised of clay soils, the time for consolidation to take place may be several years or more, depending on the length of the drainage path and the permeability of the saturated zone.

Subsidence has occurred in the west valley of the Phoenix Basin as basin sediments have compacted or consolidated from groundwater elevation declines. The decline in groundwater elevation is the result of groundwater pumping for agricultural and municipal uses that have outpaced the rate of aquifer recharge. As the groundwater elevation has decreased significantly, a reduction in volume of the sand and clay sediments through consolidation-type mechanisms has been manifested as subsidence at the ground surface followed by the development of earth fissures. Typically, there are generally two types of earth fissures. One type of earth fissure is essentially a tension crack caused by differential settlement across a local relatively incompressible subsurface high point. A typical subsurface high in the basin could be a buried mountain with surface geometry similar to what can be seen of the mountains exposed at the surface within the Phoenix Valley, as shown by the following figure.



SCHEMATIC OF EARTH FISSURE FORMATION DUE TO BURIED BEDROCK HIGH

A second type of earth fissure is caused by shear at the boundary of two significantly different compressible soils and/or materials with different rates of compression (i.e. the boundary between predominantly sand/gravel soils and silt/clay soils). Because one layer compresses significantly more than another, there is a considerable change in the amount of compression. If this change occurs over a short distance, the rate of deformation may be more than the subsurface soil can withstand and it undergoes shear. When this shear plane daylights at the ground surface, it is observed as a change in elevation. Our previous earth fissure evaluation for the adjacent SR303L project indicated the earth fissures in the vicinity of the site appear to be this is the type of (shear) earth fissures. These types of earth fissures typically have narrow apertures and do not tend to erode into large chasms. The following figure shows the schematic for the “shear” type earth fissure:



SCHEMATIC OF EARTH FISSURE FORMATION DUE TO DIFFERENTIAL SETTLEMENT

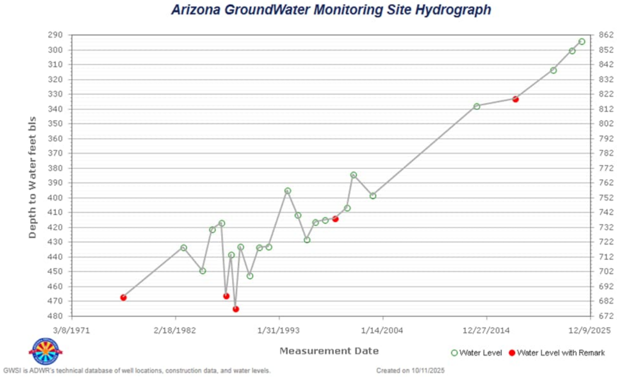
Groundwater Withdrawal

Based on information obtained from the Arizona Department of Water Resources (ADWR), Groundwater Site Inventory (GWSI) Website database, the depth to groundwater has varied over time within a couple of miles of the project and near the center of the subsidence basin. Based on information obtained at three wells, the depth to groundwater and the corresponding dates of measurement are provided in the following table.

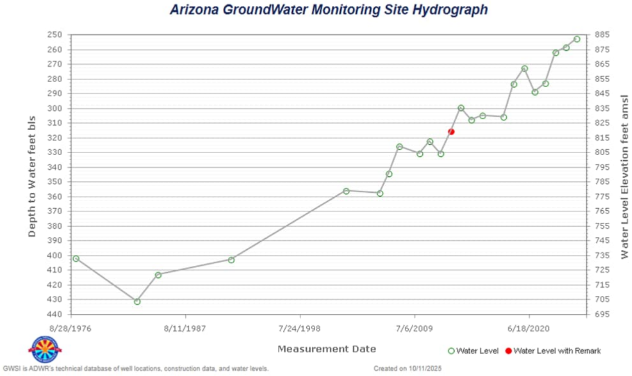
HISTORIC GROUNDWATER ELEVATION DATA				
Well Local ID	Depth to Water (ft)	Groundwater Elevation (ft)	Date Measured	Avg. Drop in Groundwater Elevation per Year (ft)
B-02-01 06DBB1	136	981	1945	4.4
	360	757	1996	
	276	841	2011	---
B-02-01 06DBB2	350	767	1966	4.3
	418	699	1982	
	290	827	2008	---
B-03-01 34DBB1	224	876	1957	4.3
	341	759	1984	
	220	880	2007	---

Based on the information provided in the table above, the groundwater elevation has been lowered as much as 224 feet between 1945 and 1996, and the average drop in groundwater elevation per year for this time period is approximately 4.3 feet.

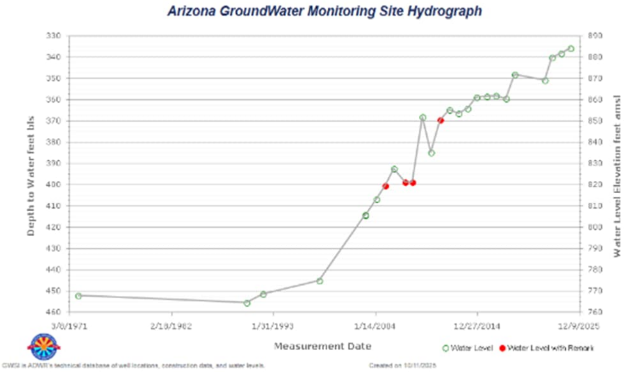
Based on information provided on the ADWR GSWI Website, wells in the vicinity of the site indicate groundwater elevations have recharged over 100 feet in the past roughly 25 years (Well Local IDs: B-03-01 29BCC, B-03-02 35BBB, B-03-01 32BAA, and B-02-01 06ABB2). The following are hydrograph charts from these wells obtained from the ADWR GSWI website:



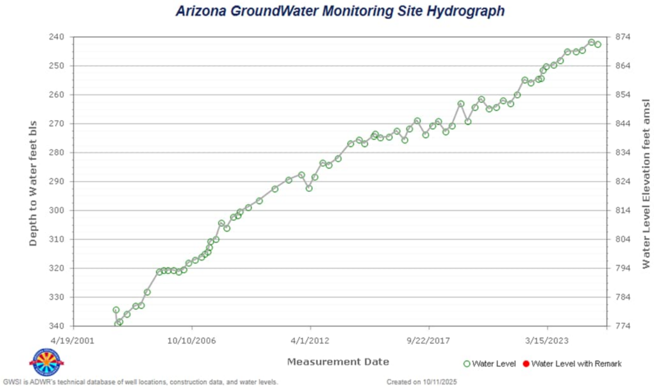
Local Well ID: B-03-01 29BCC



Local Well ID: B-03-01 32BAA



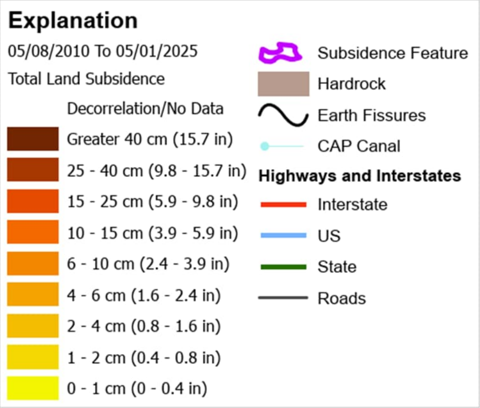
Local Well ID: B-03-02 35BBB



Local Well ID: B-02-01 06ABB2

Ground Subsidence

Shumann ([6]Shumann, 1995) reported the average rate of subsidence in the west valley of the Phoenix Basin was approximately 6 in/yr at the center of the subsidence from 1957 to 1992. Over this period of time the center of the subsidence has settled over 18 feet. While the present rate of ground subsidence has significantly decreased from the average rate observed between 1957 and 1992, the long-term actual rate of subsidence will vary depending on the land use and future rate of groundwater withdrawal (or recharge). The decrease in the rate of subsidence, is anticipated to correlate to a reduced probability of forming new earth fissures within the vicinity of the site. The following are images extracted from the referenced 2025 ADWR ([7]ADWR, 2025) land subsidence map:



Based on InSAR data on ADWR land subsidence maps referenced above, approximately 6 inches of land subsidence were measured over a 15-year time period (from 2010 to 2025). Therefore, the interpreted rate of ground subsidence in the site vicinity at present is estimated to be approximately 0.4 inches/year.

The following figures show land subsidence survey data in the vicinity of the site from the Schumann report referenced above:

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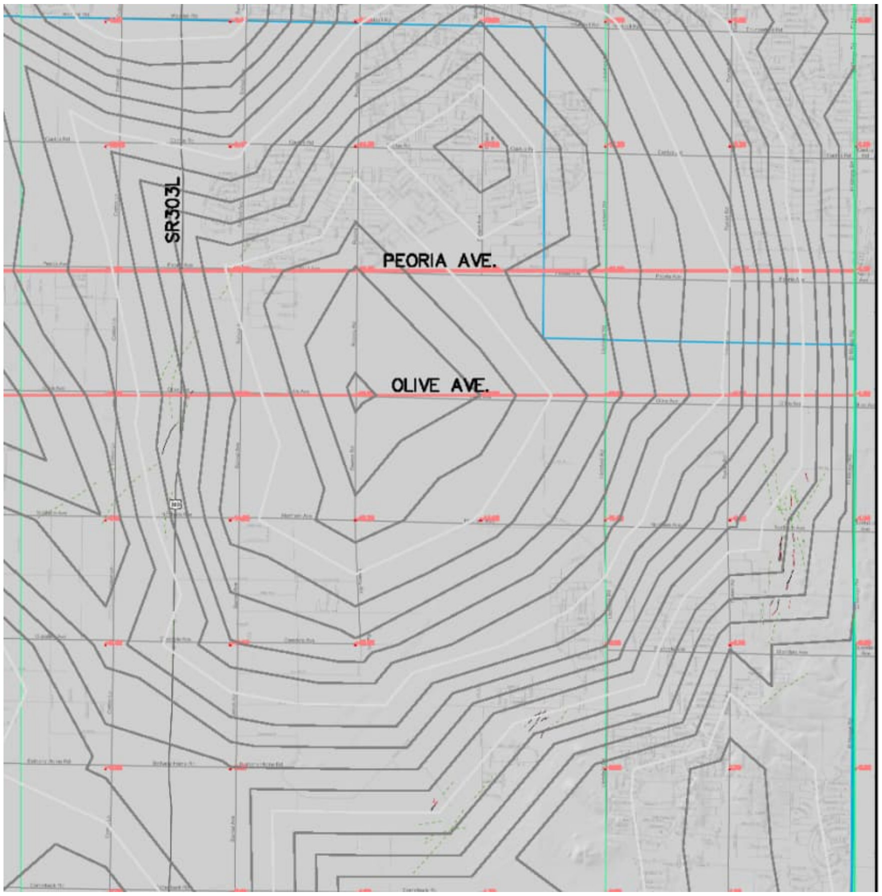
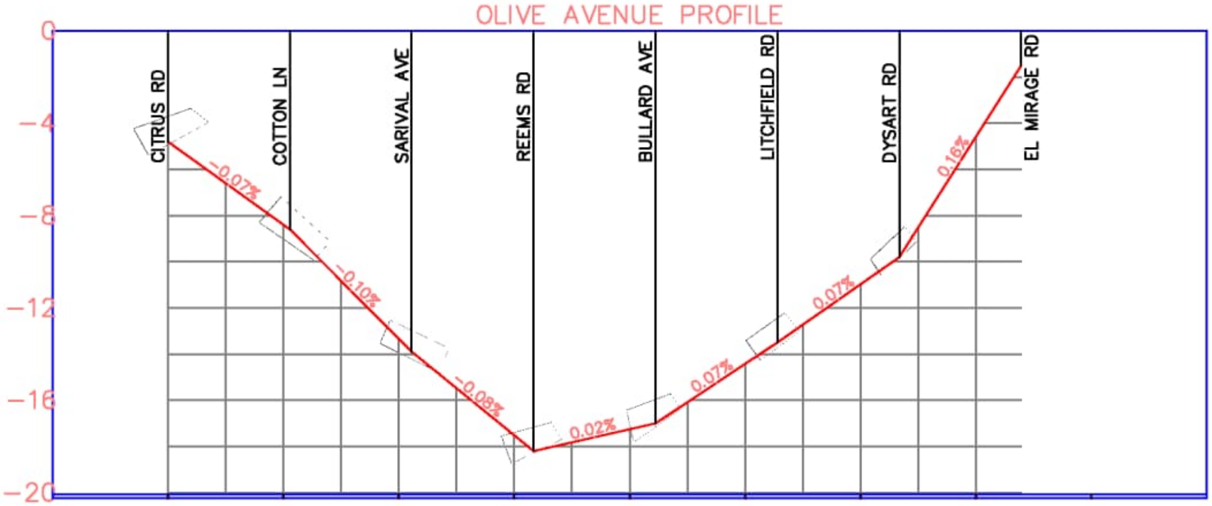
[6] Schumann, H. H. *Land Subsidence and Earth Fissure Hazards near Luke Air Force Base, Arizona;* K. R. Prince, D. L. Galloway, & S. A. Leake (Eds.), U.S. Geological Survey Subsidence Interest Group Conference, Edwards Air Force Base, Antelope Valley, California, November 18-19, 1992-abstracts and summary (pp. 18-21). Sacramento, CA: U.S. Geological Survey. (Open-File Report No. 94-432). 1995

[7] Arizona Department of Water Resources (ADWR), 2025. Total Land Subsidence in the Western Metropolitan Phoenix, Maricopa County; Based on Radarsat-2 Satellite Interferometric Synthetic Aperture Radar (InSAR) Data; Time Period of Analysis: 15.0 Years 05/08/2010 to 05/1/2025 Created 5/14/2025 by ADWR.



AZGS LUKE STUDY AREA MAP OVERLAID BY CONTOURS OF SUBSIDENCE, AS PROVIDED BY SCHUMANN, 1995.



CROSS SECTIONS THROUGH THE CONTOURS OF SUBSIDENCE ALONG OLIVE AVENUE

As outlined in the previous figures, the subsidence basin is generally centered at approximately Olive Avenue and Reems Road. The mapped earth fissures in the vicinity generally follow the subsidence basin contour lines indicating the earth fissures are likely “shear” type (due to differential settlement). Typically, the earth fissures in the Luke Study Area occur where the slope of the ground is 0.1% or higher. The ground surface slope is 0.1% or higher in the vicinity of the site at the following 3 separate locations:

- The SR303L between Sarival Road and Cotton Lane north of Northern Avenue and south of Peoria Avenue;
- Between Dysart Road and El Mirage Road south of Olive Avenue and north of Glendale Avenue; and,
- An area immediately south and southeast of Luke Air Force Base.

Historical Aerial Photography Review and Lineament Evaluation

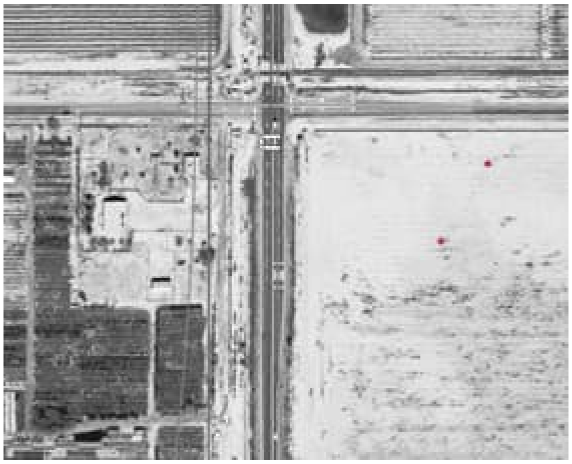
Terracon reviewed selected historical aerial photographs publicly available on the Flood Control District of Maricopa County website and on Google Earth Pro dating from 1949 to 2025. The lineament evaluation consisted of reviewing historical aerial photographs for lineations which could indicate the presence of earth fissures.

The lineations may be observed on the photographs as shadows if there is sufficient relief across the feature. Low sun angle photographs are particularly helpful identifying these types of lineations. Lines may also be caused by changes in the vegetative cover, either by a distinct change in the vegetation, or by the appearance of vegetation where there generally is none. Lastly, lines may be caused by a distinct change in the moisture content from one side of a line to the other, such as when an agricultural field is irrigated and the water runs into an earth fissure causing one side to be darker due to the irrigated water and the other side appearing to be dry because the water has run into the open earth fissure.

There are several difficulties with a lineament study when trying to identify unconfirmed earth fissures, particularly when the earth fissures cross agricultural fields that are plowed on a regular basis or when the native land is developed, and aerial photographs are not taken on a routine schedule. The following selected aerial photographs are provided to summarize our delineation show the process of identifying lineations. Red dots have been included on the aerial photographs to outline the lineation along the mapped earth fissure.

Google Earth Pro, 2025

FCDMC, 1996 Dec – 1997 Feb



FCDMC, 2000 Jan – 2000 Apr

FCDMC, 2003 Dec – 2004 Jan

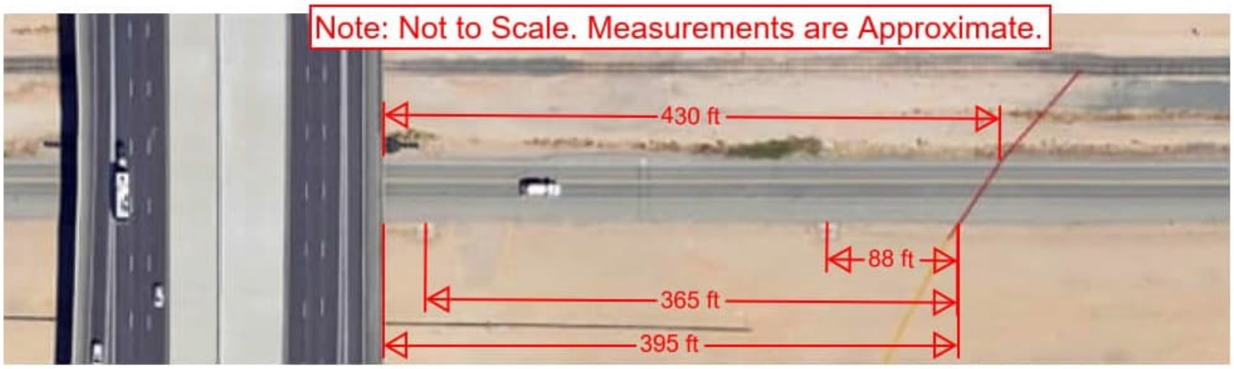
FCDMC, 2006 Oct – 2006 Nov

FCDMC, 2007 Jun – 2007 Jul

FCDMC, 2011 Sep – 2011 Oct

FCDMC, 2017 Sep – 2017 Nov

The historical aerial photograph review and lineament evaluation indicates the earth fissure is located at approximately the location mapped by the USGS (shown on the 2025 Google Earth Pro aerial photograph above). The following figure provides approximate distances (obtained with Google Earth Pro) to the mapped earth fissure based on existing features at the site:



Site Reconnaissance

Field reconnaissance of the site was performed by Terracon on October 6, 7 and 8, 2025 for visual evidence of the presence and/or potential presence of earth fissures and related features. Our field observations were performed in an effort to identify indications of the presence of the mapped earth fissure. Typical features that may indicate the presence of earth fissures include the following:

- Apparent changes in ground surface grade of several feet.
- Distress and vertical changes in surface grade of the asphalt concrete pavement on roadways along known or suspected fissure traces.
- Distress, breaks and deflections of concrete lined irrigation channels.

- Increased concentrations of animal and insect burrows.
- Ground deflation as evidenced by depressions and concentrations of small surface sinks.
- Ground surface collapse under foot traffic.
- Alignment of vegetation along suspected lineaments.

However, given the construction, surficial grading and development that has taken place in the vicinity of the mapped earth fissure, no apparent features indicating the active presence of the earth fissure were observed. In addition, based on information provided by MCDOT, we understand that earth fissure mitigation (such as pavement patching or other) has not been performed at the site due to the mapped earth fissure. Also, based on limited information provided by ADOT, we understand ADOT also has not performed earth fissure mitigation for the pavement at the location of the mapped earth fissure. Further, BNSF track maintenance personnel also indicated they were not aware of previous maintenance issues of the railroad tracks in the area of the AZGS mapped earth fissure.

Geophysical Surveys for Earth Fissure Tracing

To aid in the subsurface characterization as it relates to potential earth fissure trace(s), Terracon performed seismic refraction and ground penetrating radar (GPR) surveys on Olive Avenue at the location of the Arizona Geological Survey (AZGS) mapped earth fissure, east of SR 303L. Refer to Exhibit 1 for the approximate locations of the geophysical survey areas. These geophysical surveys were performed in general accordance with procedures outlined by Rucker ([8]1998 & [9]2006).

> Geophysical Survey Limitations: This geophysical process relies on instrument signals to indicate physical conditions in the field. Signal information can be affected by on-site conditions beyond the control of the operator, such as, but not limited to, cultural features, pavement/soil types and surface conditions. Interpretation of those signals is based on a combination of known factors combined with the experience of the operator and geophysical

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[8] Rucker, M.L., and J.R. Keaton. 1998. Tracing an Earth Fissure Using Seismic Refraction Methods and Physical Verification. In Land Subsidence Case Studies and Current Research: Proceedings of the Dr. Joseph F. Poland Symposium on Land Subsidence, edited by J.W. Borchers, pp. 207-216. Special Publication No. 8. Belmont, California: ,Association of Engineering Geologists, Star Publishing Company.

[9] Rucker, M.L., and O.C. Holmquist. 2006. Surface Seismic Methods for Locating and Tracing Earth Fissures and Other Significant Discontinuities in Cemented Unsaturated Soils and Earthen Structures. In Unsaturated Soils, edited by G.A. Miller, C.E. Zapata, S.L. Houston and D.G. Fredlund, pp. 601-612. Geotechnical Special Publication No. 147. Reston, Virginia: American Society of Civil Engineers.

scientist evaluating the results. Utilizing conventional observation, sampling, and testing of selected areas are recommended to confirm the results from the geophysical surveys. As with all geophysical methods, the geophysical results provide a level of confidence but should not be considered absolute. We cannot be responsible for the interpretation of geophysical results by others. The results presented in this report are based upon the data obtained from the geophysical surveys and from other information discussed in this report. This report does not reflect variations that may occur in areas inaccessible to the geophysical equipment, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident during or after construction.

Geophysical Survey: Seismic Refraction

The seismic system consisted of a linear series of 24 seismic sensors (geophones) and a sledge-hammer/metal plate as the impact source. Due to the dense and gravelly surface conditions, the geophones were mounted to metal pedestals rather than ground spikes. The seismic lines were centered on the mapped location of the possible earth fissure trace, based on publicly available data. In anticipation of the test pit explorations, the seismic refraction surveys were performed on September 17, 18 and 19, 2025.

The seismic data was collected by impacting the ground surface at several locations along the line and recording the resultant energy. Depending on the strength of the seismic signal, several additional shots were collected to improve signal-to-noise ratio. A field review of the energy dissipation was conducted after each shot to note zones in the dataset that appear attenuated, if observed. The recorded seismic energy for each dataset and each line are included in the attachments.

The collected seismic datasets were combined and the time of first recorded energy (“first arrivals”) were selected based on our interpretation. The selected first arrivals were plotted distance along the line vs time. Based on procedures outlined in the referenced Rucker publications, the presence of earth fissures along a seismic refraction line may dampen geophone response beyond the location of the anomaly. This is likely limited to fissures with sufficient aperture (opening width) and no infilling, since the filled fissures may not show sufficient density contrast to cause an interruption. Interruptions or significant attenuations in the signal across the seismic array may be an indication of the presence of an earth fissure. Subsurface disturbances such as earth fissures may cause interruptions in the time-plots between reciprocal shots. The time vs depth plots for each line are included in the attachments.

The results of the geophysical seismic surveys appeared to have occasional geophone recordings with some attenuations in the central portion of the survey lines. However, clear and consistent interruptions and/or significant attenuations were not apparent in the results of the geophysical seismic surveys performed at the site to conclusively identify the earth fissure location. Therefore, the results of the geophysical seismic surveys were inconclusive in regard to identifying the location of the AZGS mapped earth fissure. Earth fissures may still be present, but with a composition, orientation or other concealing condition that was not detectable with the geophysical surveys performed for the project.

Geophysical Survey: Ground Penetrating Radar

As a supplemental method to the seismic testing, Terracon also performed limited Ground Penetrating Radar (GPR) scans of the roadway south shoulder at the location of the AZGS mapped earth fissure. Refer to Exhibit 1 for the approximate location of the GPR scans. The GPR scans were generally centered on the AZGS mapped earth fissure location. The GPR system consisted of a cart-mounted 200 MHz antenna, with the goal of identifying anomalous zones beneath the pavement that may correlate with the estimated earth fissure. A series of parallel lines were collected with the GPR, combined and modeled to generate a plan view of changes in GPR amplitude with depth. Relative changes in GPR amplitude may be indications of differences in material properties. Imaging depth of GPR is controlled by several factors, including but not limited to material density, pavement integrity, moisture content, and soil salinity. The GPR scans for this site imaged to an approximate depth of 3 feet. In anticipation of the test pit explorations, the GPR surveys were performed on September 29, 2025.

Refer to Exhibit 4 for the combined GPR amplitude for the upper roughly 3 feet. The presence of an earth fissure of sufficient size would be expected to cause an anomaly in the GPR response. Anomalous zones (concentrated shades of yellow to red) were observed in the GPR data in the northwest and north central portions of the GPR scanned area. However, clear and consistent GPR anomalies indicating the presence of an earth fissure were not apparent. The anomalous zones observed with the GPR scanning appear to be related to other subsurface aggregate base or subgrade conditions, rather than indications of an earth fissure. Therefore, the results of the geophysical GPR surveys were inconclusive in regard to identifying the location of the AZGS mapped earth fissure.

Earth Fissure Trench Field Exploration

With the results of the geophysical surveys being inconclusive in identifying the location of the earth fissure, the locations of the 2 earth fissure trench explorations (designated as T-1 and T-2) were based on the historical aerial photograph review and lineament evaluation. The 2 trench explorations were performed in an effort to visually expose the AZGS mapped earth fissure.

The trenches were performed on October 6, 7 and 8, 2025. The trenches were excavated with a John Deere 310 backhoe using a 2-foot wide bucket. The trenches were excavated to depths of approximately 4 to 5 feet below the existing ground surface and a length of approximately 40 feet (along an east-to-west alignment). Trench No. T-1 was located on the south side of Olive Avenue and generally centered with the AZGS mapped earth fissure location. Trench No. T-2 was located on the south side of Olive Avenue and generally centered with the location of an apparent GPR anomalous area. Trenching on the north side of Olive Avenue was not performed due to the presence of various underground utilities and stockpiles of railroad ballast material resulting in limited exploration areas.

The attached Exhibit 5 provides a trench location map and a continuous photographic image of the trench sidewalls. The horizontal stratifications of the subsurface soils exposed on the trench walls were not observed to include significant or abrupt discontinuities or vertical shifting (indicating an earth fissure). Earth fissure crack(s) or infilled earth fissure crack(s) was/were not apparent nor observed within the trench explorations. Therefore, the earth fissure was not revealed by the trench explorations and the results of the trench explorations were inconclusive in regard to identifying the location of the AZGS mapped earth fissure. As previously mentioned, the trench excavation should also be considered inconclusive in regard to identifying the earth fissure location, as the earth fissures may still exist.

Once the trench excavations and our field observations of the trench sidewalls were completed, the trench excavations were backfilled with engineered (compacted) fill. The backfilling was performed by moisture conditioning the excavated soils to approximately their optimum moisture content (in accordance with ASTM D698), placed in relatively thin (loose lifts), and compacted to a minimum of 95% of the maximum dry density in accordance with ASTM D698. The maximum dry density and optimum moisture content from our Standard Proctor testing performed on the bulk sample obtained from Boring No. R-101 from 0 to 4 feet was used for the trench excavation backfilling operations.

Earth Fissure Evaluation Discussion and Recommendations

The following table summarizes the results of our earth fissure evaluation for the project:

Evaluation Method	Results of Evaluation
Earth Fissure Maps	Positive Evidence
Historic Aerial Photographs / Lineament Evaluation	Positive Evidence
Geophysical Survey: Seismic P-Wave & MASW	Inconclusive
Geophysical Survey: Ground Penetrating Radar	Inconclusive
Site Reconnaissance	Inconclusive
Earth Fissure Trench Exploration	Inconclusive

The results of the historic aerial photographs and lineament evaluation indicate the presence and location of the earth fissure at the project site. This earth fissure was likely a result of the historic groundwater withdrawal and subsequent ground subsidence. It appears the groundwater recharging shown by the well logs in the area may have resulted in a reduction of earth fissure activity at the project site. Based on the results of the earth fissure evaluation, we offer the following suggested options for MCDOT to consider:

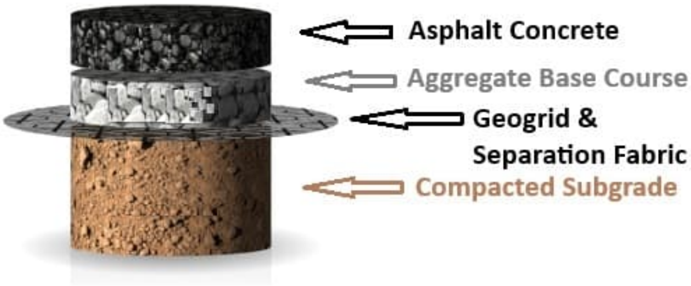
Option 1 - No Earth Fissure Mitigation – Based on the results of the earth fissure evaluation, it appears the earth fissure is relatively stable. Based on information provided by MCDOT, we understand the Olive Avenue roadway has not been patched or repaired in the past due to previous earth fissure activity. In addition, cursory information provided by ADOT also indicated no previous repairs on Olive Avenue at the location of the earth fissure. Further, BNSF track maintenance personnel also indicated they were not aware of previous maintenance issues of the railroad tracks in the area of the AZGS mapped earth fissure. The following provides a summary of pros and cons for this suggested option:

- Pros: Cost savings now. If earth fissure continues to be stable, then no need for additional costs.
- Cons: If the earth fissure creates distress on the roadway, then earth fissure mitigation may be required in the future. In addition, if the earth fissure creates distress on the roadway, then the exact location of the earth fissure would be revealed.

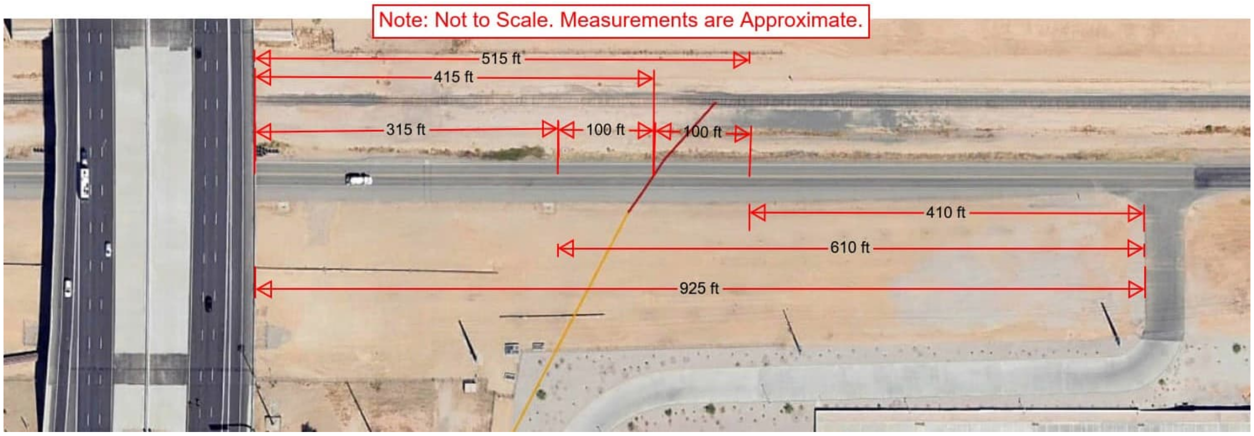
Option 2 - Intermediate Earth Fissure Mitigation – The aggregate base course for the planned new pavement section could be reinforced with a layer of geogrid (e.g., Tensar TX190, BX1200, or similar). The geogrid layer for this option is recommended to include an attached separation geotextile. The geogrid (with attached separation fabric) should be placed along the entire width of the roadway and extend 100 feet west and east of the AZGS mapped earth fissure (totaling a 200-foot length of aggregate base course reinforced with geogrid). The placement of geogrid reinforcement (with attached separation fabric) should be in accordance with the manufacturer's recommendations. The following provides a summary of pros and cons for this suggested option:

- Pros: Likely reduced cost when compared to the earth fissure soil-cement reinforcement recommended by AMEC. This option would provide increased reinforcement to the pavement section when compared to no reinforcement.
- Cons: If the earth fissure is sufficiently active in the future, there is the potential of distress on the roadway (even with the geogrid reinforcement), which then could require earth fissure mitigation in the future. Similar to the previous option, if the earth fissure creates distress on the roadway, then the exact location of the earth fissure would be revealed.

The following image shows a typical pavement section consisting of asphalt concrete (AC), aggregate base course (ABC) and geogrid reinforcement (with attached separation fabric):



The following image shows the approximate extents outlined above for the length of the project roadway recommended to include a geogrid (and attached separation fabric) reinforcement for this option:



Option 3 – AMEC Earth Fissure Mitigation – This option includes constructing the earth fissure mitigation shown on the 100% plans for the project and in accordance with the AMEC Earth Fissure Mitigation Report dated June 15, 2017 (AMEC Project No. 17-2017-4026). The historic aerial photographs and lineament evaluation indicated the earth fissure is approximately at the earth fissure location mapped by AZGS. Therefore, if this option is selected, the location of the earth fissure mitigation shown on the 100% plans should be centered with the AZGS mapped earth fissure location. The following provides a summary of pros and cons for this suggested option:

- Pros: Provides significant reinforcement to mitigate against the earth fissure.
- Cons: Given the inconclusive results of the various earth fissure evaluation methods performed for the project, there is some uncertainty in the actual location of the earth fissure; therefore, there is a potential of not placing the AMEC earth fissure mitigation entirely along the earth fissure or along the earth fissure.

Geotechnical Characterization

Note: As outlined in the Project Description Section of this report, previous geotechnical engineering services performed by AMEC for MCDOT included the project site. Based on the information provided and discussions with MCDOT, we understand Terracon can rely on the previous geotechnical engineering information presented in the AMEC reports. Therefore, selected data from the AMEC geotechnical engineering reports was used to supplement this geotechnical engineering report.

Subsurface Conditions

Specific conditions encountered at each boring location are indicated on the individual boring logs presented in the Exploration Results section. Stratification boundaries on the boring logs represents the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. The following table summarizes the pavement thicknesses observed and the subgrade soil conditions encountered.

Location	Approx. AC Thickness (inches)	Approx. ABC Thickness (inches)	Subgrade Soil Encountered	Roadway	Exploration Completed By:
B-7	--	--	Silty Sand	Olive Ave.	AMEC
R-101	--	--	Fill: Silty Clayey Sand	Olive Ave.	Terracon
C-4	1-3/8	1-5/8	--	Olive Ave.	AMEC
B-8	--	--	Silty Sand	Olive Ave.	AMEC
R-102	--	--	Sandy Silty Clay	Olive Ave.	Terracon
B-9	--	--	Silty Clayey Sand	Olive Ave.	AMEC
C-5	2¾	1¼	--	Olive Ave.	AMEC
B-10	--	--	Sandy Silty Clay	Olive Ave.	AMEC
B-11	--	--	Silty Clayey Sand	Olive Ave.	AMEC
C-6	1½	¾	--	Olive Ave.	AMEC
B-12	--	--	Silty Clayey Sand	Olive Ave.	AMEC
B-13	--	--	Clayey Sand	Olive Ave.	AMEC
C-7	4¼	None	--	Olive Ave.	AMEC
B-14	--	--	Clayey Sand	Olive Ave.	AMEC
R-103	--	--	Clayey Sand	Sarival Ave	Terracon
R-104	--	--	Silty Clayey Sand	Sarival Ave	Terracon
R-105	--	--	Sandy Silty Clay	Reems Rd.	Terracon
R-106	--	--	Clayey Sand	Reems Rd.	Terracon

Based on conditions encountered by Terracon and AMEC in the borings at the project site, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to the Bottom of Stratum	Material Description	Relative Density / Consistency
Stratum 1	2 to 4½ inches	AC: 1-3/8 to 4½ inches ABC: None to 1-5/8 inches	----
Stratum 2	0 to 5 Feet	Generally Silty and/or Clayey Sands with occurrences of Sandy Silty Clay and Sandy Lean Clay	Loose to Medium Dense / Stiff to Very Stiff
Stratum 3	25½ feet (maximum depth of exploration)	Stratified deposits of fine- and coarse-grained soils including Silty and/or Clayey Sands, Sandy Lean Clay, Sandy Silty Clay, and Sandy Silt.	Variable: Loose to Dense / Stiff to Hard

Notes:

The surface and near surface soils at roadway borings indicated greater relative densities / consistencies.

Fill soils were encountered to a depth of approximately 4 to 5 feet at the location of Borings R-101, S-102, and D-102.

Summary of Laboratory Test Results

Laboratory tests were performed on selected soil samples and the test results are presented in the Exploration Results. Soil samples obtained from the borings were used for geotechnical engineering analysis for the proposed project. The following is a brief summary of laboratory testing performed on selected soils samples obtained from the borings:

Laboratory Test	Description of Test Results
Atterberg Limits/ Gradation	The Atterberg limits test results of the near surface soils along the project alignment generally exhibit low (and occasionally medium) plasticity characteristics (with plasticity indices ranging from 0 to 15, with an average of 8). The gradation test results of these near surface soils indicate percent fines (percent passing the sieve No. 200) ranging from approximately 22 to 63 percent (with an average of 44), percent sand ranged from approximately 37 to 78 percent, and percent gravel ranged from about 0 to 7 percent.
In-situ Ring Density / Moisture	Testing of selected ring samples obtained from the borings at depths within the near surface soils (upper 5 feet) indicated in-situ moisture contents ranging from approximately 2 to 16 percent with an average of approximately 6 percent; and in-situ dry densities ranging from

Laboratory Test	Description of Test Results
	approximately 96 to 117 pounds per cubic foot (pcf) with an average of approximately 107 pcf.
Laboratory Moisture-Density Relationships	Standard Proctor (ASTM D698) test results indicated maximum dry densities of the site soils ranging from approximately 118.4 to 129.1 pounds per cubic foot (pcf) at optimum moisture contents ranging from approximately 9.0 to 12.5 percent.
Remolded Swell	The remolded swell testing on the soils indicated expansion potentials ranging from approximately 0.1 to 2.8 percent (with an average of 1.0%) when compacted to approximately 95 percent of their maximum dry density (ASTM D698) at a moisture content of approximately 2 percent below optimum with 100 to 144 pounds per square foot (psf) surcharge. Based on the results of our field and laboratory testing, we anticipate the site soils to generally have a low expansion potential.
R-Value	R-Value testing indicated results ranging from approximately 28 to 75.
Consolidation/ Compression	In response to wetting of relatively undisturbed samples while supporting typical foundation pressures, the near surface soils exhibit variable low to significant hydro-compaction (collapse) potentials. Hydro-compactive soils (sometimes referred to as collapsible soils) are capable of supporting typical building loads at natural moisture contents. However, these same materials undergo volume decrease (settlement/consolidation) when subjected to increases in moisture content under constant load. These same soils also indicate low to moderate compression under typical foundation pressures.

The following table indicates the classifications of the roadway subgrade soils based on the American Association of State Highway and Transportation Officials (AASHTO) soil classification system. Based on this classification, the pavement subgrade materials underlying the proposed new pavements are generally considered to generally have Fair subgrade support characteristics for pavements across the project alignment. The project alignment also includes isolated occurrences of Poor and Good subgrade support characteristics.

The AASHTO classification method also provides for the calculation of a Group Index, which is used as a scale for rating soil quality within a group. The Group Index (GI) values from the laboratory testing are summarized in the table below. With the exception of the subgrade soils at the location of B-7 and B-13, the Group Index values indicate the subgrade soils are generally considered somewhat uniform across the project site.

SUBGRADE SOIL CLASSIFICATION				
Boring No.	Approx. Depth (feet)	USCS Classification	AASHTO Classification	AASHTO Group Index
B-7	0 – 5	CL	A-6	4
R-101	0 – 4	SC-SM	A-2-4	0
B-8	0 – 5	SM	A-2-4	0
R-102	0 – 5	CL-ML	A-4	1
B-9	0 – 5	SC-SM	A-4	0
B-10	0 – 5	CL-ML	A-4	1
B-11	0 – 5	SC-SM	A-4	0
B-12	0 – 5	SC-SM	A-4	0
B-13	0 – 5	SC	A-6	3
B-14	0 – 5	SC	A-2-6	1
R-103	0 – 4	SC	A-4	0
R-104	0 – 5	SC-SM	A-4	0
R-105	0 – 0.8	CL-ML	A-4	2
R-106	0 – 5	SC	A-4	1

Note: The AASHTO Classifications indicate the following general subgrade support characteristics:

🟩	Indicates Excellent to Good Subgrade Support Characteristics
🟨	Indicates Fair Subgrade Support Characteristics
🟥	Indicates Fair to Poor Subgrade Support Characteristics

Expansion Potential

The near surface soils encountered at the site along the proposed roadway improvements were generally comprised of Silty and/or Clayey Sands with occurrences of Sandy Silty Clay and Sandy Lean Clay. The plasticity characteristics of these site soils were generally in the low (and occasionally medium) plasticity range. The laboratory testing included performing standard laboratory moisture-density relationships (i.e. standard Proctor ASTM D698) and remolded swell tests on the near surface soils sampled from our borings. The remolded swell testing on the soils indicated expansion potentials ranging from approximately 0.1 to 2.8 (with an average of 1.0%) percent when compacted to approximately 95 percent of their maximum dry density (ASTM D698) at a moisture content of approximately 2 percent below optimum with 100 to 144 pounds per square foot (psf) surcharge. Therefore, the majority of the subgrade soils underlying the project site are anticipated to have a low expansion potential and not require treatment for swelling soils.

However, the laboratory testing performed on the subgrade soils at the location of the (AMEC) Boring B-13 indicated a moderate expansive potential of approximately 2.8%. Therefore, recommendations for lime stabilization of the subgrade soils are presented in the following sections of this report for this localized Boring B-13 area (for the subgrade soils along Olive Avenue from Reems Road to approximately 500 feet east of Reems Road).

Groundwater Conditions

Groundwater was not observed in the test borings at the time of our field exploration, nor when checked upon completion of drilling. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Groundwater conditions can change with varying seasonal and weather conditions, and other factors.

Based on information obtained from the Arizona Department of Water Resources – Groundwater Data website, the depth to regional groundwater was most recently measured in November 26, 2002 to be approximately 477 feet below the ground surface (approximate elevation of 699 feet above mean sea level) at an Arizona Department of Water Resources (ADWR) monitored well site (Local I.D.: B-02-03 36ABB) located at approximately the southwest corner of Olive Avenue and SR303L.

Double Ring Infiltration Testing

Double ring infiltration testing was performed at the proposed retention basin areas at the locations shown on the attached Exploration Plan. The infiltration testing was performed in general accordance with the procedures outlined in ASTM D3385 *Standard Test Method for Infiltration Rate of Soil in Field Using Double-Ring Infiltrometer* test method as required by the Maricopa County Flood Control District. A backhoe and operator were subcontracted to excavate to a depth of approximately 3 to 4 feet below the existing ground surface at the infiltration test locations. In addition, a soil boring was drilled at each infiltration test location.

A log of each soil boring and detailed test results of field measurements of the double ring infiltration tests are shown in the attached Exploration and Laboratory Results section of this report. The double ring infiltration test field measurements are provided to aid with the design of the proposed storm-water retention basins. We understand the storm-water retention basin design will be performed by others.

The field infiltration rates measured are based on the soil conditions encountered at the particular location of the infiltration tests, and the actual infiltration rate may vary from the values reported here. The following table summarizes the field measurements of the double ring infiltration testing performed at the site:

Infiltration Test Results

Test Hole	Depth (feet)	Soil Classification	Inner Ring Field Infiltration Rate (inches/hour)
DRI-101	3	Silty Clayey Sand	6.1
DRI-102	4	Silty Clayey Sand	5.2
DRI-103	3	Silty Clayey Sand	1.1
DRI-104	4	Sandy Silty Clay	4.0

It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the on-site retention basin areas. The infiltration rates presented in this report are unfactored field measurements, and a de-rating factor should be applied to the infiltration rate during the design of the proposed storm-water retention basins (performed by others). The de-rating factors should be in accordance with the Maricopa County Drainage Policies and Standards.

We recommend that excavations for the retention basins be excavated with light weight equipment to help reduce compaction of the basin bottom surface which will ultimately be used for infiltration of storm water. Once constructed, no traffic should be allowed to travel across the basin bottom. It should be noted that compaction of the basin bottom will result in reduced infiltration rates. If compaction of the basin bottom does occur, the exposed surface should be scarified to a minimum depth of 8 inches and left uncompacted.

Corrosivity

The table below lists the results of laboratory testing for pH, minimum electrical resistivity, soluble sulfate, and soluble chloride. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction. The following table provides a summary of the corrosivity test results:

Boring No.	Sample Depth (feet)	Soil Description	pH	Minimum Electrical Resistivity (Ω-cm)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)
R-102	0 – 5	Sandy Silty Clay	8.3	2,147	51	18
B-8	0 – 5	Silty Sand	8.8	3,425	122	11
B-11	0 – 5	Silty Clayey Sand	7.9	1,439	117	29
S-101	0 – 5	Silty Clayey Sand	8.7	3,221	121	8
S-102	0 – 4	Silty Clayey Sand	8.6	2,013	129	16
S-103	0 – 5	Silty Sand	8.6	2,214	160	51
S-104	5 – 10	Clayey Sand	8.3	1,476	144	68

Boring No.	Sample Depth (feet)	Soil Description	pH	Minimum Electrical Resistivity (**Ω**-cm)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)
S-105	0 – 5	Sandy Lean Clay	8.4	939	173	75
S-106	5 – 10	Silty Sand	8.6	2,349	104	45

Results of soluble sulfate testing indicate that samples of the on-site soils tested classify as S0 according to Table 19.3.1.1 of Section 318 of the American Concrete Institute (ACI) Building Code Requirements for Structural Concrete. Therefore, American Society for Testing and Materials (ASTM) Type I/II portland cement is considered suitable for concrete at the site in contact with similar soluble sulfate concentrations. Concrete should be designed in accordance with the provisions of the ACI Building Code Requirements for Structural Concrete, Section 318, Chapter 19.

These values should be used to help determine potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction. Refer to Summary of Laboratory Results contained in Exploration Results for the complete results of the corrosivity testing performed on the site soils in conjunction with this geotechnical exploration. The corrosion information presented is specific to the samples tested. If the actual soils that will be in contact with the structures at the site are different than those tested, then additional corrosion testing should be performed. Terracon is not a corrosion engineer, and our scope of work was limited to performing corrosion laboratory tests on selected samples, presenting these results, and providing a brief comparison of the results to selected criteria. A qualified corrosion engineer should be consulted if corrosion of underground utilities and structures is a concern.

Pavement Structural Section Design

General Pavement Comments

Geotechnical and pavement engineering recommendations for the construction of the pavements associated with the proposed roadway improvements are presented in the following sections. These recommendations are based on our understanding of the project, the results of our field exploration and laboratory testing for the site, and our engineering analysis and design.

> Note: Based on information provided by MCDOT, we understand the pavement design for this project will be based on MCDOT Roadway Design Manual for AASHTO-93 and we understand Mechanistic-Empirical (ME) pavement design is not required for this project. Therefore, this report excludes ME pavement design.

Traffic Analysis

The traffic data presented in this report such as roadway classification, Average Daily Traffic (ADT), predicted growth rates and truck percentages, and estimated unit costs were provided by MCDOT. Detailed design calculations regarding conversion of the traffic data to 18-kip Equivalent Axle Loads (ESALs) are included in this report. The following tables summarize the information provided to Terracon:

General Traffic Data

Roadway Section	Street Classification	Planned Number of Lanes	2023 ADT
Olive Avenue – From SR303L to Sarival Avenue	Principal Arterial	5-lanes consisting of 2 lanes in each direction & 1 center turn lane)	4,856
Olive Avenue – From Sarival Ave to Reems Road	Principal Arterial		4,205
Sarival Avenue – ¼-mile Intersection Improvements	Minor Arterial	2 lanes in each direction with median and/or turn lanes	2,258
Reems Road – ¼-mile Intersection Improvements	Major Collector (Industrial)	1 lane in each direction with thru, median, and/or turn lanes	6,513

Design Traffic Data

Roadway Section	2026 ADT*	Design Period (years)	Estimated Growth Rate (%)	Estimated Truck Percentage (**TEF 1.2)***	Car Percentage (**TEF 0.0008)
Olive Ave – SR303L to Sarival	5,621	20	5	5%	95%
Olive Ave – Sarival to Reems	4,868	20	5	5%	95%
Sarival Avenue - Intersection	2,614	20	5	5%	95%
Reems Avenue - Intersection	7,540	20	5	5%	95%

*Note: The 2023 projected to 2026 based on the estimated growth rate.
**Note: Traffic Equivalency Factor (TEF).
***Note: The traffic data provided indicated lower percent trucks; and the truck percentage used for the design is based on information provided by MCDOT.

The above ADT data are 2-way and each direction is assumed to receive the same amount of traffic, which results in a Directional Distribution Factor of 50 percent. Based on the planned number of lanes, Lane Distribution Factors of 100 and 90 percent were selected. Based on this information, the initial two-way daily traffic ($W_{0(2-18)}$), in terms of 18-kip equivalent single axle loads (ESALs), was determined by multiplying the number of cars and trucks by their TEF. Based on the data shown above, we also calculated the Overall

Growth Factor (OGF) for a 20-year design period. The initial two-way daily traffic and OGF we calculated for the proposed roadway improvements are the following:

$W_{0(2\text{-}18)}$ and OGF

Roadway Section	Initial Two-Way Daily 18-Kip ESAL ($W_{0(2\text{-}18)}$)	OGF
Olive Avenue – From SR303L to Sarival Avenue	341.5	33.07
Olive Avenue – From Sarival Ave to Reems Road	295.8	33.07
Sarival Avenue – ¼-mile Intersection Improvements	158.8	33.07
Reems Road – ¼-mile Intersection Improvements	458.1	33.07

The two-way 18-kip ESAL for the design period ($W_{2\text{-}18}$) was calculated by multiplying the initial two-way daily 18-kip ESAL by the OGF and by 365 days. The resulting values were then multiplied by the Directional Distribution Factor and by the Lane Distribution Factor in order to determine the design lane 18-kip ESALs (W_{18}). The two way 18-kip ESALs for the design period and the design lane 18-kip ESALs for the proposed roadway improvements are the following:

Roadway Section	Two-Way 18-Kip Design ESAL ($W_{2\text{-}18}$)	Design Lane 18-kip ESALs (W_{18})
Olive Avenue – From SR303L to Sarival Avenue	4,121,974	1,854,888
Olive Avenue – From Sarival Ave to Reems Road	3,569,787	1,606,404
Sarival Avenue – ¼-mile Intersection Improvements	1,916,890	862,601
Reems Road – ¼-mile Intersection Improvements	5,529,209	2,764,605

Pavement Subgrade Parameters

The design resilient modulus (M_R) for the pavement analyses was determined in accordance with the procedures of the MCDOT Roadway Design Manual. The methodology uses data from actual R-value tests as well as R-value data correlated with sieve and plasticity test results. Samples of subgrade materials were tested for sieve analysis, plasticity index, and R-value. Based on the results of the laboratory testing and our analyses of the AASHTO Group Index data, the subgrade conditions along the alignment of the proposed new pavements were averaged and a single design R-value was used along the entire project. Based on the laboratory test results and in general accordance with the MCDOT Roadway Design Manual, the calculated mean R-value (R_{MEAN}) and corresponding soil resilient modulus (M_R) are included as an attachment to this report and are summarized in the following table:

R_{MEAN} and M_R

Roadway Section	Mean R- Value (R_{MEAN})	Resilient Modulus (M_R)
Olive Ave – SR303L to Sarival	37.9	23,002 psi
Olive Ave – Sarival to Reems		
Sarival Avenue - Intersection		
Reems Avenue - Intersection		

Pavement Design Parameters

Analyses for the pavement design of the project were based on the procedures of AASHTO as modified by the MCDOT Roadway Design Manual. Based on the information outlined in this report, the following design parameters were determined by the procedures outlined in the MCDOT Roadway Design Manual and were utilized for pavement engineering analyses for the project:

Design Parameter		Per MCDOT Design Method	
Project Roadway		Olive Ave & Sarival Ave	Reems Road
Roadway Classification		Principal/ Minor Arterial	Major Collector
Analysis Period		20 years	
Level of Reliability Standard Normal Deviate, Z_R		95% -1.645	90% -1.282
Overall Standard Deviation		0.45	
Serviceability	Initial (P_0) PSI	4.5	4.4
	Terminal (Pt) PSI	2.5	2.3
Seasonal Variation Factor		1.0	
Layer Structural Coefficients	PMTR Asphalt Concrete (PMTR AC)	0.42	
	Asphalt Concrete (AC)	0.42	
	Aggregate Base (ABC)	0.12	

Pavement Thickness Design Recommendations

Design calculations for the project incorporating the parameters outlined above are attached to this report. Based on the results of the design calculations, the minimum Structural Number (SN) required for the project is summarized in the following table:

Pavement Design Summary

Roadway Section	Design ESALs (20 years)	Design Resilient Modulus (M_R in psi)	Calculated Structural Number Required (SN)	Minimum SN Required
Olive Ave – SR303L to Sarival	1,854,888	23,002	2.64	2.88
Olive Ave – Sarival to Reems	1,606,404		2.58	2.88
Sarival Avenue - Intersection	862,601		2.33	2.88
Reems Avenue - Intersection	2,764,605		2.64	2.88

The Calculated SN Required for the roadways are below the Minimum SN Required by the MCDOT Roadway Design Manual. Therefore, a single pavement structure recommendation with its alternatives is presented for the project roadways. Based on the information provided as outlined in this report and in general accordance with the MCDOT Roadway Design Manual, the following table outlines the recommended pavement structure sections for the proposed roadway improvements:

AC Recommended Pavement Section Alternatives for:
Olive Avenue, Sarival Avenue and Reems Road [1, 2]

Pavement Construction Item	Thicknesses (inches)	
	Alt. A (PMTR AC/ AC/ ABC)	Alt. B (Alt A. with Geogrid)
PMTR AC (½-inch mix) (MAG 321) [3]	2.0	2.0
AC Pavement (¾-inch mix) (MAG 321)	3.5	3.5
Aggregate Base Course (MAG 310)	5	5
Geogrid Reinforcement	--	YES [4]
Total Pavement Thickness:	10.5	10.5
[2] Required Structural Number (SN):	2.88	2.88
[3] Actual Structural Number (SN):	2.91	2.91

Note 1: The asphalt concrete for this project should be based on a gyratory mix. Polymer and tire rubber modified asphalt concrete (PMTR AC); Asphalt Concrete (AC); Aggregate Base Course (ABC). Note 2: A layered analysis indicated the minimum layer thicknesses shown in the table above. Note 3: The surface layer of Alternative A consists of polymer and tire rubber modified asphalt concrete (PMTR AC) in accordance with Section 710 of the MCDOT Supplement to the MAG specifications. Note 4: Pavement reinforcement for Earth Fissure Mitigation Option 2 with geogrid and attached separation fabric (e.g., Tensar TX190, BX1200, or similar). The placement of geogrid reinforcement (with attached separation fabric) should be in accordance with the manufacturer's recommendations.

Site grading within the new pavement areas should be accomplished as recommended in this report. A compacted subgrade of on-site soils or imported soils with equal or greater supporting properties is assumed. In an effort to reduce water infiltration and retard premature oxidation of the surfacing, the pavement surface should be sealed after the first summer of use, and routinely thereafter.

Lime Stabilization: The field and laboratory testing indicated 1 isolated occurrence of moderate expansion subgrade soils at the location of Boring B-13 (on Olive Avenue). Therefore, the subgrade soils underlying the proposed pavements in the area of Boring B-13 should be stabilized in place to a depth of 6 inches as outlined in the MCDOT Roadway Design Manual (and MAG Section 309 Lime Slurry Stabilization). The subgrade lime stabilization should extend under the proposed pavement of Olive Avenue from Reems Road to approximately 500 feet east of Reems Road (or approximately 250 feet east and west of Boring B-13). In addition, the lime stabilization should also have a lateral extent beyond the north and south edges of the pavement of 2 feet.

> Note: Based on the information provided, a full depth asphalt pavement section is not considered for this project; therefore, full depth asphalt pavement recommendations are excluded from this report.

Preliminary Economic Evaluation of Alternatives

The MCDOT Pavement Design Guide recommends an economic evaluation of the pavement design alternative for this project. The preliminary cost estimate were prepared based on unit rates provided by MCDOT and their corresponding price factors presented in Section 10.3 of the MCDOT Roadway Design Manual. The following table summarizes the estimated cost of the recommended pavement section alternatives for the proposed improvements:

PRELIMINARY EVALUATION OF ALTERNATIVES

Pavement Construction Item	Thickness (in)		Unit Price ($/sy/in)	Costs Per Square Yard	
	Alt. A	Alt. B		Alt. A	Alt. B
321 PMTR Asphalt Concrete	2	2	$7.45	$14.90	$14.90
321 Asphalt Concrete Pavement	3.5	3.5	$7.34	$25.69	$25.69
310 Aggregate Base Course	5	5	$1.61	$8.05	$8.05
Geogrid Reinforcement w/ Separation Fabric	--	Yes	Quote	--	Add Geogrid
Total Cost Per Square Yard				$48.64	$48.64 + Geogrid

The results of this economic evaluation favor Alternative A for initial cost considerations followed by Alternative B. If the PMTR AC quantities are practical for the construction of the proposed improvements, then Alternative A is recommended. This evaluation only represents potential estimated initial costs and does not account for life-cycle costs which would include costs for future maintenance and rehabilitation efforts.

Box Culvert Foundation Design and Construction

Based on the information provided, we understand the project will include the construction of the following box culvert structures:

- Reinforced Concrete Box Culvert (RCBC) crossing Olive Avenue diagonally at approx. 100 feet east of Sarival Avenue (approx. Sta. 218+00).
- RCBC adjacent to the south of Olive Avenue at approx. 2,300 feet east of Sarival Avenue (approx. Sta. 240+00).
- RCBC adjacent to the south of Olive Avenue at approx. 800 feet west of Reems Road (approx. Sta. 257+00).
- RCBC adjacent to the south of Olive Avenue at approx. 200 feet west of Reems Road (approx. Sta. 263+00).
- Two RCBCs near crossings with the BNSF Railroad at approx. Sta. (215+00 and 215+50).

Foundation Subgrade Preparation

We understand the box culvert structures are planned to be supported on a mat slab type foundation. Based on the geotechnical exploration, the site soils underlying the planned box culvert structures include relatively weak (low blow count) soils with low to moderate collapse potentials. Further, as the box culverts manage stormwater, the underlying soils in the area of the box culvert are anticipated to be subjected to increases of moisture content. Therefore, the planned box culvert structures are recommended to be supported on engineered (compacted) fill.

If engineered fill is imported to the project site, the engineered fill should provide equal or greater strength properties than the native soils and should provide a uniform thickness and bearing surface underlying the foundation footprint area. Any loose/disturbed or otherwise unsuitable material in the bottom of foundations excavations should be removed before foundation concrete is placed. Exposed areas which will receive fill, once properly cleared and benched where necessary, should be proof-rolled to identify areas of continuously low density, loose, soft or otherwise unsuitable soils, then these (unsuitable) soils should be removed and replaced as engineered fill as directed by the project geotechnical engineer or their representative. Engineered fill should extend below proposed foundations within the geometric configurations and depths indicated in the following table:

Foundation Type	Depth of Engineered Fill Below Foundation	Lateral Extent of Engineered Fill Beyond Edge of Foundation
Box Culvert / Mat Foundation	A minimum depth of 2 feet below the bottom of the proposed foundations or 2 feet below existing grade, whichever is deeper.	A minimum of 2 feet horizontally beyond the edges of foundations.

Note1: If the site conditions include existing features preventing the recommended lateral extent of the engineered fill beyond the edge of the foundation, then as an alternative the foundation over-excavation can backfilled with a 1-sack controlled low strength material (CLSM) as outlined in the Maricopa Associated Governments (MAG) Uniform Standard Specifications, Section 728. The recommended lateral extent of a minimum of 2 feet horizontally beyond the edges of the foundation can be reduced up to the edge of the foundation (provided the entire footprint of the planned foundation is supported on at least a 2-foot thick bearing stratum of CLSM).

Note2: Boring No. S-107 in the area of the BNSF right-of-way was not accessible. Therefore, the following additional measures are recommended for the culvert planned in the BNSF railroad right-of-way. The recommended minimum depth of Engineered Fill and including its lateral extent (outlined above) for the culvert planned in the BNSF railroad right-of-way should consist of 1-sack CLSM (MAG, Section 728).

Mat-Slab Foundation Design Recommendations

Design recommendations for mat-slab foundations for the proposed box culverts and reinforced concrete wingwalls or headwalls (if used on the project) are presented below. The following mat-slab- and shallow spread-foundation recommendations are outlined in the following table:

Item	Description
Foundation Type	Conventional Shallow Mat-Slab Foundations and Small Wing Wall Footings
Required Bearing Stratum	Compacted engineered fill placed within the geometric configurations and depths below foundations as outlined in the Foundation Subgrade Preparation Section of this report.
Allowable Bearing Pressure	Any practical value up to 1,500 psf
Minimum Foundation Dimensions	Mat-Slab Foundation: 2 feet Wing Wall Footings: 1.5 feet
Maximum Foundation Dimensions	Mat-Slab Foundation: 10 feet Wing Wall Footings: 4 feet
Minimum Embedment below	1 foot for mat-slab foundations

Item	Description
Finished Grade	2 feet for shallow spread-type foundations
Estimated Total Settlement from Structural Loads	Approximately 1 inch or less
Estimated Differential Settlement	About ¾ of total settlement

Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation. The allowable foundation bearing pressure applies to dead loads plus design live load conditions. The weight of the foundation concrete below grade may be neglected in dead load computations. Foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in walls is recommended. If the foundations are anticipated to be subjected to scour, then the recommended embedment depth should be increased by the scour depth.

We estimate a modulus of subgrade reaction (k_s) value of 175 pounds per square inch per inch of deflection (pci) may be used for mat-slab foundations supported on the engineered fill soils. If practicable, we recommend a perimeter turn-down (or thickened edge) extending 8 to 12 inches below the bottom of the mat-slab foundations in an effort to reduce lateral moisture infiltration into the bearing soils.

Foundation excavations should be observed by a qualified representative of the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, the geotechnical engineer should be contacted to provide supplemental recommendations.

Lateral Earth Pressure Parameters

Lateral earth pressures on retaining walls will be dependent on the materials used as backfill. We recommend materials used for retaining wall backfill meet the requirements of ADOT Structure Backfill. Structure Backfill should be in accordance with Section 203 of the ADOT Standard Specifications. Recommended lateral earth pressures are as follows:

Design Case	Equivalent Fluid Pressures[3]	
	Effective Stress (Drained) Condition[1]	Total Stress (Saturated) Condition[1]
Active Case (ADOT Structure Backfill)	35 psf/ft	80 psf/ft
Passive Case (On-Site Soils)	305 psf/ft	195 psf/ft
At-Rest Case (ADOT Structure Backfill)	55 psf/ft	90 psf/ft
Coefficient of Base[2] Friction (On-Site Soils)	0.35	

Note[1]: The values are based on the use of ADOT Structure Backfill or equivalent.
Note[2]: The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.
Note[3]: The earth pressures do not include a safety factor. Therefore, appropriate safety factors should be applied to the design.

The lateral earth pressures herein exclude any factor of safety, they assume a horizontal backfill, they do not include surcharge loading, and they are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design. The lateral earth pressures presented above do not include any surcharge due to live loads acting on approach slabs. Appropriate additional loading and load factors should be applied in the design, if applicable.

Fill against foundation and retaining walls should be compacted to densities specified in the Materials Design section of this report. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.

If ADOT Structure Backfill is specified in the design, the wall backfill should be placed in accordance with the details shown on ADOT Standard Drawing SD 5.02 (or other applicable standard drawing). To reduce the potential of hydrostatic loading on retaining walls, drainage systems should be incorporated into the design where applicable. Drain systems consisting of continuous porous backfill or geocomposite as outlined in ADOT Standard Drawing SD 7.01, Sheet 1 of 5 (or other applicable standard drawing) are recommended. Drain systems should be discharged to weep holes appropriately placed along the face of each wall.

Materials Design

Materials Specifications

The use of Maricopa Association of Governments (MAG) 2025 Uniform Standard Specifications and Details for Public Works Construction and MCDOT supplements are recommended for work on the project. Based on the recommendations outlined in this report, the specifications, at a minimum, should include those listed in the following table.

MAG Specification	Specification Title	Comments/Recommendations
201	Clearing and Grubbing	--
205	Roadway Excavation	--
206	Structure Excavation and Backfill	--
210	Imported Borrow	--
211	Fill Construction	All fills placed on the project should be compacted to a minimum of 95% of the maximum density determined in accordance with ASTM D698. Moisture conditioning the fill materials to within 2% of optimum moisture content is recommended.
301	Subgrade Preparation	--
309	Lime Stabilization	--
310	Placement and Construction of Aggregate Base Course	For areas of the site that may need a leveling course.
321	Placement and Construction of Asphalt Concrete Pavement	½-inch and/or ¾-inch Gyratory Asphalt Mix for High Traffic Conditions is recommended for the asphalt concrete on this project in accordance with Section 710.
329	Tack Coat	Tack coat between AC layers.
702	Base Materials	For areas of the site that may need a leveling course, Aggregate Base Course on the project should conform to the requirements of Section 702.2.
710	Asphalt Concrete	½-inch and/or ¾-inch Gyratory Asphalt Mix for High Traffic Conditions is recommended to the asphalt concrete on this project.
601	Trench Excavation, Backfilling and Compaction	--

Upon request, Terracon is available to assist in the review and development of the final specifications for the project.

Site Preparation and Earthwork

We recommend that all other site preparation and earthwork on the project be undertaken under the applicable portions of MAG Specifications. Recommended changes to these specifications as outlined in the preceding table should be included in the specifications or special provisions for the project. Subgrade preparation in new pavement areas should include scarification, moisture conditioning, and compaction, as outlined in the MAG specifications.

Excavation Characteristics

It is anticipated that excavations within the upper approximately 5 to 10 feet for the construction along the project roadway alignment can be accomplished with conventional earthmoving equipment capable of handling silty and/or clayey sands with loose to medium dense relative densities, as well as occurrences of sandy silty clay and sandy lean clay with stiff to very stiff consistencies. The subgrade soils exposed during construction are generally expected to be relatively stable provided adequate slopes or shoring is implemented. In some areas of the site, some sloughing of the soils should be anticipated due to the granular characteristics of the site soils. The stability of the subgrade may also be affected by precipitation, repetitive construction traffic or other factors.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottoms. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Permanent Slope Recommendations

The following recommendations are presented for construction of new permanent slopes for the project. We recommend permanent unprotected cut and fill slopes be constructed at a slope ratio no steeper than 3H:1V (horizontal to vertical). For cut and fill slopes protected with slope paving, slopes no steeper than 2.5H:1V are recommended.

Earthwork Factors

The earthwork factors are based on a comparison of the in-situ dry densities from ring samples to the density of bulk samples compacted to 95 percent of maximum dry density as determined by ASTM D698. The estimated shrinkage of the surface and near surface site soils when used as compacted fill is expected to be in the order of 10 percent shrinkage based on compacting the materials to a minimum of 95 percent of the maximum dry density determined in accordance with ASTM D698. The earthwork factor estimate is included as an attachment to this report.

These estimates are general in nature, and are based on our experience, limited data from our field exploration, and the soil conditions we encountered at the site. Earthwork factors may vary dependent upon the actual subsurface conditions, which may include variations in soil gradations and gravel contents. Earthwork values are also expected to be less in areas subjected to lower levels of compaction or where the existing natural soils are denser. Similarly, earthwork values are also expected to be greater in areas subjected to higher levels of compaction or where the existing natural soils are looser.

A ground compaction factor of approximately 0.1 feet should be applied when estimating the change in elevation of the native soil surface due to scarification, moisture conditioning and re-compaction prior to fill placement.

Grading and Drainage

To the extent possible, grades should provide effective drainage away from the proposed pavement structures during and after construction. Water permitted to pond next to the pavements can result in moisture content increases in subgrade soils and consequently in premature deterioration of the pavement structure and increased maintenance.

Positive drainage should be provided during construction and maintained throughout the life of the proposed improvements at the site. Infiltration of water into trenches should be prevented during construction. We recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 10 feet from the pavement structures. Backfill placed at the site should be well compacted and free of all construction debris to reduce the moisture infiltration.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Calculation Package

Design Traffic Analysis

Spreadsheet To Calculate Traffic for Pavement Design

- Traffic Analysis is based upon procedures by the Asphalt Institute, MS-1 (2008)
- Average Daily Traffic (ADT) is required along with annual growth rate
- Lane factor adjusts design lane traffic for 2, 4 or 6 lanes
- Truck quantities are based on Rural, Urban or Interstate statistics
- All Truck Factors are 18-kip equivalents per vehicle

Initial Data

PROJECT DATA

Project name:	Olive Avenue
Location:	**From SR303L to Sarival Avenue**
Terracon Project No.	CP255023

STREET DATA

Street Name	Olive Ave W
Current Average Daily Traffic (ADT)	5,621
Design Period (years)	20
Annual Growth Rate (%)	5.00%
Number of Traffic Lanes (2, 4 or 6)	4
Percentage of Trucks (%)	5.00%

STREET CLASSIFICATIONS

Rural Systems	Urban Systems
◆ Interstate	◆ Interstate
◆ Principal	◆ Freeway
◆ Minor Arterial	◆ Principal
◆ Major Collector	◆ Minor Arterial
◆ Minor Collector	◆ Collector

Equivalent 18-kip Axle Load Analysis

Vehicle Type	**% Traffic**	**No. of Vehicles**	**Truck Factor**	**Growth Factor**	**Equivalent Axle Loads**
Proposed Roadway					
Passenger Cars	95.00%	1,949,082	0.0008	33.07	51,559
Trucks	5.00%	102,583	1.2000	33.07	4,070,416
All Single Units and Automobiles	100%	2,051,665			4,121,974
All Vehicles	100%	2,051,665			4,121,974

Traffic Summary

TOTALS

Equivalent Axle Loads (EAL's)	**4,121,974**
Lane Factor	**0.45**
Design Equivalent Axle Loads	**1,854,888**
Design Traffic Number (DTN)	**254.1**

Exhibit C-1

Design Traffic Analysis

Spreadsheet To Calculate Traffic for Pavement Design

- Traffic Analysis is based upon procedures by the Asphalt Institute, MS-1 (2008)
- Average Daily Traffic (ADT) is required along with annual growth rate
- Lane factor adjusts design lane traffic for 2, 4 or 6 lanes
- Truck quantities are based on Rural, Urban or Interstate statistics
- All Truck Factors are 18-kip equivalents per vehicle

Initial Data

PROJECT DATA

Project name:	Olive Avenue
Location:	**From Sarival Avenue to Reems Road**
Terracon Project No.	CP255023

STREET DATA

Street Name	Olive Ave E
Current Average Daily Traffic (ADT)	4,868
Design Period (years)	20
Annual Growth Rate (%)	5.00%
Number of Traffic Lanes (2, 4 or 6)	4
Percentage of Trucks (%)	5.00%

STREET CLASSIFICATIONS

Rural Systems	Urban Systems
◆ Interstate	◆ Interstate
◆ Principal	◆ Freeway
◆ Minor Arterial	◆ Principal
◆ Major Collector	◆ Minor Arterial
◆ Minor Collector	◆ Collector

Equivalent 18-kip Axle Load Analysis

Vehicle Type	**% Traffic**	**No. of Vehicles**	**Truck Factor**	**Growth Factor**	**Equivalent Axle Loads**
Proposed Roadway					
Passenger Cars	95.00%	1,687,979	0.0008	33.07	44,652
Trucks	5.00%	88,841	1.2000	33.07	3,525,135
All Single Units and Automobiles	100%	1,776,820			3,569,787
All Vehicles	100%	1,776,820			3,569,787

Traffic Summary

TOTALS

Equivalent Axle Loads (EAL's)	**3,569,787**
Lane Factor	**0.45**
Design Equivalent Axle Loads	**1,606,404**
Design Traffic Number (DTN)	**220.1**

Terracon Consultants, Inc.

Exhibit C-1

Design Traffic Analysis

Spreadsheet To Calculate Traffic for Pavement Design

- Traffic Analysis is based upon procedures by the Asphalt Institute, MS-1 (2008)
- Average Daily Traffic (ADT) is required along with annual growth rate
- Lane factor adjusts design lane traffic for 2, 4 or 6 lanes
- Truck quantities are based on Rural, Urban or Interstate statistics
- All Truck Factors are 18-kip equivalents per vehicle

Initial Data

PROJECT DATA

Project name:	Sarival Avenue
Location:	**1/4-mile Intersection Improvements at Olive Ave**
Terracon Project No.	CP255023

STREET DATA

Street Name	Sarival Ave
Current Average Daily Traffic (ADT)	2,614
Design Period (years)	20
Annual Growth Rate (%)	5.00%
Number of Traffic Lanes (2, 4 or 6)	4
Percentage of Trucks (%)	5.00%

STREET CLASSIFICATIONS

Rural Systems	Urban Systems
◆ Interstate	◆ Interstate
◆ Principal	◆ Freeway
◆ Minor Arterial	◆ Principal
◆ Major Collector	◆ Minor Arterial
◆ Minor Collector	◆ Collector

Equivalent 18-kip Axle Load Analysis

Vehicle Type	**% Traffic**	**No. of Vehicles**	**Truck Factor**	**Growth Factor**	**Equivalent Axle Loads**
Proposed Roadway					
Passenger Cars	95.00%	906,405	0.0008	33.07	23,977
Trucks	5.00%	47,706	1.2000	33.07	1,892,913
All Single Units and Automobiles	100%	954,110			1,916,890
All Vehicles	100%	954,110			1,916,890

Traffic Summary

TOTALS

Equivalent Axle Loads (EAL's)	**1,916,890**
Lane Factor	**0.45**
Design Equivalent Axle Loads	**862,601**
Design Traffic Number (DTN)	**118.2**

Exhibit C-1

Design Traffic Analysis

Spreadsheet To Calculate Traffic for Pavement Design

- ◆ Traffic Analysis is based upon procedures by the Asphalt Institute, MS-1 (2008)
- ◆ Average Daily Traffic (ADT) is required along with annual growth rate
- ◆ Lane factor adjusts design lane traffic for 2, 4 or 6 lanes
- ◆ Truck quantities are based on Rural, Urban or Interstate statistics
- ◆ All Truck Factors are 18-kip equivalents per vehicle

Initial Data

PROJECT DATA

Project name:	Reems Road
Location:	**1/4-mile Intersection Improvements at Olive Ave**
Terracon Project No.	CP255023

STREET DATA

Street Name	Reems Road
Current Average Daily Traffic (ADT)	7,540
Design Period (years)	20
Annual Growth Rate (%)	5.00%
Number of Traffic Lanes (2, 4 or 6)	2
Percentage of Trucks (%)	5.00%

STREET CLASSIFICATIONS

Rural Systems

- ◆ Interstate
- ◆ Principal
- ◆ Minor Arterial
- ◆ Major Collector
- ◆ Minor Collector

Urban Systems

- ◆ Interstate
- ◆ Freeway
- ◆ Principal
- ◆ Minor Arterial
- ◆ Collector

Equivalent 18-kip Axle Load Analysis

Vehicle Type	**% Traffic**	**No. of Vehicles**	**Truck Factor**	**Growth Factor**	**Equivalent Axle Loads**
Proposed Roadway					
Passenger Cars	95.00%	2,614,495	0.0008	33.07	69,161
Trucks	5.00%	137,605	1.2000	33.07	5,460,049
All Single Units and Automobiles	100%	2,752,100			5,529,209
All Vehicles	100%	2,752,100			5,529,209

Traffic Summary

TOTALS

Equivalent Axle Loads (EAL's)	**5,529,209**
Lane Factor	**0.50**
Design Equivalent Axle Loads	**2,764,605**
Design Traffic Number (DTN)	**378.7**

Terracon Consultants, Inc. **Exhibit C-1**

Design Resilient Modulus Analysis

Project Data

PROJECT NAME, LOCATION and SEASONAL VARIATION FACTOR

Project Name: MCDOT Olive Ave - SR303L to Reems Rd
Location: Maricopa County
Seasonal Variation Factor: 1.0

Laboratory Test Data

Boring No. Point ID	Boring Location	Depth (ft)	LL	PI	-#200	Laboratory R-Value	Correlated R-Value
B-7	Olive Ave - AMEC	0 - 5	30	14	53		25
R-101	Olive Ave - Terracon	0 - 4	21	7	22	57	55
B-8	Olive Ave - AMEC	0 - 5	0	0	27	75	70
R-102	Olive Ave - Terracon	0 - 5	22	5	61	52	39
B-9	Olive Ave - AMEC	0 - 5	22	5	40	32	50
B-10	Olive Ave - AMEC	0 - 5	25	6	59		37
B-11	Olive Ave - AMEC	0 - 5	21	4	43	30	51
B-12	Olive Ave - AMEC	0 - 5	22	6	49		42
B-13	Olive Ave - AMEC	0 - 5	29	15	43	32	26
B-14	Olive Ave - AMEC	0 - 5	31	15	28		31
R-103	Sarival Ave - Terracon	0 - 4	23	9	39	38	39
R-104	Sarival Ave - Terracon	0 - 5	20	4	44	35	51
R-105	Reems Rd - Terracon	0 - 0.8	25	7	63	28	34
R-106	Reems Rd - Terracon	0 - 5	25	8	48	33	38

Mean R-Value and Modulus Calculations

Number of Laboratory Tested R-Values:	10	(Nt)
Average of Laboratory Tested R-Value Results:	41.20	(Rt)
Standard Deviation of Laboratory Tested R-Values:	15.25	(SDt)
Number of Correlated R-Value:	14	(Nc)
Average of Correlated R-Value Results:	42.00	(Rc)
Standard Deviation of Correlated R-Values:	12.25	(SDc)
Adjusted Average of Tested R-Values:	35.9	
Adjusted Average of Correlated R-Values:	39.8	(Rc)
Calculation for Mean R-Value:		

$$R_{mean} = \frac{2xN_t \times R_t \times SD_c^2 + N_c \times R_c \times SD_t^2}{2xN_t \times SD_c^2 + N_c \times SD_t^2}$$

R_{mean} = **37.9**

Seasonal Variation Factor for Project Location= **1.0**
Design Resilient Modulus M_r (adjusted for SVF)= **23,002** psi

Exhibit C-3

Flexible Pavement Design Analysis

Design Criteria

PROJECT DATA

Pavement Designation	Olive Ave W
Design Life (years)	20
Equivalent Axle Loads/Day	254
Total ESALs	1,854,888
Seasonal Variation Factor	1.0
Reliability	95%
Overall Standard Deviation	0.45

SUBGRADE CONDITIONS

Mean R-Value, R_{Mean}	37.9
Resilient Modulus MR (psi)	23,002
Design Modulus (psi)	23,002

SERVICEABILITY

Initial Design Serviceability Index	4.5
Terminal Design Serviceability Index	2.5

LAYER COEFFICIENTS	Structural	Drainage
PMTR Asphalt Concrete	0.42	N/A
Asphalt Concrete	0.42	N/A
Aggregate Base Course	0.12	1.00

Design Calculations

Required Structural Number SN: **2.64** **(Min. 2.88 for Principal Arterial)**

Alternative	Recommended Pavement Section Thickness Inches				Total Structural Number	Δ Structural Number
	PMTR Asphalt Concrete	Asphalt Concrete	Aggregate Base Course	Lime Treated Subgrade		
A	2.0	3.5	5		2.91	0.27
B		5.5	5		2.91	0.27
C		7			2.94	0.30

Flexible Pavement Design Analysis

Design Criteria

PROJECT DATA

Pavement Designation	Olive Ave E
Design Life (years)	20
Equivalent Axle Loads/Day	220
Total ESALs	1,606,404
Seasonal Variation Factor	1.0
Reliability	95%
Overall Standard Deviation	0.45

SUBGRADE CONDITIONS

Mean R-Value, R_{Mean}	37.9
Resilient Modulus MR (psi)	23,002
Design Modulus (psi)	23,002

SERVICEABILITY

Initial Design Serviceability Index	4.5
Terminal Design Serviceability Index	2.5

LAYER COEFFICIENTS	**Structural**	**Drainage**
PMTR Asphalt Concrete	0.42	N/A
Asphalt Concrete	0.42	N/A
Aggregate Base Course	0.12	1.00

Design Calculations

Required Structural Number SN: **2.58** **(Min. 2.88 for Principal Arterial)**

Alternative	Recommended Pavement Section Thickness Inches				Total Structural Number	Δ Structural Number
	PMTR Asphalt Concrete	Asphalt Concrete	Aggregate Base Course	Lime Treated Subgrade		
A	2.0	3.5	5		2.91	0.33
B		5.5	5		2.91	0.33
C		7			2.94	0.36

Flexible Pavement Design Analysis

Design Criteria

PROJECT DATA

Pavement Designation	Sarival Ave
Design Life (years)	20
Equivalent Axle Loads/Day	118
Total ESALs	862,601
Seasonal Variation Factor	1.0
Reliability	95%
Overall Standard Deviation	0.45

SUBGRADE CONDITIONS

Mean R-Value, R_{Mean}	37.9
Resilient Modulus MR (psi)	23,002
Design Modulus (psi)	23,002

SERVICEABILITY

Initial Design Serviceability Index	4.5
Terminal Design Serviceability Index	2.5

LAYER COEFFICIENTS	Structural	Drainage
PMTR Asphalt Concrete	0.42	N/A
Asphalt Concrete	0.42	N/A
Aggregate Base Course	0.12	1.00

Design Calculations

Required Structural Number SN: **2.33** **(Min. 2.88 for Minor Arterial)**

Alternative	Recommended Pavement Section Thickness Inches				Total Structural Number	Δ Structural Number
	PMTR Asphalt Concrete	Asphalt Concrete	Aggregate Base Course	Lime Treated Subgrade		
A	2.0	3.5	5		2.91	0.58
B		5.5	5		2.91	0.58
C		7			2.94	0.61

Exhibit C-4

Flexible Pavement Design Analysis

Design Criteria

PROJECT DATA

Pavement Designation	Reems Rd
Design Life (years)	20
Equivalent Axle Loads/Day	379
Total ESALs	2,764,605
Seasonal Variation Factor	1.0
Reliability	90%
Overall Standard Deviation	0.45

SUBGRADE CONDITIONS

Mean R-Value, R_{Mean}	37.9
Resilient Modulus MR (psi)	23,002
Design Modulus (psi)	23,002

SERVICEABILITY

Initial Design Serviceability Index	4.4
Terminal Design Serviceability Index	2.3

LAYER COEFFICIENTS	**Structural**	**Drainage**
PMTR Asphalt Concrete	0.42	N/A
Asphalt Concrete	0.42	N/A
Aggregate Base Course	0.12	1.00

Design Calculations

Required Structural Number SN: 2.64 (Min. 2.88 for Major Collector Ind.)

Alternative	Recommended Pavement Section Thickness Inches				Total Structural Number	Δ Structural Number
	PMTR Asphalt Concrete	Asphalt Concrete	Aggregate Base Course	Lime Treated Subgrade		
A	2.0	3.5	5		2.91	0.27
B		5.5	5		2.91	0.27
C		7			2.94	0.30

Exhibit C-4

EARTHWORK SHRINKAGE ESTIMATES

MCDOT Project No.: **TT0561**

Terracon Project No.: **CP255023**

Project Name: Olive Avenue - From SR303L to Reems Road

Boring	Depth (bgs)	Maximum Dry Density (pcf)	95% of Max Dry Density (pcf)	Optimum Moisture (%)	(In-situ) Dry Density (pcf)	(In-situ) Moisture Content (%)	Compaction (%)	Shrinkage / Bulking (%)
R-101	2 to 3'	126.8	120.5	9.0	109.0	2.0	86	10
R-102	2 to 3'	118.7	112.8	11.7	96	4	81	15
R-103	2 to 3'	127.2	120.8	9.4	117	9	92	3
R-104	2 to 3'	126.8	120.5	9.3	111.0	6.0	88	8
B-8	1 to 2'	129.1	122.6	9.0	111.3	7.2	86	9
B-10	1 to 2'	126.2	119.9	11.1	109.1	16	86	9
B-11	1 to 2'	124.2	118.0	10.1	108.4	5.8	87	8
B-12	1 to 2'	124.2	118.0	10.1	107.9	4.1	87	9
B-13	1 to 2'	118.4	112.5	12.5	97.9	7.3	83	13
B-14	1 to 2'	118.4	112.5	12.5	111.5	7.4	94	1

ESTIMATED AVERAGE PERCENT SHRINKAGE:	**8**

Note: Positive numbers indicate Shrinkage and negative numbers indicate Bulking.

Exhibit: C-6

Attachments

Exploration and Testing Procedures

Field Exploration

Terracon performed a geotechnical field exploration that included test borings, double ring infiltration testing, geophysical surveys, and earth fissure trench excavations. The test borings were performed from September 2 through 5, 2025. The double ring infiltration testing was performed on September 30, 2025 and October 7, 2025. The earth fissure trench excavations were performed from October 6 through 8, 2025. The geophysical P-Wave and MASW surveys were performed on September 17, 18 and 19, 2025. The geophysical ground penetrating radar survey was performed on September 29, 2025.

> Note: As outlined in the Project Description Section of this report, previous geotechnical engineering services performed by AMEC for MCDOT included the project site. Based on the information provided and discussions with MCDOT, we understand Terracon can rely on the previous geotechnical engineering information presented in the AMEC reports. Therefore, selected data from the AMEC geotechnical engineering reports was used to supplement this geotechnical engineering report.

The approximate exploration locations at the project site are shown on the Exploration Plan, and the location and depth of the explorations are summarized in the following table:

Number of Borings	Boring ID Nos.	Approximate Boring Depth (feet)	Location	Exploration Completed By:
6	R-101 through R-104	10	Proposed Roadway Improvements	Terracon
6	R-105 (hand auger)	1		
6	R-106 (hand auger)	5		
6	S-101 through S-106 (S-107 pending BNSF access)	25	Proposed Culvert Structure Areas	Terracon
4	D-101 through D-104	20	Proposed Stormwater Basin Areas	Terracon
4	DRI-101 through DRI-104	3 to 4	Proposed Stormwater Basin Areas	Terracon
3	T-1 and T-2	4 to 5	Earth Fissure Exploration Trench	Terracon
8	B-7 through B-14	10 to 20	Proposed Roadway Improvements	AMEC
4	C-4 through C-7	< 1	Proposed Roadway Improvements	AMEC

Boring Layout and Elevations (of Terracon explorations): Terracon personnel provided the boring layout using handheld GPS equipment (with estimated horizontal accuracy of about ±15 feet) and referencing existing site features. Approximate ground surface elevations were obtained using Google Earth Pro. If a more precise boring layout or elevations are desired, we recommend boring be surveyed.

Subsurface Exploration Procedures (of Terracon explorations): The borings were advanced with a truck-mounted CME-75 drill rig utilizing 8-inch outside diameter hollow-stem augers. At selected intervals, samples of the subsurface materials were taken at each boring location by driving split-spoon (SPT) or ring-lined barrel samplers in general accordance with ASTM Standards. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A 3-inch O.D. split-barrel sampling spoon with 2.5-inch I.D. ring lined sampler was also used for sampling the soil borings. Ring-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration.

> Note: Borings R-105 and R-106 were manually excavated with a 3-inch outside diameter hand auger due to overhead utility conflicts for the truck mounted drill rig tower and no penetration testing was conducted within these borings. Boring R-105 encountered hand auger refusal at approximately 1 foot and was attempted 4 times.

Bulk samples of subsurface materials were obtained from all the borings. Groundwater was not encountered during the field exploration. For safety purposes, the borings were backfilled with auger cuttings mixed with cement. The earth fissure trench excavations were backfilled by moisture conditioning the excavated soils, placing the moisture conditioned soils in relatively thin loose lifts, compacting using a backhoe sheeps-foot, and performing nuclear density testing to confirm a minimum 95% compaction (ASTM D698).

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Double Ring Infiltration Testing: As outlined in this report, double ring infiltration testing was performed at 4 locations for proposed retention basin areas. The infiltration testing was performed in general accordance with the procedures outlined in ASTM D3385 *Standard Test Method for Infiltration Rate of Soil in Field Using Double-Ring Infiltrometer* test method as required by the Maricopa County Flood Control District. The testing was performed at depths of approximately 3 to 4 feet bgs. In addition, a soil boring was drilled at each infiltration test location.

Geophysical Survey – Seismic Refraction: As outlined in this report, Terracon performed 5 seismic refraction survey lines were performed for the project. The survey lines were oriented east-to-west and generally centered at the AZGS mapped earth fissure. The seismic system consisted of a linear series of 24 seismic sensors (geophones) and a sledge-hammer/metal plate as the impact source.

Geophysical Survey - Ground Penetrating Radar: As outlined in this report, Terracon performed a 10 Ground Penetrating Radar (GPR) scans/lines of the roadway south shoulder at the location of the AZGS mapped earth fissure. The GPR system consisted of a cart-mounted 200 MHz antenna. The series of parallel lines were collected with the GPR, combined and modeled to generate a plan view of changes in GPR amplitude with depth.

Earth Fissure Trench Explorations: As outlined in this report, Terracon performed 2 earth fissure trench explorations (designated as T-1 and T-2) in the area of the AZGS mapped earth fissure. The trenches were performed on October 6, 7 and 8, 2025. The trenches were excavated with a John Deere 310 backhoe using a 2-foot wide bucket. The trenches were excavated to depths of approximately 4 to 5 feet below the existing ground surface and a length of approximately 40 feet (along an east-to-west alignment). The trenches were backfilled with the excavated soils and placed as engineered (compacted) fill.

Laboratory Testing

Samples retrieved during the Terracon field exploration were classified in accordance with the Unified Soil Classification System (USCS) and taken to the laboratory for further observation by the project geotechnical engineer. At that time, the field descriptions were confirmed or modified as necessary, and an applicable laboratory testing program was formulated to determine the engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in the Exploration Results section of this report. These results were used for the geotechnical engineering analyses, and the development of the geotechnical engineering recommendations presented in this report. Laboratory tests were performed in general accordance with the applicable ASTM, local, or other accepted standards.

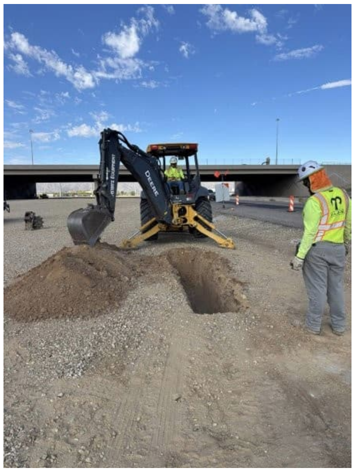
Selected soil samples obtained from the site were tested for the following engineering properties:

- Moisture Content
- Dry Unit Weight
- Atterberg Limits
- Grain Size Analysis
- Standard Proctor
- Remolded Swell
- R-Value
- Consolidation/Compression
- Soil Corrosivity (pH, Minimum Electrical Resistivity & Soluble Sulfate & Chloride)

Photography Log

	
Near Boring R-102, Facing West, Olive Ave	Near Boring S-105, Facing West, Olive Ave
	
Near Boring R-103, Facing South, Sarival Ave	Near Boring R-106, Facing East, Reems Rd
	
Boring R-106, Overhead Utility, Hand Aguer	Boring D-103

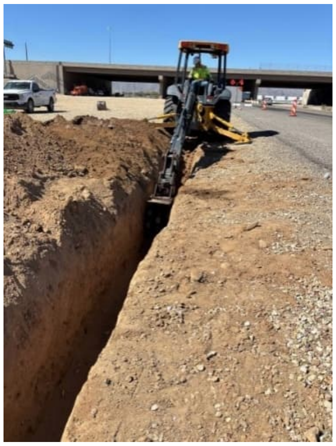
Earth Fissure Trench 1



Earth Fissure Trench 2, Excavation

Earth Fissure Trench 2

Typical, Moisture Conditioning Backfill



Typical, Backfill Compaction

Typical, Nuclear Density Testing

Site Location and Exploration Plans

Contents:

Site Location

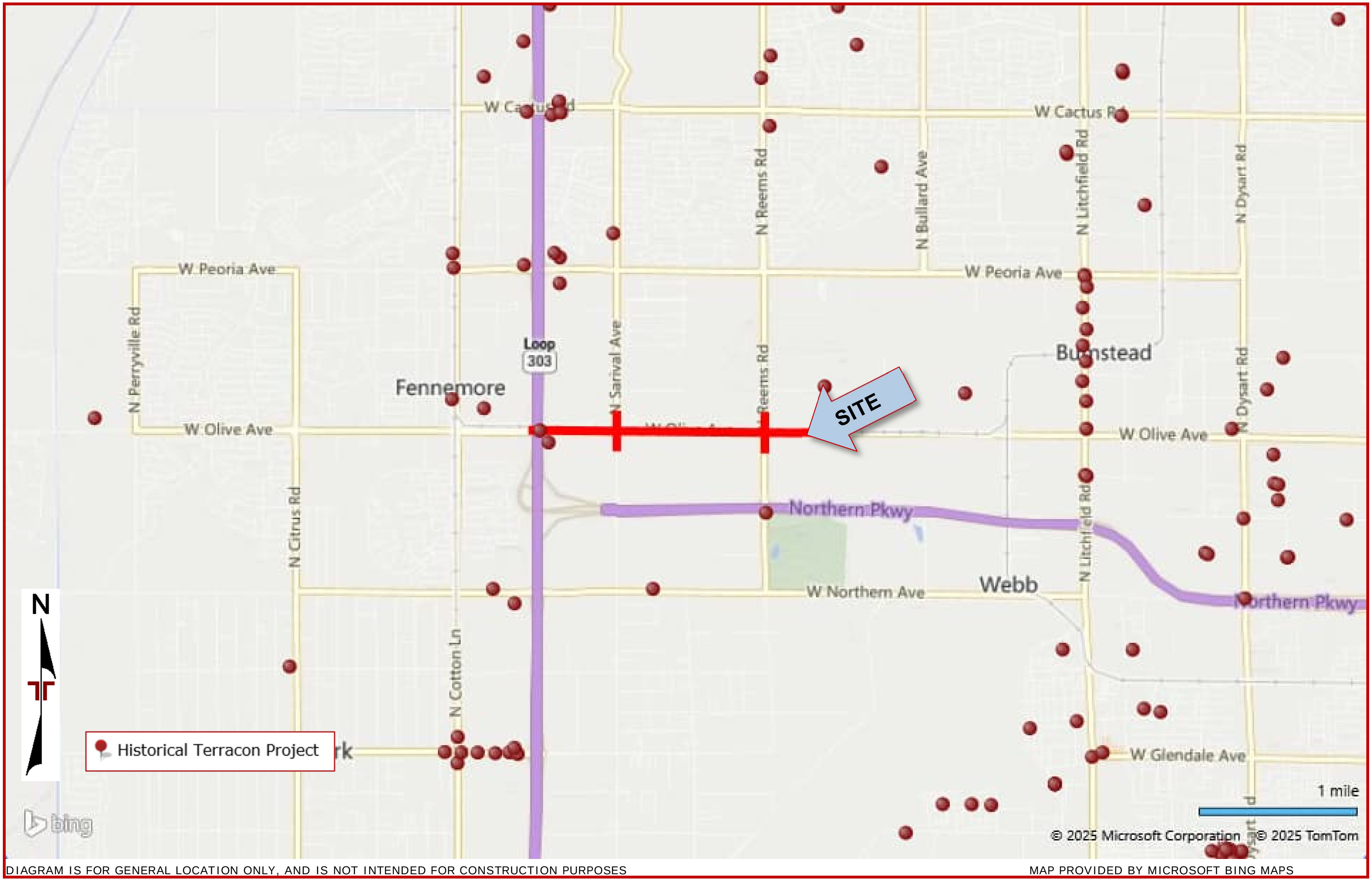


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Log No. R-101

Location: See Exploration Plan

Latitude: 33.5663° Longitude: -112.4158°

Depth (Ft.)	Description	Approximate Elevation: 1159 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	FILL - SILTY CLAYEY SAND (SC-SM), fine to coarse sand, low plasticity, brown, medium dense					25-28	2.3	109	21-14-7	22.3
4.0		1155								
	SILTY SAND (SM), fine to coarse sand, nonplastic, loose		5			6-4	2.2	101		
			10			3-2-2 N=4				
10.5		1148.5								

Boring Terminated at 10.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-05-2025

Boring Completed
09-05-2025

Boring Log No. R-102

Location: See Exploration Plan

Latitude: 33.5663° Longitude: -112.4117°

Depth (Ft.) Approximate Elevation: 1152 (Ft.)

Graphic Log	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
▨	**SANDY SILTY CLAY (CL-ML)**, fine to coarse sand, low plasticity, brown, stiff, weak cementation				7-8	3.5	96	22-17-5	60.8
▨	very stiff	5			8-10	4.4	98		
▨	fine sand, stiff 10.0 1142	10			4-10	6.6	110		
	Boring Terminated at 10 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-05-2025

Boring Completed
09-05-2025

Boring Log No. R-103

Location: See Exploration Plan

Latitude: 33.5680° Longitude: -112.4097°

Graphic Log	Depth (Ft.) / Approximate Elevation: 1150 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
▨	**CLAYEY SAND (SC)**, fine to coarse sand, low plasticity, brown, medium dense			↕				23-14-9	38.9
				☒	8-9	9.1	117		
	4.0 1146								
▨	**SILTY SAND (SM)**, trace gravel, fine to coarse sand, nonplastic, brown, loose			☒	3-5	3.0	105		
		5							
	10.0 1140	10		☒	4-5	12.1	106		
	Boring Terminated at 10 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-03-2025

Boring Completed
09-03-2025

Boring Log No. R-104

Location: See Exploration Plan

Latitude: 33.5644° Longitude: -112.4096°

Depth (Ft.)	Approximate Elevation: 1144 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SILTY CLAYEY SAND (SC-SM), fine to coarse sand, low plasticity, brown, medium dense								
					15-15	5.6	111	20-16-4	44.3
	loose				6-7	2.7	106		
		5							
8.0	1136								
	SANDY LEAN CLAY (CL), fine sand, low plasticity, brown, medium stiff				2-2-3 N=5				
		10							
10.5	1133.5								

Boring Terminated at 10.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-03-2025

Boring Completed
09-03-2025

Boring Log No. R-105

Graphic Log	Location: See Exploration Plan Latitude: 33.5679° Longitude: -112.3937° Depth (Ft.) Approximate Elevation: 1144 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
▨	**SANDY SILTY CLAY (CL-ML)**, fine to coarse sand, low plasticity, brown 0.8 1143.25			I				25-18-7	63.3
	Hand Auger Refusal on Cemented Soil at 0.75 Foot								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Water Level Observations
Groundwater not encountered

Drill Rig
Hand Auger

Notes
Four offset attempts were made and all refused shallower than 0.75 feet.

Advancement Method
3" Hand Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-02-2025

Boring Completed
09-02-2025

Boring Log No. R-106

Graphic Log	Location: See Exploration Plan Latitude: 33.5643° Longitude: -112.3935° Depth (Ft.) Approximate Elevation: 1120 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
▨	**CLAYEY SAND (SC)**, fine to coarse sand, low plasticity, brown 5.0 1115	5		↕				25-17-8	48
	Boring Terminated at 5 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
3" Hand Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
Hand Auger

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

Boring Log No. S-101

Location: See Exploration Plan

Latitude: 33.5663° Longitude: -112.4093°

Depth (Ft.) Approximate Elevation: 1147 (Ft.)

Depth (Ft.)	Description	Elevation (Ft.)	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SILTY CLAYEY SAND (SC-SM), fine to coarse sand, low plasticity, brown, medium dense						
2–3			9-16	10.9	116	21-16-5	47.3
4–5	loose		7-8	2.0	105		
7–8.5	very loose		1-2-1 N=3				
9.0		1138					
9–10	**SANDY LEAN CLAY (CL)**, fine sand, low plasticity, brown, medium stiff		3-6	11.2	104		
14–15.5	trace gravel, fine to coarse gravel, medium plasticity, light brown, very stiff		8-14-13 N=27				
18.0		1129					
	SILTY SAND (SM), trace gravel, fine to coarse sand, fine to coarse gravel, nonplastic, brown, dense						
19–20.5			6-13-20 N=33				
24–25.5	medium dense		8-13-14 N=27				
25.5		1121.5					

Boring Terminated at 25.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Water Level Observations
Groundwater not encountered

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-03-2025

Boring Completed
09-03-2025

Notes

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Boring Log No. S-102

Location: See Exploration Plan

Latitude: 33.5662° Longitude: -112.4091°

Approximate Elevation: 1147 (Ft.)

Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	FILL - SILTY CLAYEY SAND WITH GRAVEL (SC-SM), fine to coarse sand, fine to coarse gravel, low plasticity, brown, medium dense					13-17	8.6	105		
4.0		1143								
	SILTY SAND WITH GRAVEL (SM), fine to coarse sand, fine to coarse gravel, nonplastic, brown, medium dense		5			9-12-9 N=21			NP	26.7
	loose					7-4	8.7	100		
9.0		1138								
	SANDY LEAN CLAY (CL), fine sand, low to medium plasticity, brown, medium stiff					2-3				
			10							
	medium plasticity, very stiff					7-19	3.6	106		
			15							
			20			11-11-16 N=27				
	trace gravel, fine to coarse sand, fine gravel, stratified with silty sand					10-19				
25.0		1122	25							
	Boring Terminated at 25 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Water Level Observations
Groundwater not encountered

Notes

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-03-2025

Boring Completed
09-03-2025

Boring Log No. S-103

Location: See Exploration Plan

Latitude: 33.5660° Longitude: -112.4021°

Depth (Ft.) Approximate Elevation: 1135 (Ft.)

Depth (Ft.) / Elevation	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SILTY SAND (SM), trace gravel, fine to coarse sand, fine to coarse gravel, nonplastic, brown, medium dense				8-17	4.0	116	NP	33.7
	loose				3-3	6.3	99		
5.0 / 1130	**SANDY LEAN CLAY (CL)**, trace gravel, fine to coarse sand, fine to coarse gravel, medium plasticity, brown, medium stiff	5			3-3-3 N=6				
	very stiff				7-15	10.4	112		
		10							
		15			8-9-9 N=18				
18.5 / 1116.5	**SILTY SAND WITH GRAVEL (SM)**, fine to coarse sand, fine to coarse gravel, nonplastic, light brown, medium dense	20			4-8-8 N=16				
25.5 / 1109.5	low plasticity, stratified with clayey sand	25			8-11-9 N=20				

Boring Terminated at 25.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-03-2025

Boring Completed
09-03-2025

Boring Log No. S-104

Location: See Exploration Plan

Latitude: 33.5660° Longitude: -112.3963°

Approximate Elevation: 1128 (Ft.)

Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SANDY LEAN CLAY (CL), trace gravel, fine to coarse sand, fine gravel, low plasticity, brown, very stiff, weak cementation									
						12-19	3.7	118		
	stiff, stratified with silty clayey sand					5-8	5.4	104		
5.0		1123	5							
	CLAYEY SAND (SC), fine to coarse sand, low plasticity, brown, medium dense									
						5-5-7 N=12			23-15-8	37.1
9.0		1119								
	SANDY LEAN CLAY (CL), fine to coarse sand, medium plasticity, brown, stiff					8-12	12.6	107		
			10							
	trace gravel, fine gravel, light brown, very stiff					8-17	12.2	114		
			15							
19.0		1109								
	CLAYEY SAND WITH GRAVEL (SC), fine to coarse sand, fine to coarse gravel, low plasticity, light brown, medium dense									
			20			8-10-9 N=19				
			25			9-13-14 N=27				
25.5		1102.5								
	Boring Terminated at 25.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Water Level Observations
Groundwater not encountered

Notes

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

1050 N Fairway Dr Ste G103
Avondale, AZ

Boring Log No. S-105

Location: See Exploration Plan

Latitude: 33.5659° Longitude: -112.3944°

Graphic Log	Depth (Ft.) Approximate Elevation: 1126 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SANDY LEAN CLAY (CL), fine to coarse sand, fine gravel, medium plasticity, brown, stiff				7-8	7.5	108	25-14-11	52.7
	medium stiff	5			2-3-4 N=7				
					5-5	11.6	91		
	low to medium plasticity, very stiff, weak cementation	10			6-16	12.9	100		
	14.0 1112								
	SILTY SAND (SM), trace gravel, fine to coarse sand, fine to coarse gravel, nonplastic, brown, medium dense	15			3-5-7 N=12				
	stratified with sandy lean clay	20			9-11-15 N=26				
	25.5 1100.5	25			9-11-13 N=24				
	Boring Terminated at 25.5 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

Boring Log No. S-106

Location: See Exploration Plan

Latitude: 33.5664° Longitude: -112.4101°

Depth (Ft.) / Approximate Elevation: 1149 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
SILTY SAND (SM), fine to coarse sand, nonplastic, brown, medium dense								
				10-10	7.3	118		
very loose	5			3-1-2 N=3				
				2-4	10.5	101	NP	27.5
fine to coarse sand, weak cementation	10			2-4	7.5	103		
medium dense	15			7-11-13 N=24				
	20			6-8-12 N=20				
25.5 1123.5	25			9-11-12 N=23				
Boring Terminated at 25.5 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-05-2025

Boring Completed
09-05-2025

Boring Log No. D-101

Location: See Exploration Plan

Latitude: 33.5660° Longitude: -112.4071°

Depth (Ft.) Approximate Elevation: 1142 (Ft.)

Graphic Log	Depth (Ft.) / Description / Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
▨	**SILTY CLAYEY SAND (SC-SM)**, fine to coarse sand, low plasticity, brown, loose				6-9	1.8		21-17-4	31.8
	4.0 — 1138								
▥	**SANDY SILT (ML)**, fine sand, nonplastic, brown, stiff	5			5-5	1.9	101		
	8.0 — 1134								
▨	**SANDY LEAN CLAY (CL)**, trace gravel, fine to coarse sand, fine gravel, medium plasticity, reddish brown, very stiff, moderate cementation	10			8-15	10.0	110		
	hard	15			9-16-19 N=35				
	16.0 — 1126								
▥	**SILTY SAND (SM)**, trace gravel, fine to coarse sand, fine to coarse gravel, nonplastic, brown, medium dense	20			11-12-11 N=23				
	20.5 — 1121.5								
	Boring Terminated at 20.5 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

Terracon
1050 N Fairway Dr Ste G103
Avondale, AZ

Boring Log No. D-102

Location: See Exploration Plan

Latitude: 33.5660° Longitude: -112.4040°

Approximate Elevation: 1138 (Ft.)

Graphic Log	Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
		FILL - SILTY CLAYEY SAND (SC-SM), fine to coarse sand, low plasticity, brown, loose									
							8-8	3.4	104	20-13-7	49.4
							4-6	4.5	102		
	5.0		1133	5							
		SILTY CLAYEY SAND (SC-SM), fine to coarse sand, low plasticity, brown, loose									
	8.0		1130								
		SANDY LEAN CLAY (CL), fine to coarse sand, medium plasticity, brown, medium stiff, weak cementation									
							4-7	11.2	105		
				10							
		trace gravel, fine gravel, stiff									
				15			5-7-8 N=15				
		very stiff, stratified with silty sand									
				20			6-10-11 N=21				
	20.5		1117.5								
		Boring Terminated at 20.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

Boring Log No. D-103

Location: See Exploration Plan

Latitude: 33.5660° Longitude: -112.4004°

Graphic Log	Depth (Ft.)		Approximate Elevation: 1131 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
▨		**SILTY CLAYEY SAND (SC-SM)**, fine to coarse sand, low plasticity, brown, loose					3-4	2.9	103	21-16-5	43.4
		low to medium plasticity, weak cementation		5			3-3-2 N=5				
	9.0		1122								
▨		**CLAYEY SAND (SC)**, fine to coarse sand, medium plasticity, medium dense		10			11-16	12.2	108		
				15			9-11-13 N=24				
		dense		20			15-15-19 N=34				
	20.5		1110.5								
		Boring Terminated at 20.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Notes

Water Level Observations
Groundwater not encountered

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

Boring Log No. D-104

Location: See Exploration Plan

Latitude: 33.5659° Longitude: -112.3971°

Depth (Ft.) Approximate Elevation: 1127 (Ft.)

Depth (Ft.)	Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SANDY SILTY CLAY (CL-ML), fine to coarse sand, low plasticity, brown, stiff, weak cementation									
						6-9	5.5	102	20-14-6	58.9
						5-8	9.9	96		
5.0		1122	5							
	SANDY LEAN CLAY (CL), medium plasticity, light brown, stiff									
	very stiff, weak cementation					11-23	14.6	99		
			10							
	stiff					4-4-4 N=8				
			15							
18.0		1109								
	SILTY SAND WITH GRAVEL (SM), fine to coarse sand, fine to coarse gravel, nonplastic, brown, loose									
						4-3-3 N=6				
			20							
20.5		1106.5								
	Boring Terminated at 20.5 Feet									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevation Reference: Elevations were obtained from Google Earth Pro.

Water Level Observations
Groundwater not encountered

Notes

Advancement Method
8" O.D. Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings mixed with cement upon completion.

Drill Rig
CME 55

Hammer Type
Automatic

Driller
Wildcat

Logged by
C. Heathershaw

Boring Started
09-04-2025

Boring Completed
09-04-2025

DOUBLE RING INFILTRATION TEST SUMMARY

Project

Project Name: Olive Avenue Roadway Improvements
Project Location: Glendale/Waddell, Arizona
Project Number: CP255023

Test Details

Test No.: DRI-101
Depth (Elev.): 3 feet
Technician: S. Connelly
Date: 9/30/2025
Weather: Sunny
Liquid Type: Water
Coordinates: 33.5660, -112.4073

Test Setup

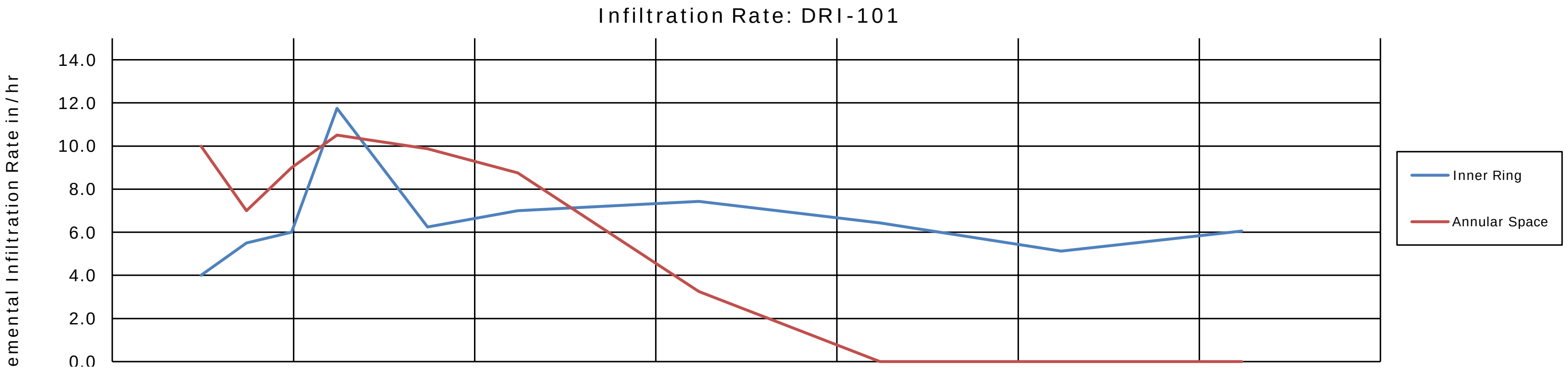
Inner Ring Area:	113.1	in^2
Inner Ring Diameter:	12.0	in
Annular space between Outer and Inner rings:	339	in^2
Outer Ring Diameter:	24.0	in
Depth of Liquid Inner Ring:	8.50	in
Depth of Liquid Annular Space:	8.00	in

Soil Description

Depth: 3 feet
Description: Silty-clayey sand (SC-SM)

Trial No.	Time		Elapsed Time (hr:min:sec)	Volume Measurements				Infiltration Rate, in/hr	
				Start		Finish			
	Start	Finish		Inner Ring Volume, in^3	Annular Space Volume, in^3	Inner Ring Volume, in^3	Annular Space Volume,in^3	Inner Ring	Annular Space
1	9:15:00 AM	9:30:00 AM	0:15:00	961	2714	848	1866	4.00	10.00
2	9:30:00 AM	9:45:00 AM	0:15:00	707	2121	551	1527	5.50	7.00
3	9:45:00 AM	10:00:00 AM	0:15:00	1074	3308	905	2545	6.00	9.00
4	10:00:00 AM	10:15:00 AM	0:15:00	1159	3435	827	2545	11.75	10.50
5	10:15:00 AM	10:45:00 AM	0:30:00	1018	3457	664	1781	6.25	9.87
6	10:45:00 AM	11:15:00 AM	0:30:00	1103	3478	707	1993	7.00	8.75
7	11:15:00 AM	12:15:00 PM	1:00:00	1244	2078	403	975	7.44	3.25
8	12:15:00 PM	1:15:00 PM	1:00:00	1364	5853	636	5853	6.44	0.00
9	1:15:00 PM	2:15:00 PM	1:00:00	1060	5853	481	5853	5.13	0.00
10	2:15:00 PM	3:15:00 PM	1:00:00	1089	5853	403	5853	6.06	0.00

*Note: ran out of water for annular space (outer ring) following Trial No. 7.



DOUBLE RING INFILTRATION TEST SUMMARY

Project

Project Name: Olive Avenue Roadway Improvements
Project Location: Glendale/Waddell, Arizona
Project Number: CP255023

Test Details

Test No.: DRI-102
Depth (Elev.): 4 feet
Technician: S. Connelly
Date: 9/30/2025
Weather: Sunny
Liquid Type: Water
Coordinates: 33.56597, -112.40388

Test Setup

Inner Ring Area:	113.1	in^2
Inner Ring Diameter:	12.0	in
Annular space between Outer and Inner rings:	339	in^2
Outer Ring Diameter:	24.0	in
Depth of Liquid Inner Ring:	9.00	in
Depth of Liquid Annular Space:	9.50	in

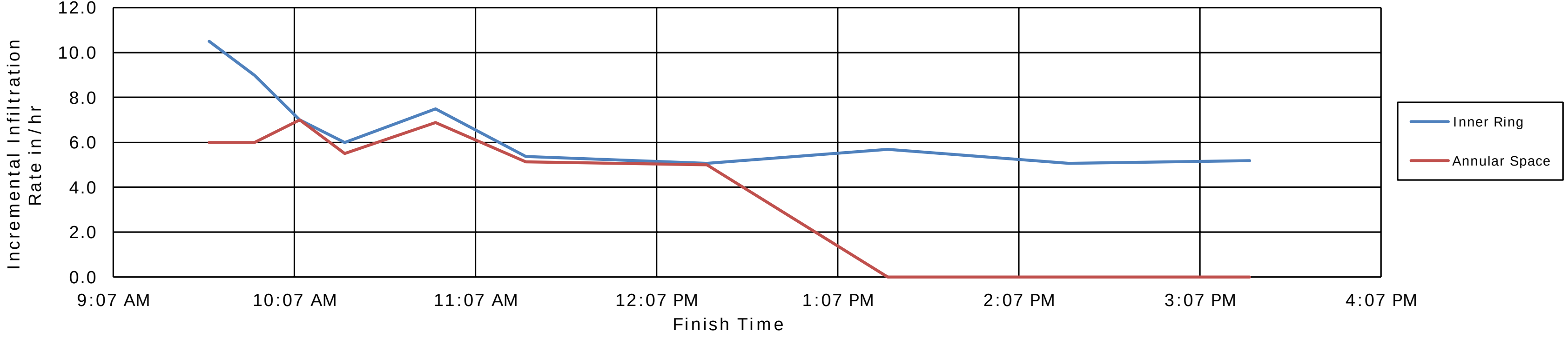
Soil Description

Depth: 4 feet
Description: Silty Clayey Sand (SC-SM)

Trial No.	Time		Elapsed Time (hr:min:sec)	Volume Measurements				Infiltration Rate, in/hr	
				Start		Finish			
	Start	Finish		Inner Ring Volume, in^3	Annular Space Volume, in^3	Inner Ring Volume, in^3	Annular Space Volume, in^3	Inner Ring	Annular Space
1	9:24:00 AM	9:39:00 AM	0:15:00	1018	3223	721	2714	10.50	6.00
2	9:39:00 AM	9:54:00 AM	0:15:00	1188	3563	933	3054	9.00	6.00
3	9:54:00 AM	10:09:00 AM	0:15:00	933	3054	735	2460	7.00	7.00
4	10:09:00 AM	10:24:00 AM	0:15:00	1131	3478	961	3011	6.00	5.50
5	10:24:00 AM	10:54:00 AM	0:30:00	961	3011	537	1845	7.50	6.88
6	10:54:00 AM	11:24:00 AM	0:30:00	1216	3329	912	2460	5.38	5.13
7	11:24:00 AM	12:24:00 PM	1:00:00	912	2460	339	763	5.06	5.00
8	12:24:00 PM	1:24:00 PM	1:00:00	990	5768	346	5768	5.69	0.00
9	1:24:00 PM	2:24:00 PM	1:00:00	1018	5768	445	5768	5.06	0.00
10	2:24:00 PM	3:24:00 PM	1:00:00	1110	5768	523	5768	5.19	0.00

*Note: ran out of water for annular space (outer ring) following Trial No. 7.

Infiltration Rate: DRI-102



DOUBLE RING INFILTRATION TEST SUMMARY

Project

Project Name: Olive Avenue Roadway Improvements
Project Location: Glendale/Waddell, Arizona
Project Number: CP255023

Test Details

Test No.: DRI-103
Depth (Elev.): 3 feet
Technician: O. Tote
Date: 10/7/2025
Weather: Sunny
Liquid Type: Water
Coordinates: 33.56598, -112.40056

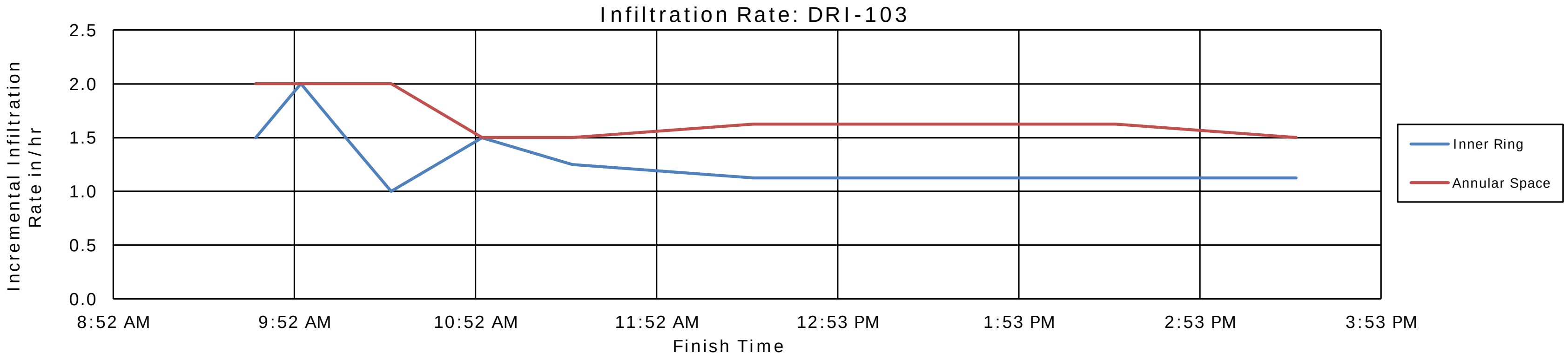
Test Setup

Inner Ring Area:	113.1	in^2
Inner Ring Diameter:	12.0	in
Annular space between Outer and Inner rings:	339	in^2
Outer Ring Diameter:	24.0	in
Depth of Liquid Inner Ring:	10.00	in
Depth of Liquid Annular Space:	11.25	in

Soil Description

Depth: 3 feet
Description: Silty Clayey Sand (SC-SM)

	Time			Volume Measurements				Infiltration Rate, in/hr	
				Start		Finish			
Trial No.	Start	Finish	Elapsed Time (hr:min:sec)	Inner Ring Volume, in^3	Annular Space Volume, in^3	Inner Ring Volume, in^3	Annular Space Volume,in^3	Inner Ring	Annular Space
1	9:25:00 AM	9:40:00 AM	0:15:00	1131	3817	1089	3647	1.50	2.00
2	9:40:00 AM	9:55:00 AM	0:15:00	1202	3987	1145	3817	2.00	2.00
3	9:55:00 AM	10:10:00 AM	0:15:00	1145	3817	1103	3647	1.50	2.00
4	10:10:00 AM	10:25:00 AM	0:15:00	1103	3647	1074	3478	1.00	2.00
5	10:25:00 AM	10:55:00 AM	0:30:00	1258	3987	1173	3732	1.50	1.50
6	10:55:00 AM	11:25:00 AM	0:30:00	1173	3732	1103	3478	1.25	1.50
7	11:25:00 AM	12:25:00 PM	1:00:00	1216	4199	1089	3647	1.13	1.63
8	12:25:00 PM	1:25:00 PM	1:00:00	1159	3987	1032	3435	1.13	1.63
9	1:25:00 PM	2:25:00 PM	1:00:00	1131	4029	1004	3478	1.13	1.63
10	2:25:00 PM	3:25:00 PM	1:00:00	1004	3478	877	2969	1.13	1.50



DOUBLE RING INFILTRATION TEST SUMMARY

Project

Project Name: Olive Avenue Roadway Improvements
Project Location: Glendale/Waddell, Arizona
Project Number: CP255023

Test Details

Test No.: DRI-104
Depth (Elev.): 4 feet
Technician: O. Tote
Date: 9/30/2025
Weather: Sunny
Liquid Type: Water
Coordinates: 33.56590, -112.39706

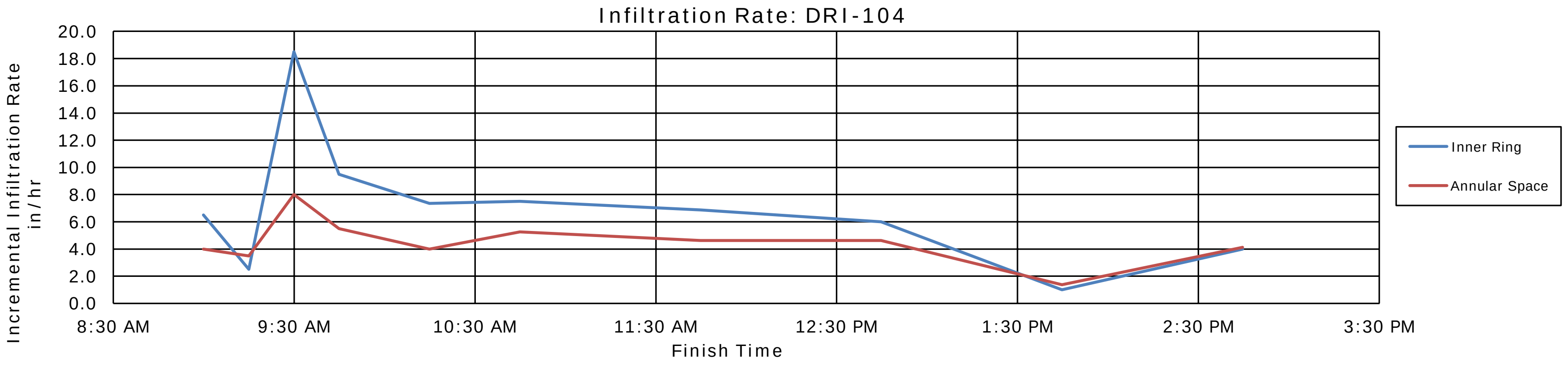
Test Setup

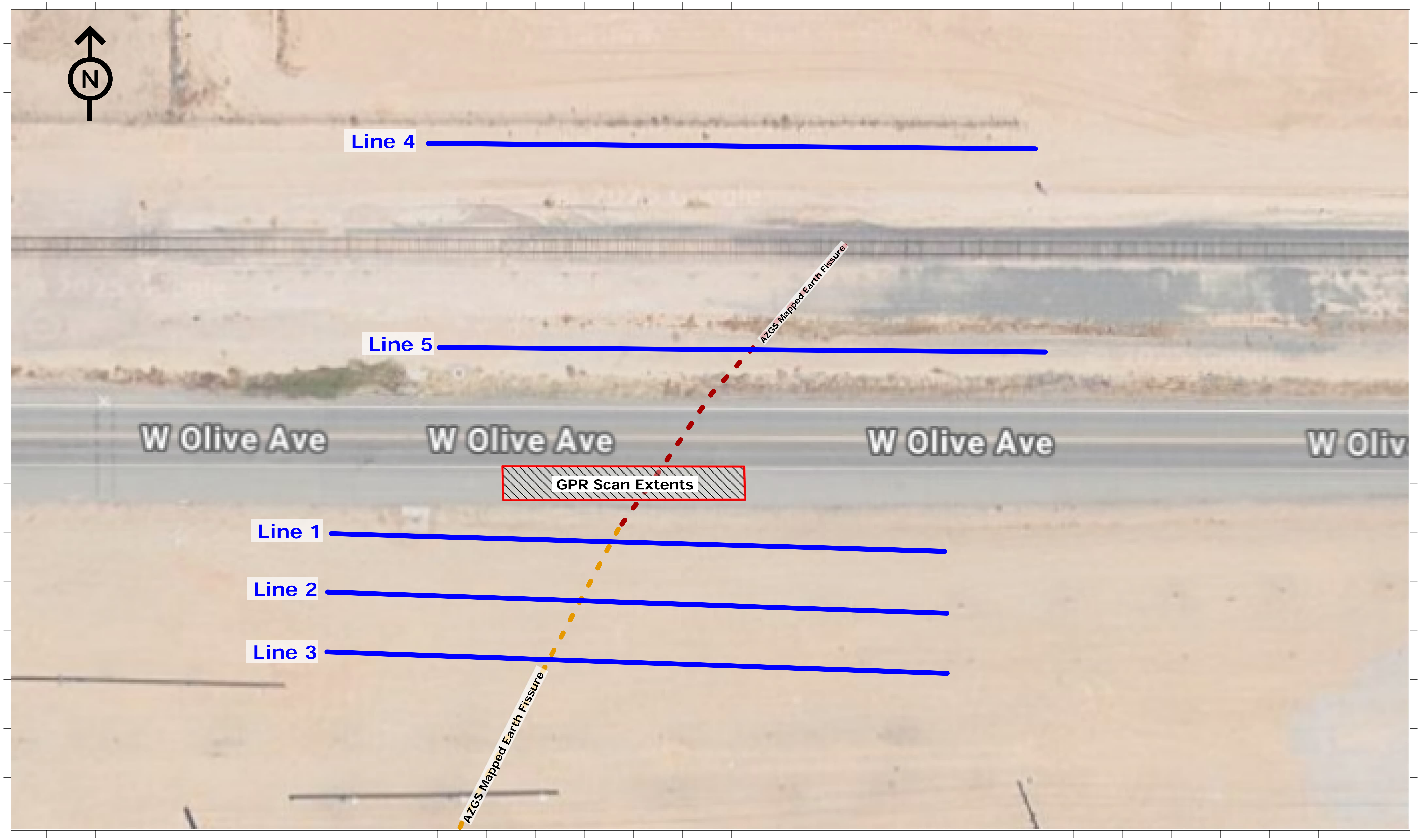
Inner Ring Area:	113.1	in^2
Inner Ring Diameter:	12.0	in
Annular space between Outer and Inner rings:	339	in^2
Outer Ring Diameter:	24.0	in
Depth of Liquid Inner Ring:	8.25	in
Depth of Liquid Annular Space:	8.13	in

Soil Description

Depth: 4 feet
Description: Sandy Silty Clay (CL-ML)

	Time		Elapsed Time (hr:min:sec)	Volume Measurements				Infiltration Rate, in/hr	
				Start		Finish			
Trial No.	Start	Finish		Inner Ring Volume, in^3	Annular Space Volume, in^3	Inner Ring Volume, in^3	Annular Space Volume,in^3	Inner Ring	Annular Space
1	8:45:00 AM	9:00:00 AM	0:15:00	933	2757	749	2417	6.50	4.00
2	9:00:00 AM	9:15:00 AM	0:15:00	749	2417	679	2121	2.50	3.50
3	9:15:00 AM	9:30:00 AM	0:15:00	792	2121	269	1442	18.50	8.00
4	9:30:00 AM	9:45:00 AM	0:15:00	806	2248	537	1781	9.50	5.50
5	9:45:00 AM	10:15:00 AM	0:30:00	891	2375	475	1696	7.35	4.00
6	10:15:00 AM	10:45:00 AM	0:30:00	636	2205	212	1315	7.50	5.25
7	10:45:00 AM	11:45:00 AM	1:00:00	877	2502	99	933	6.88	4.63
8	11:45:00 AM	12:45:00 PM	1:00:00	919	2460	240	891	6.00	4.63
9	12:45:00 PM	1:45:00 PM	1:00:00	877	2375	763	1909	1.00	1.38
10	1:45:00 PM	2:45:00 PM	1:00:00	679	1909	226	509	4.00	4.12





Legend

━ Seismic Array

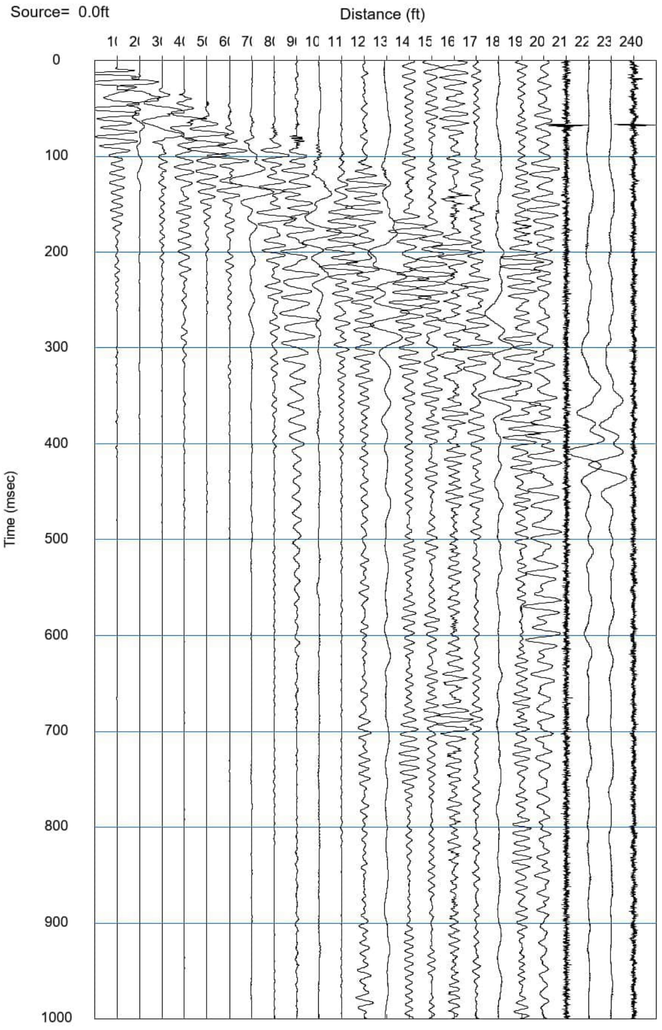
Notes

1. 2025 aerial imagery acquired from Google and may not reflect current site conditions.
2. Map Scale: 1" = 45'.
3. Historical mapped earth fissure location provided by AZGS.

Exhibit 1 - Geophysical Site Map

Project: Olive Avenue Roadway Improvments
Location: Surprise, AZ
Client: AZDOT
Project No.:CP255023
Date: October 14, 2025

Line 1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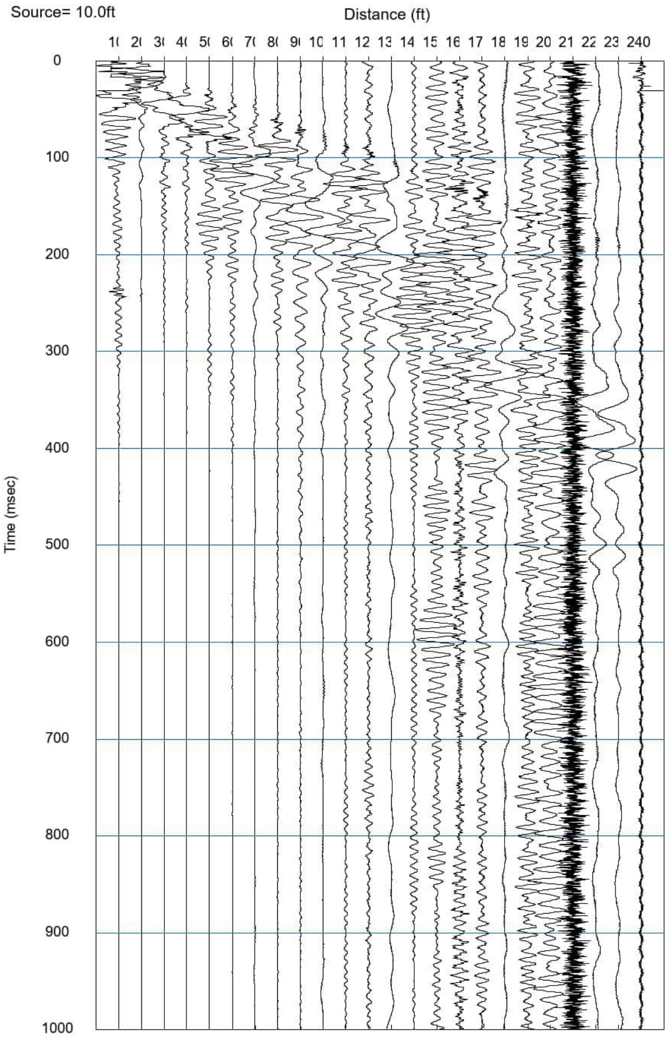
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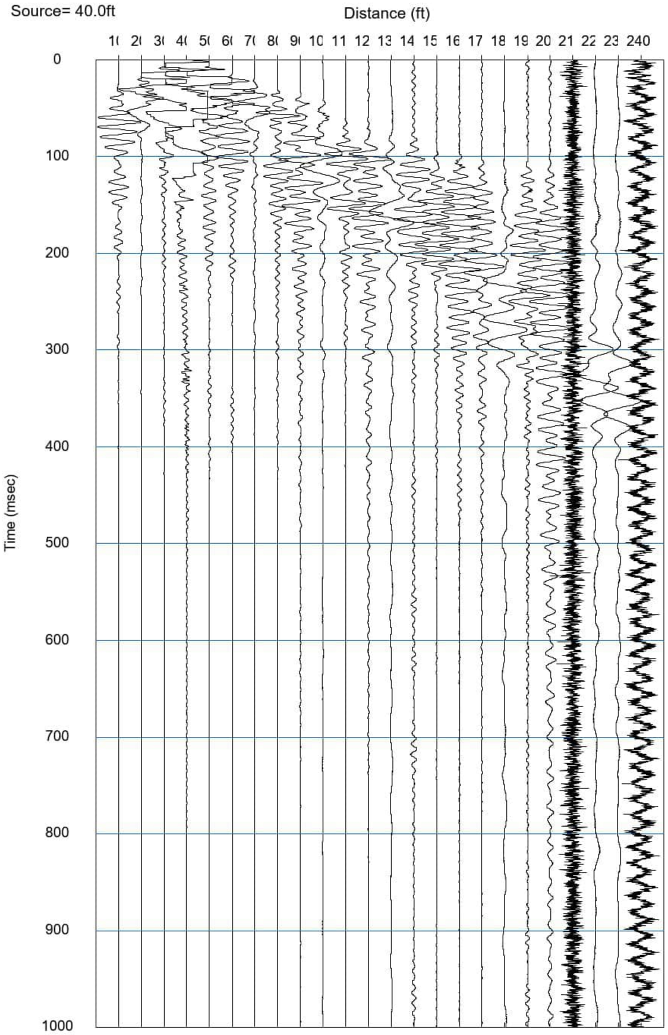
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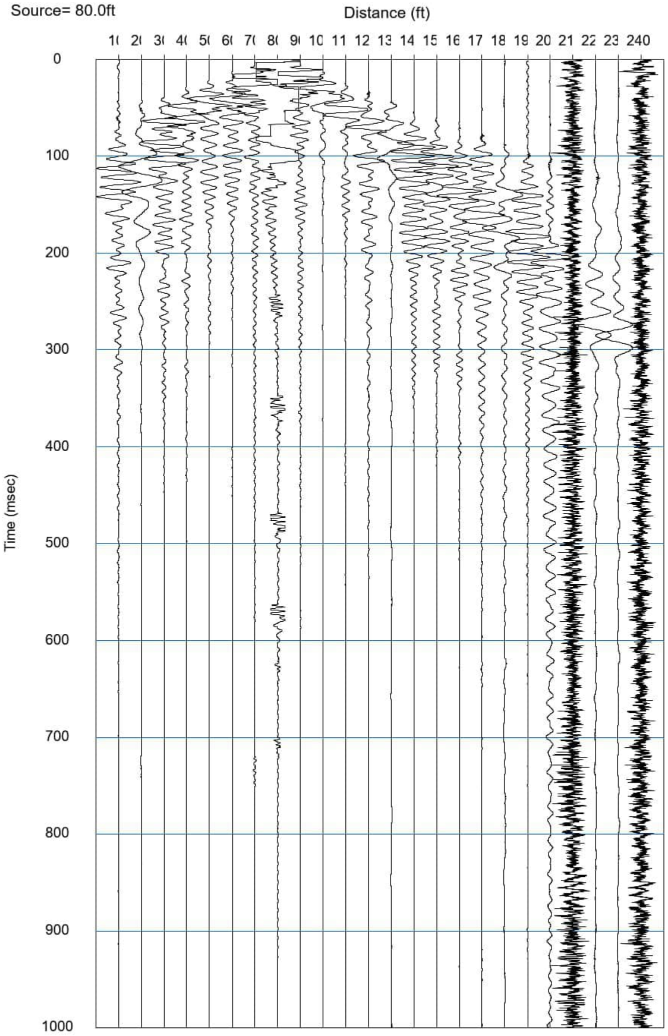
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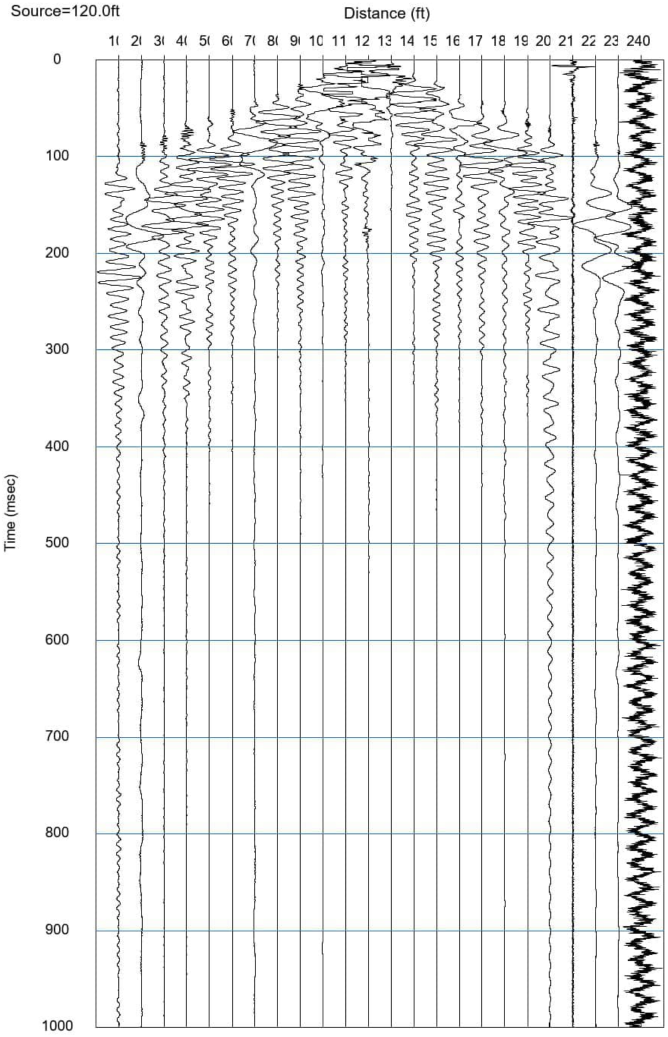
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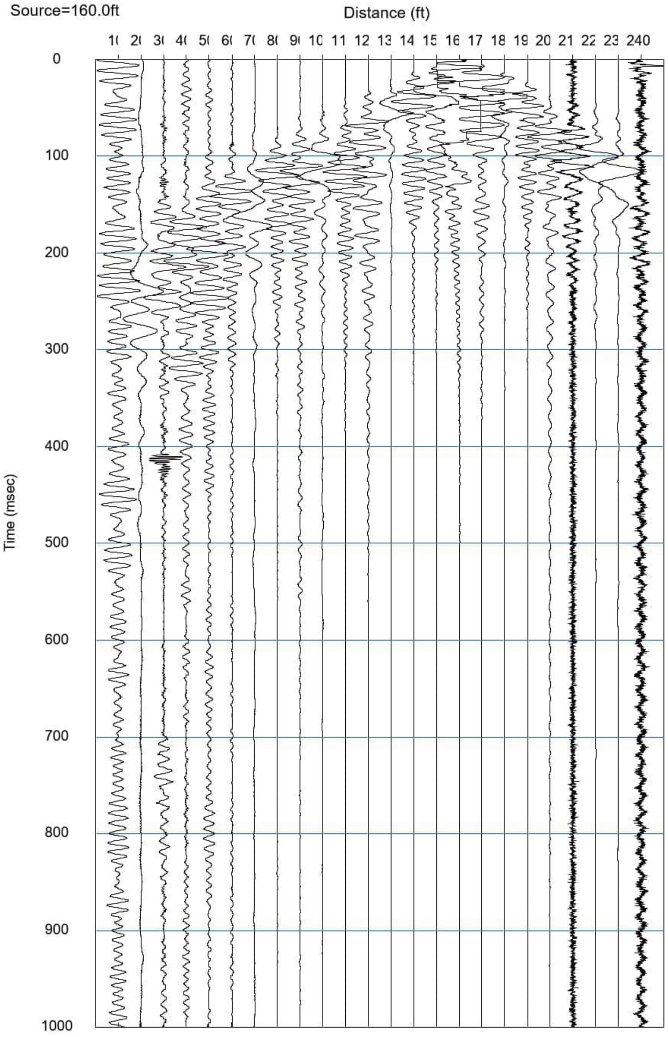
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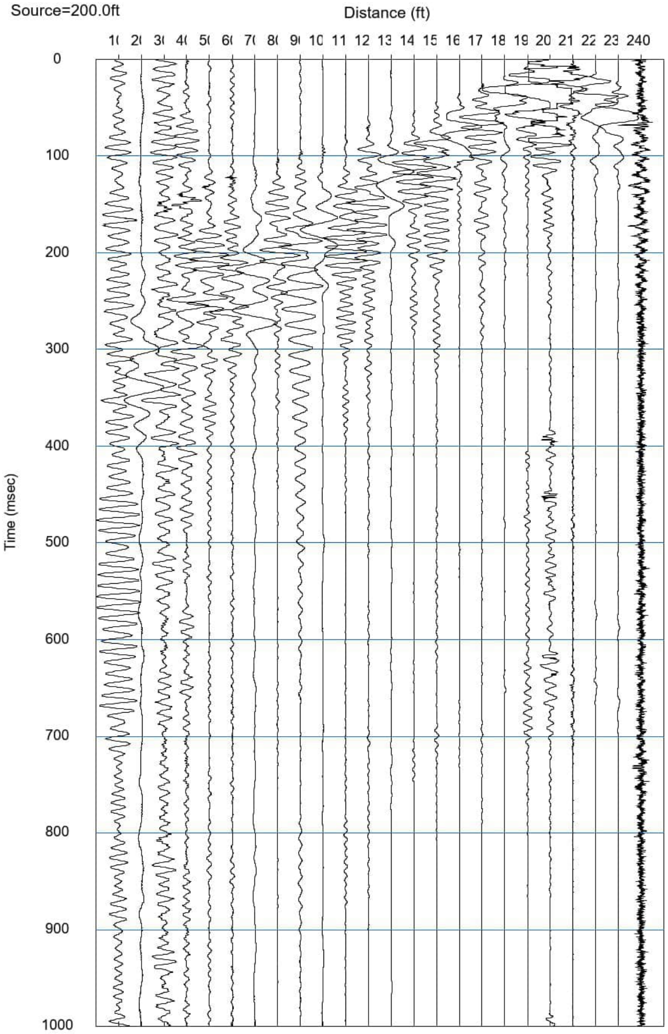
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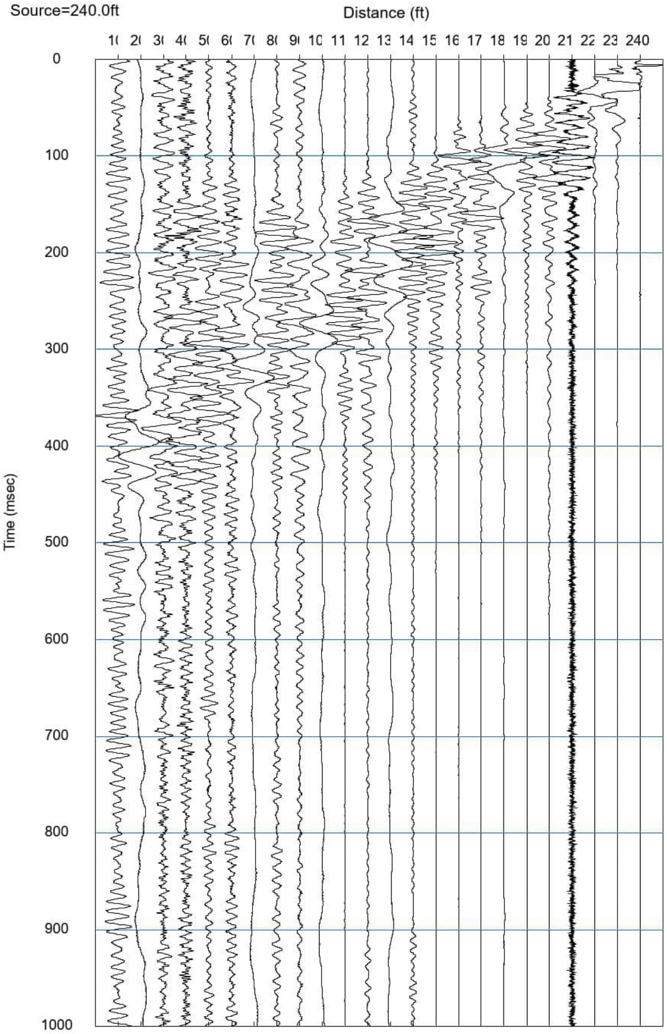
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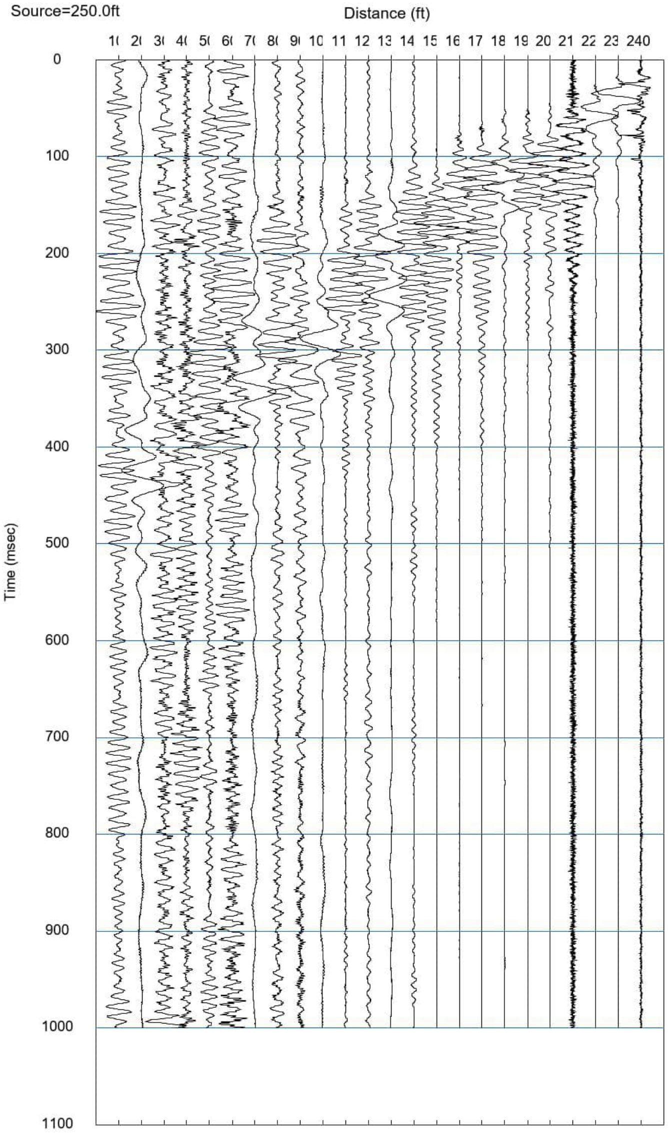
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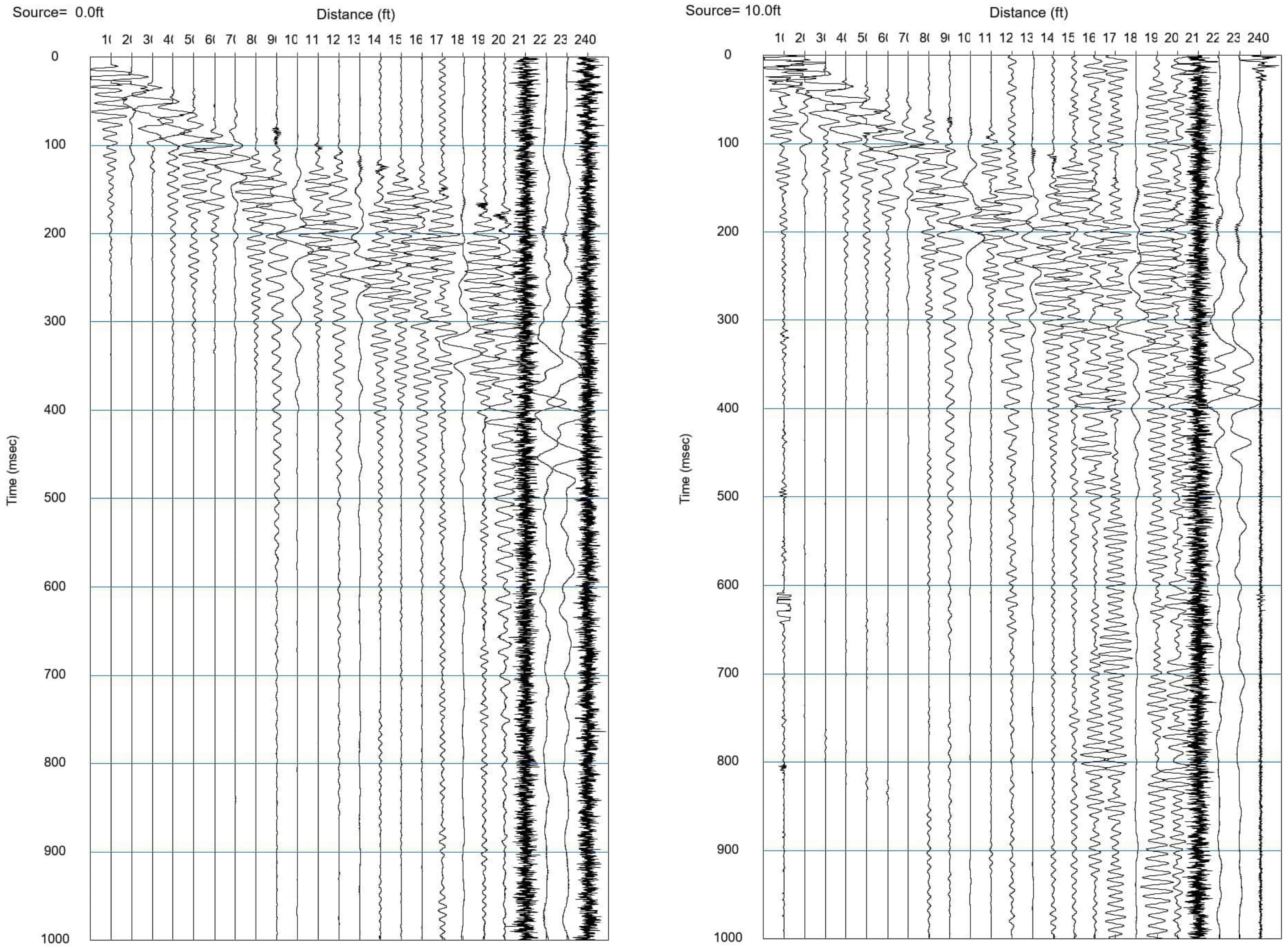
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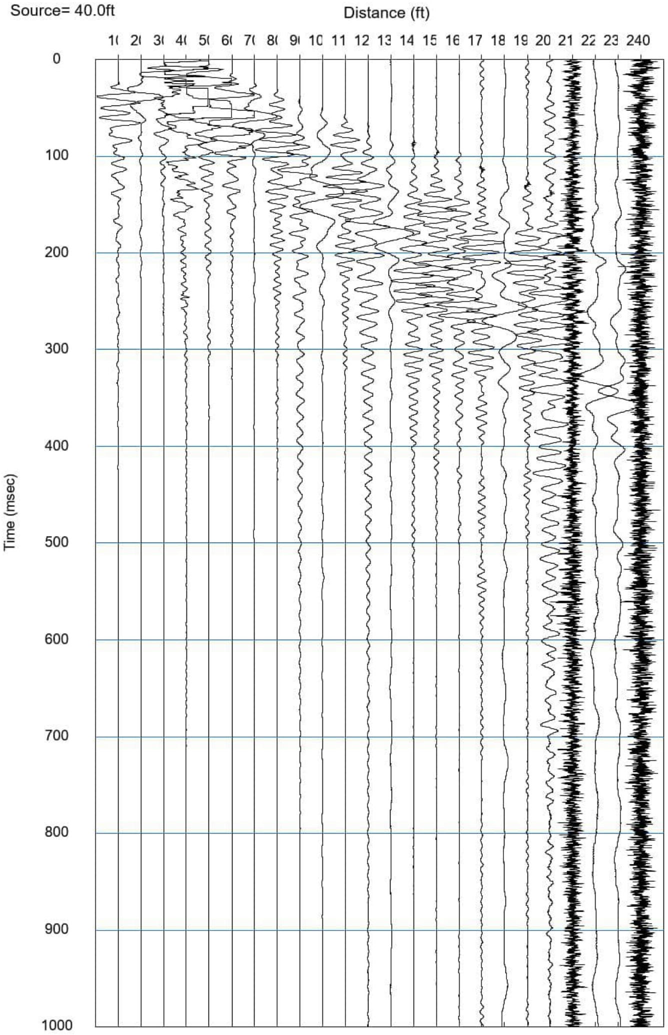
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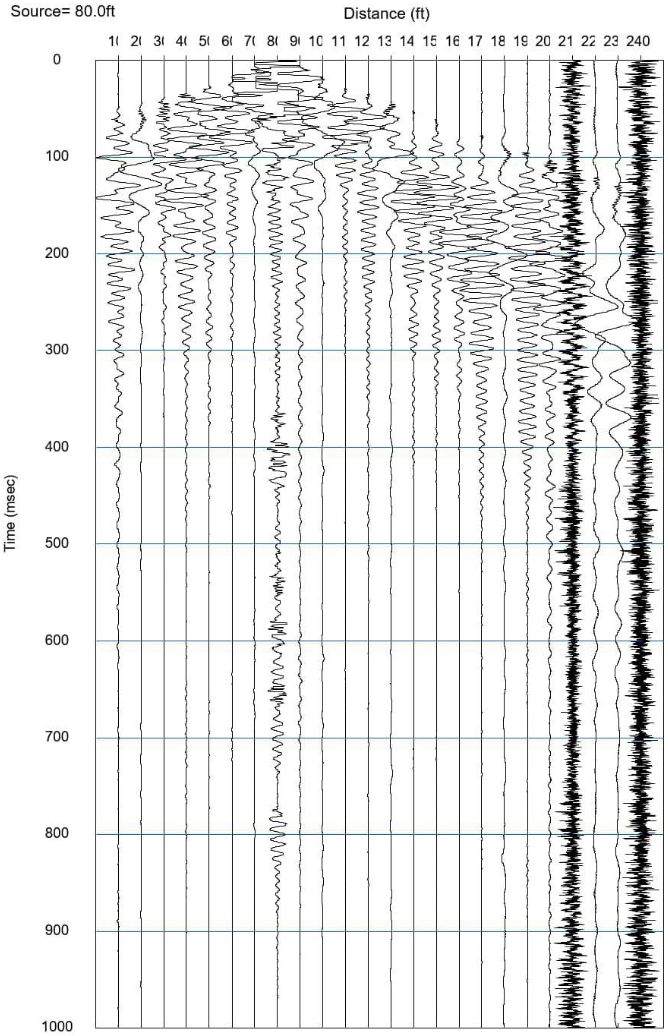
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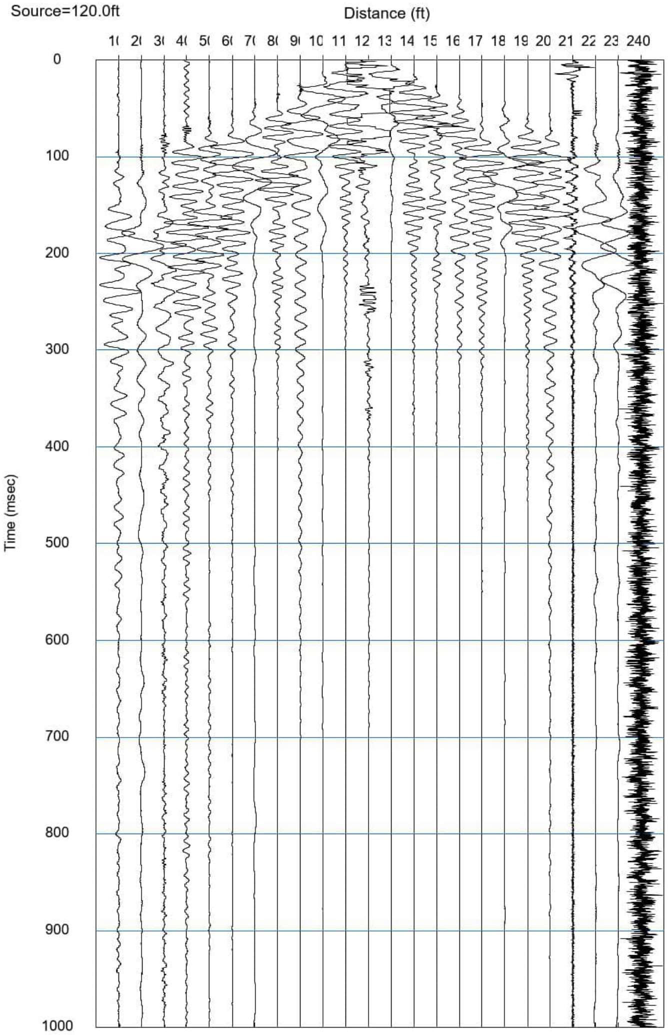
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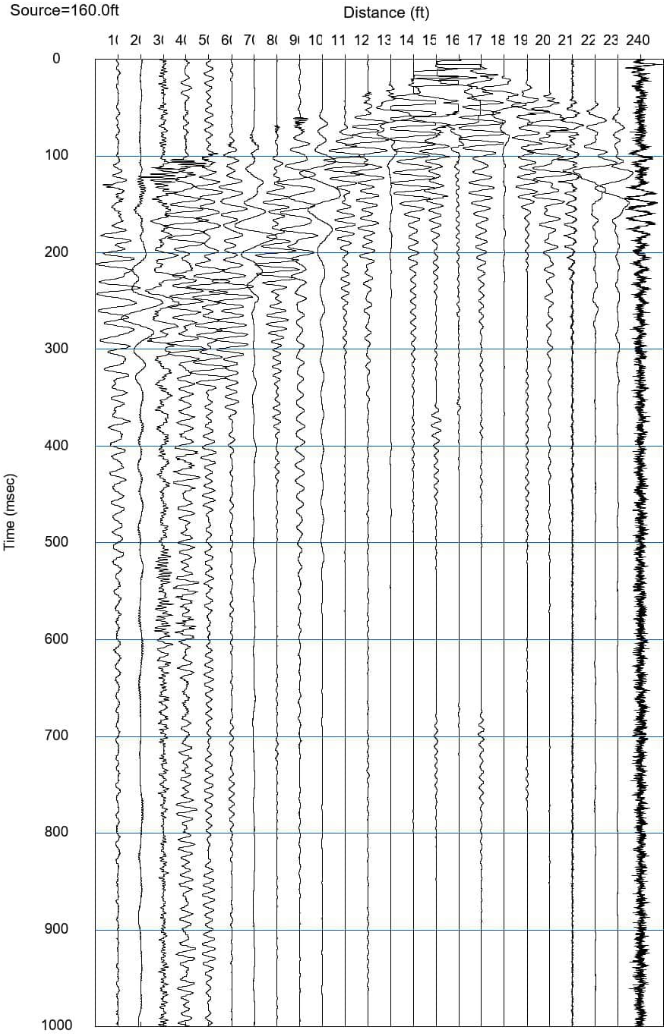
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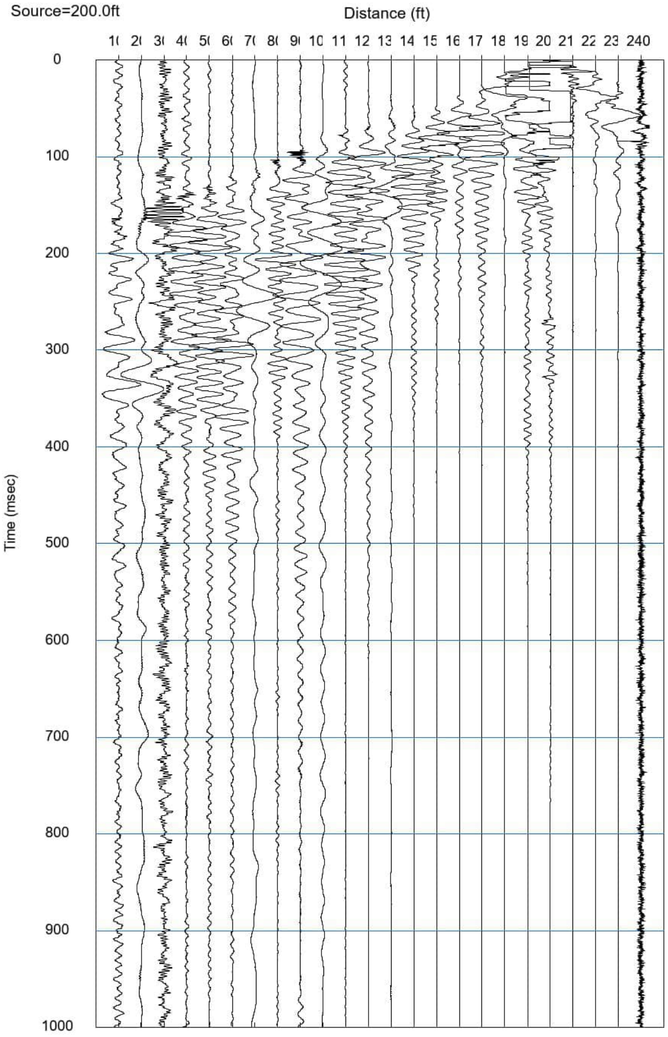
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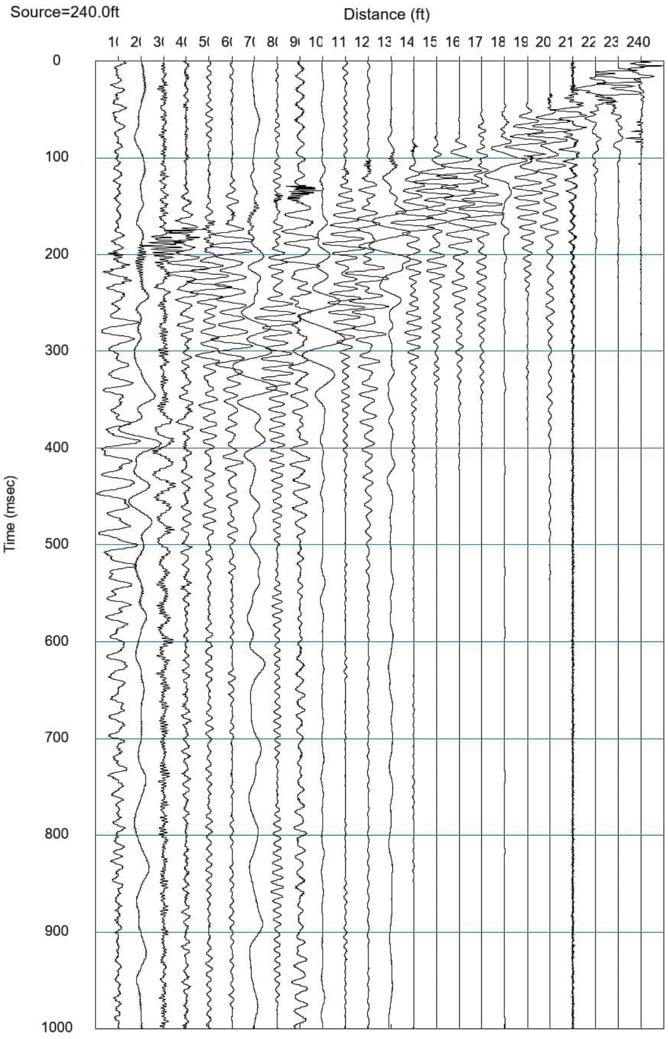
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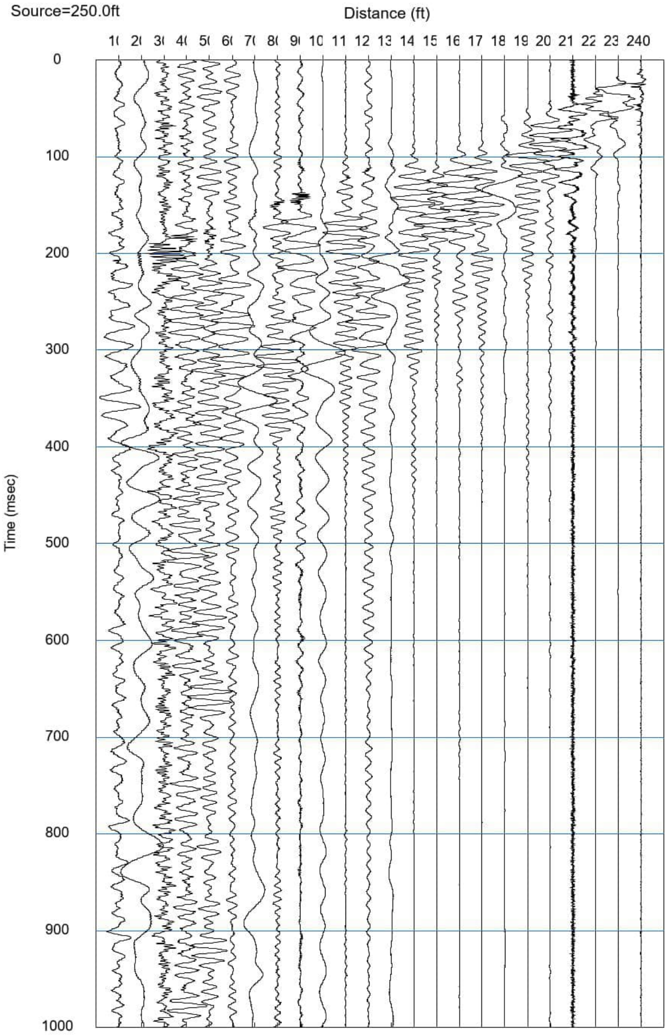
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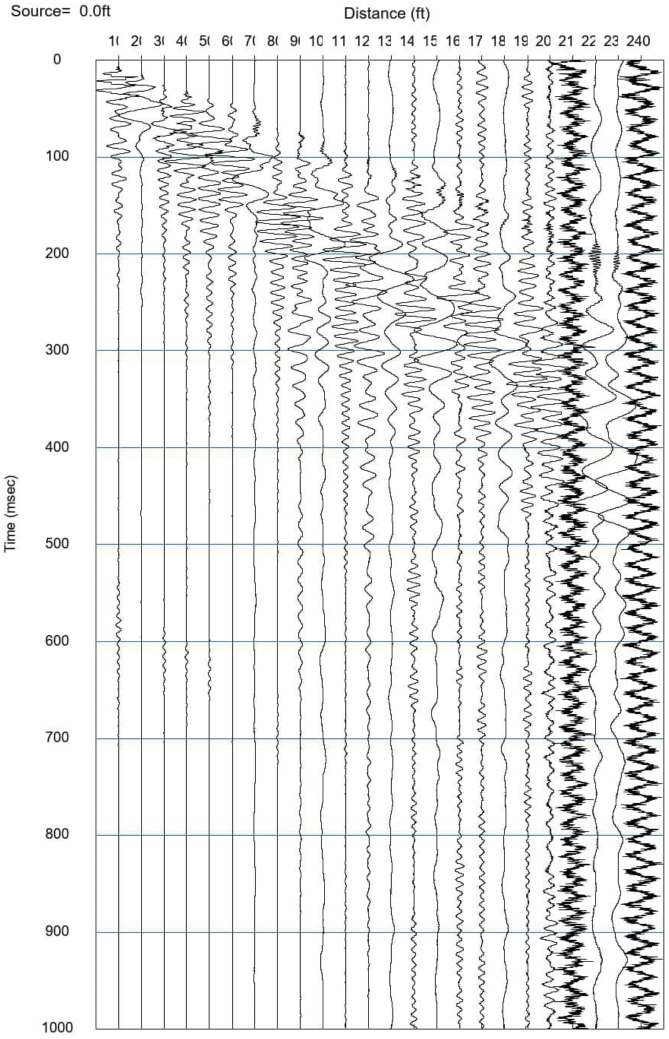
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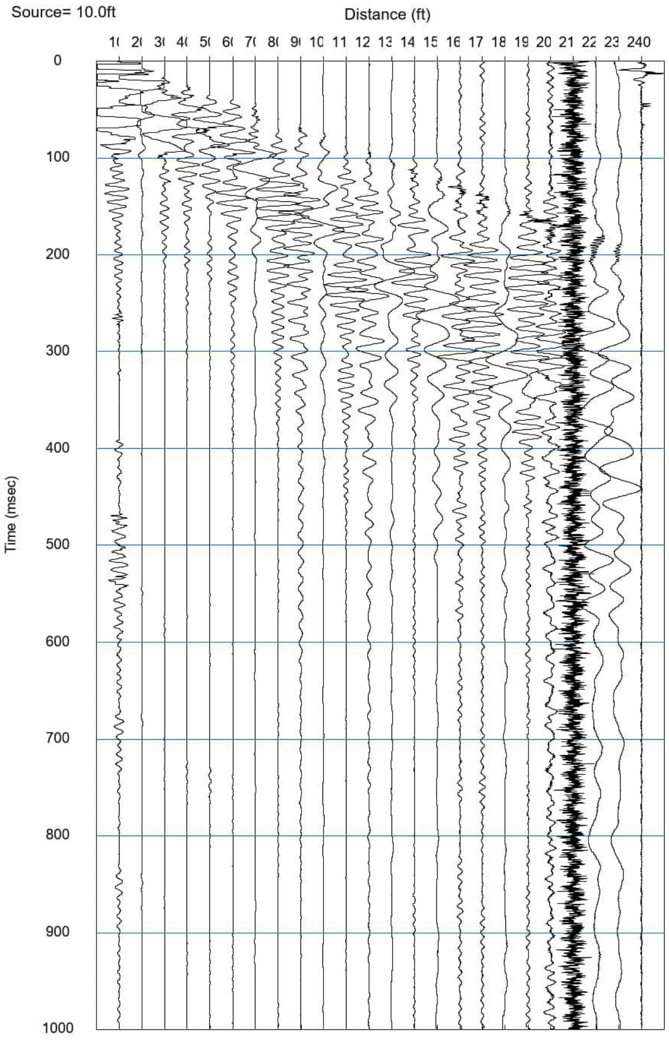
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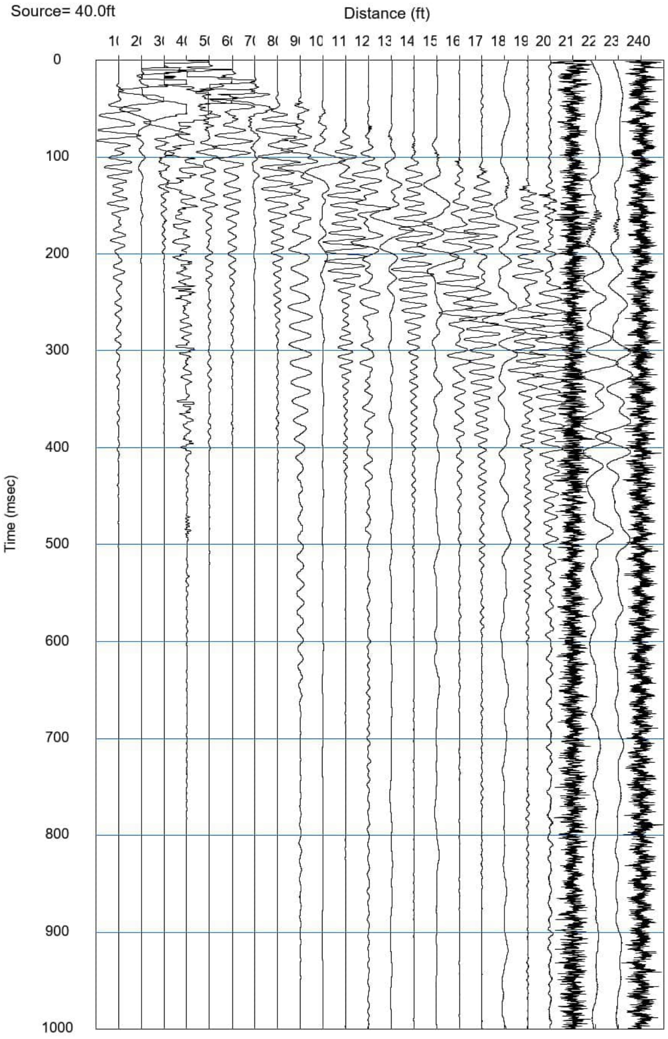
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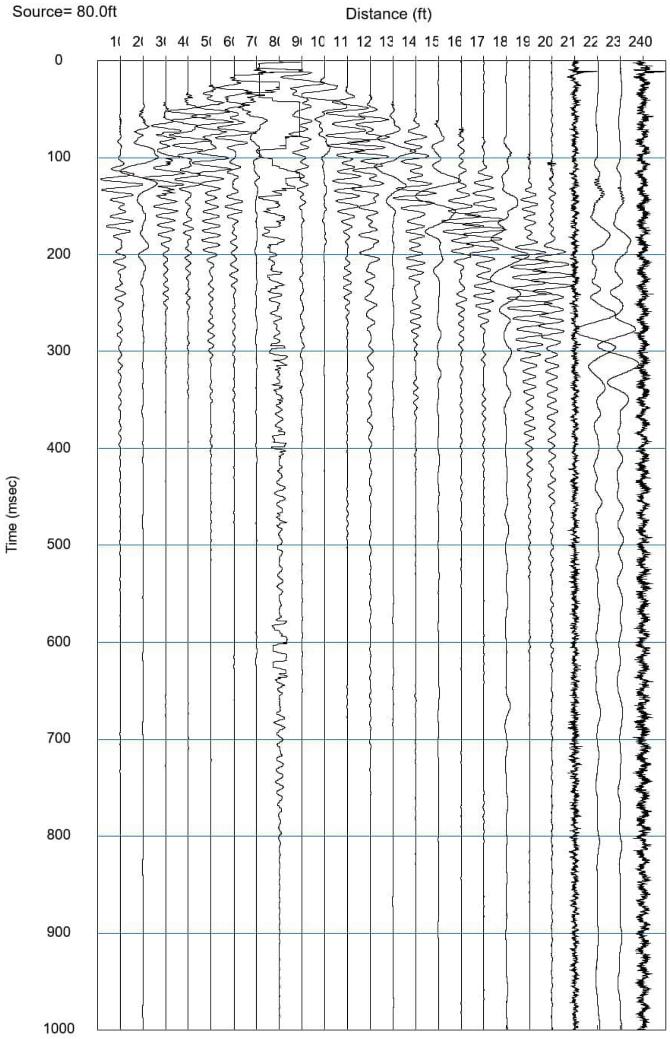
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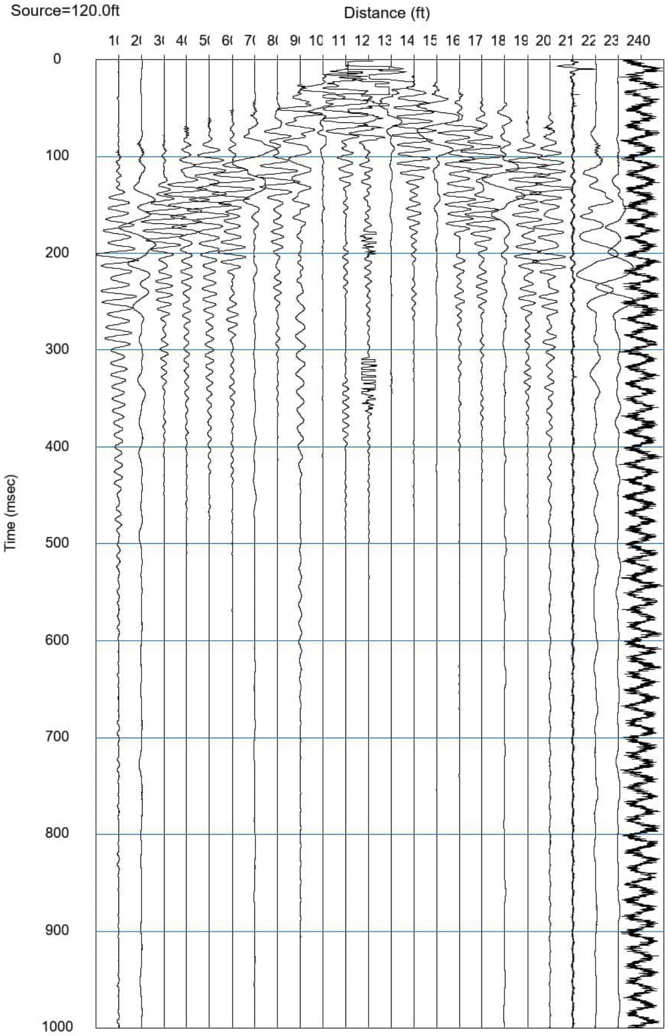
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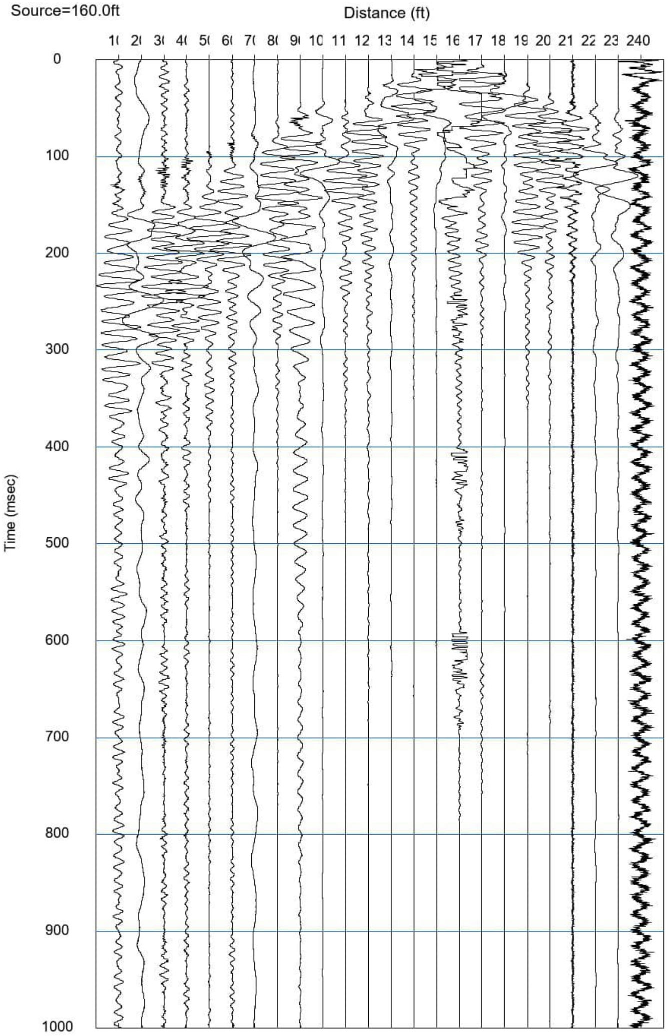
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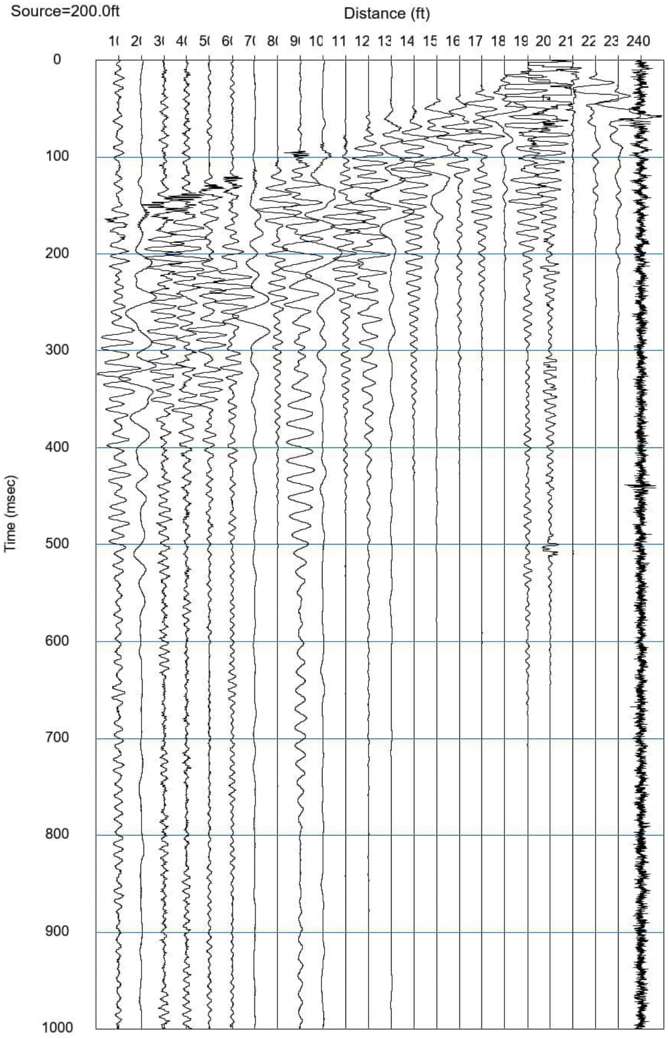
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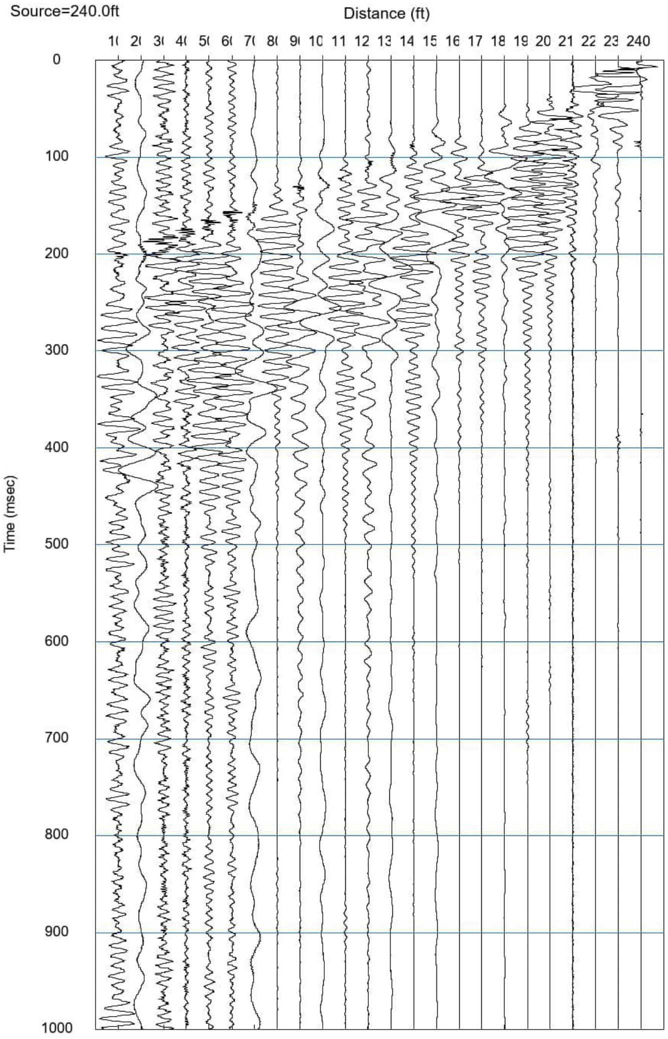
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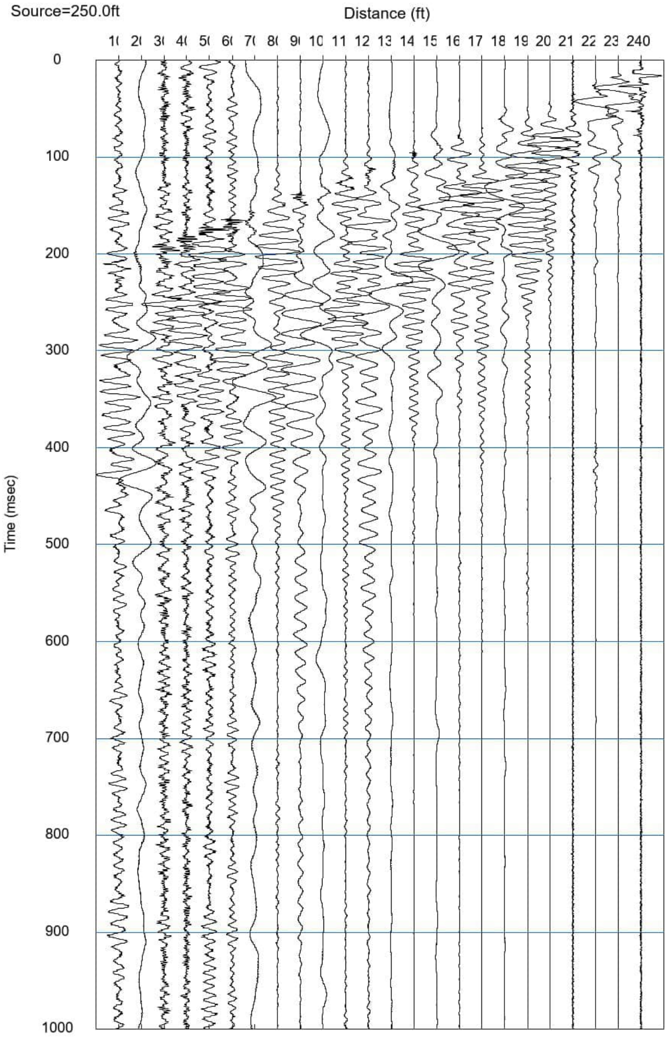
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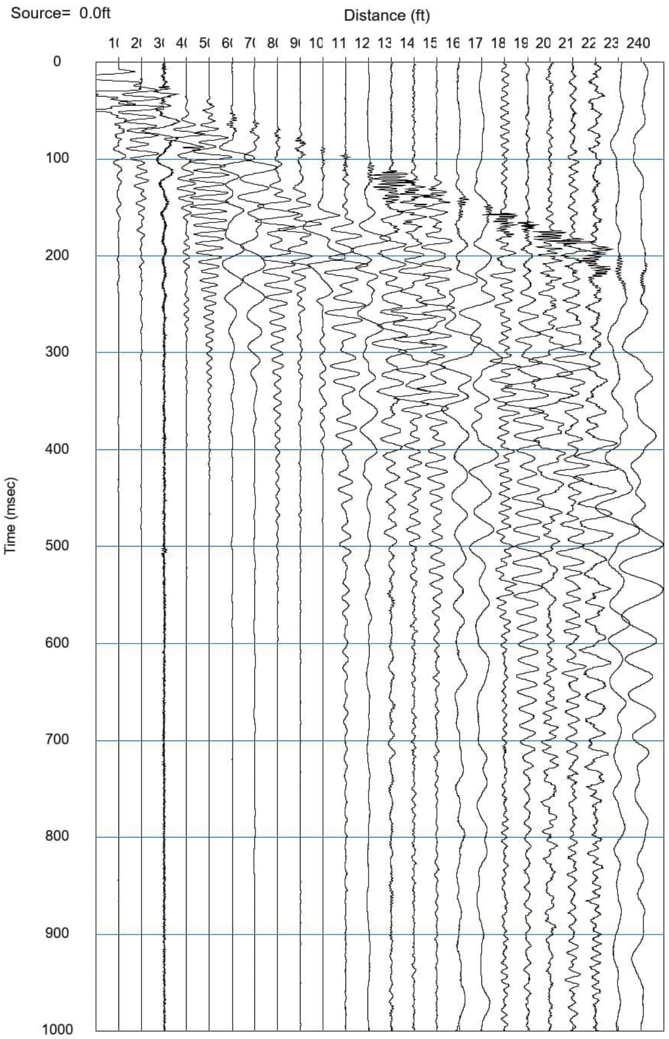
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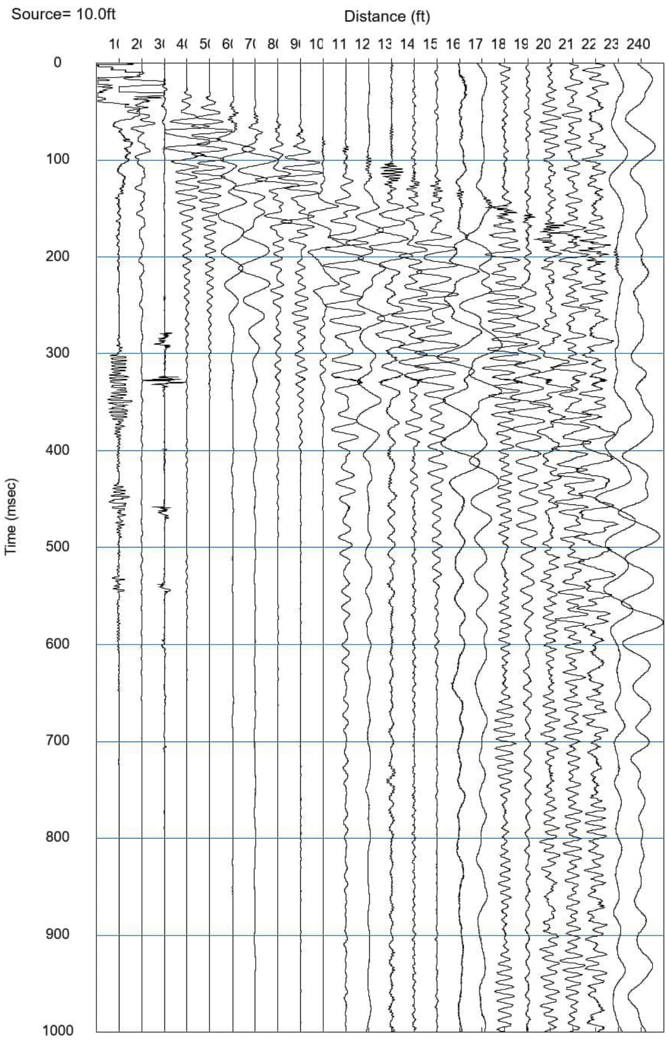
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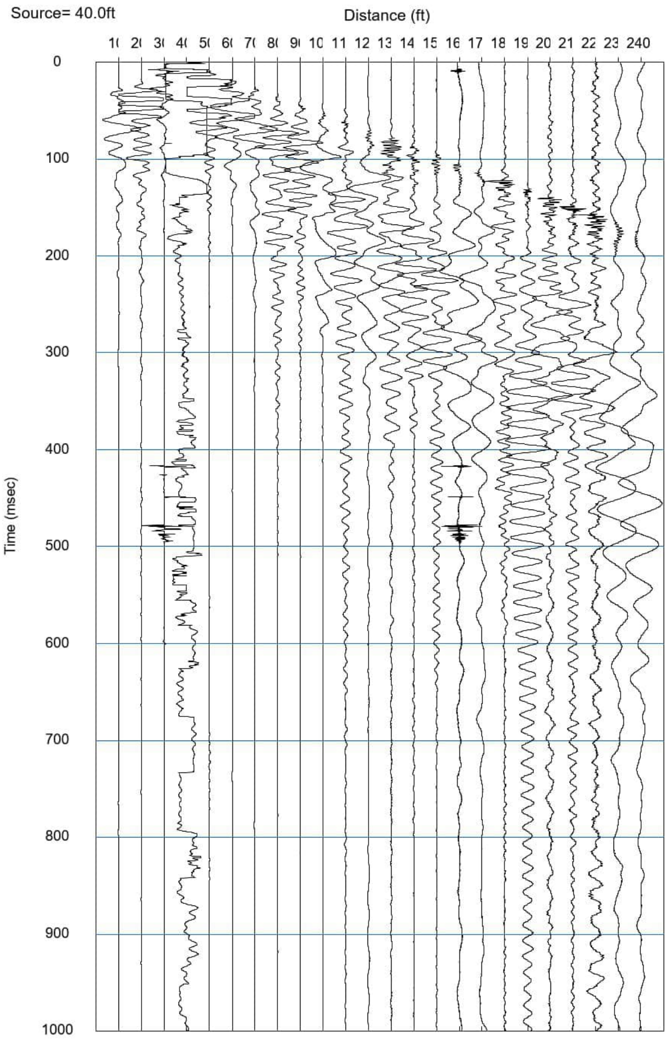
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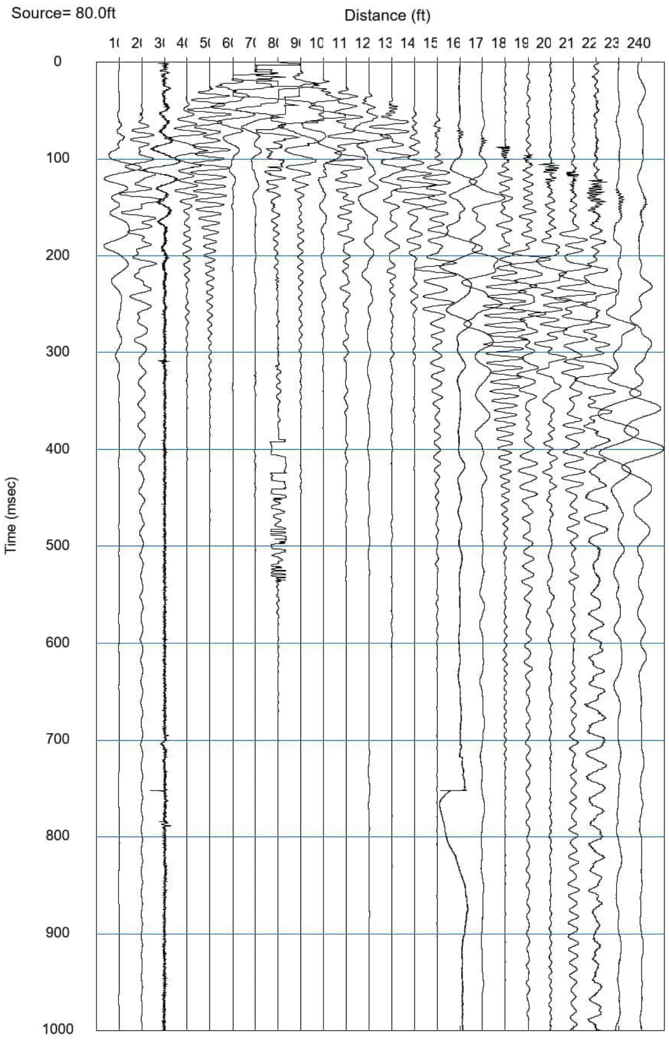
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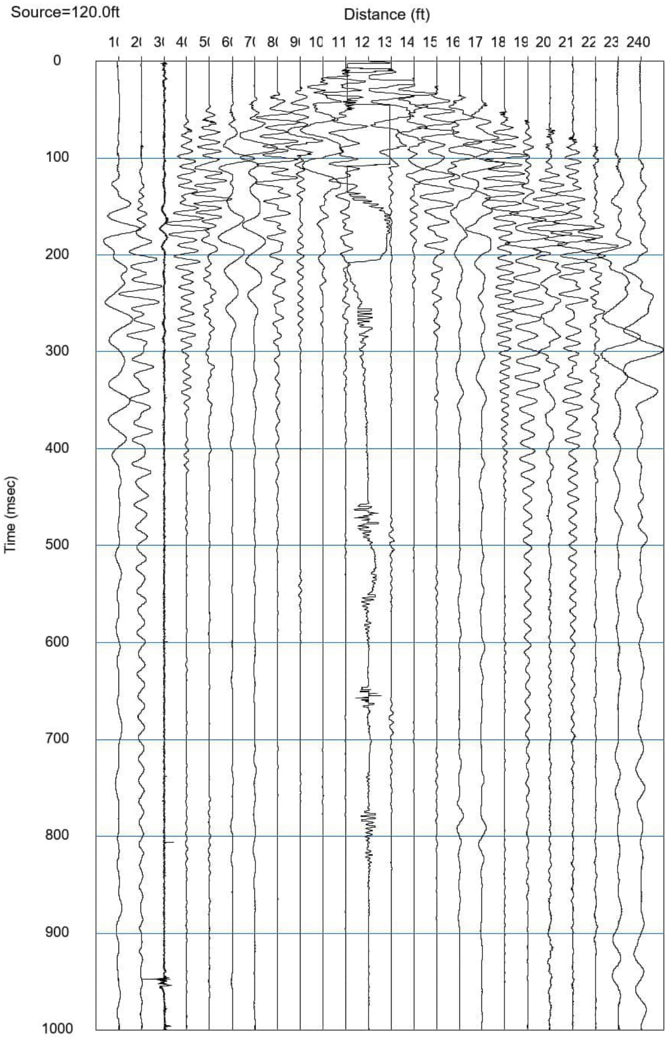
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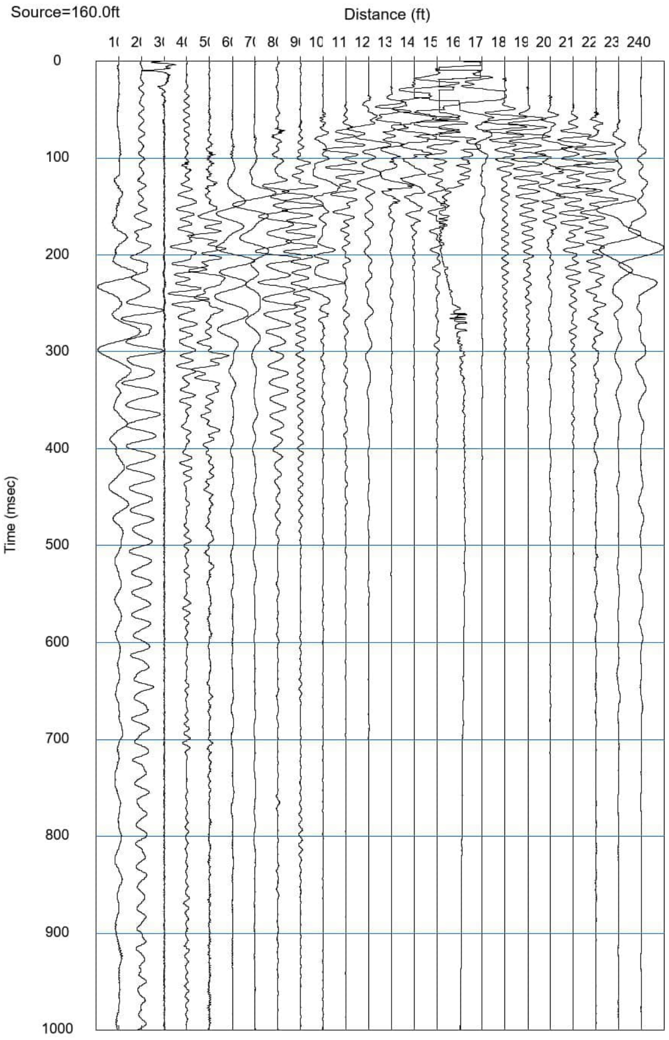
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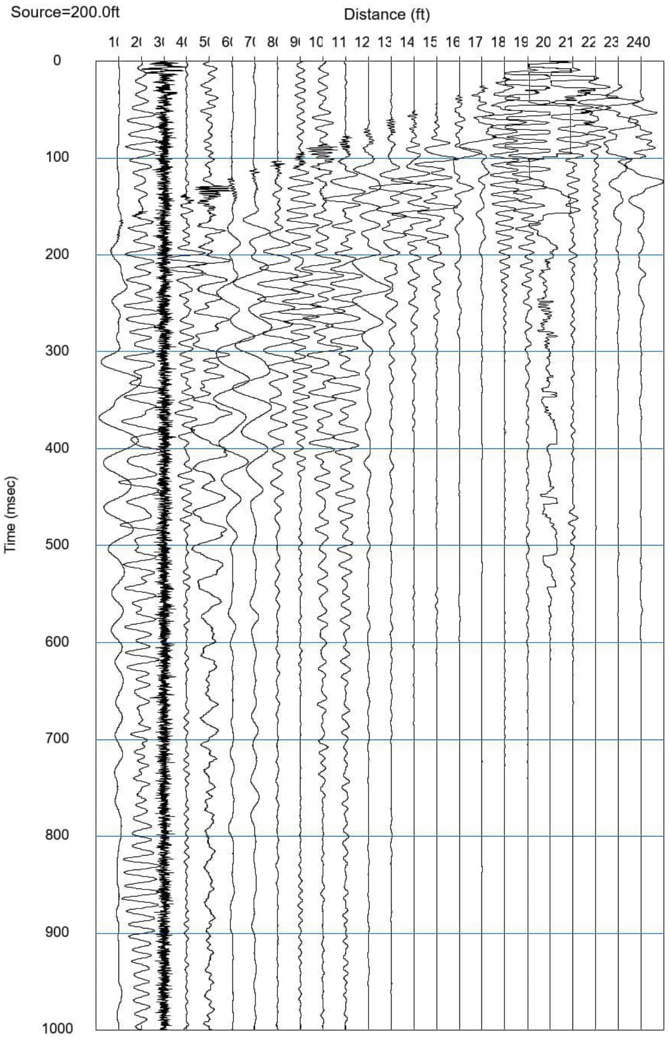
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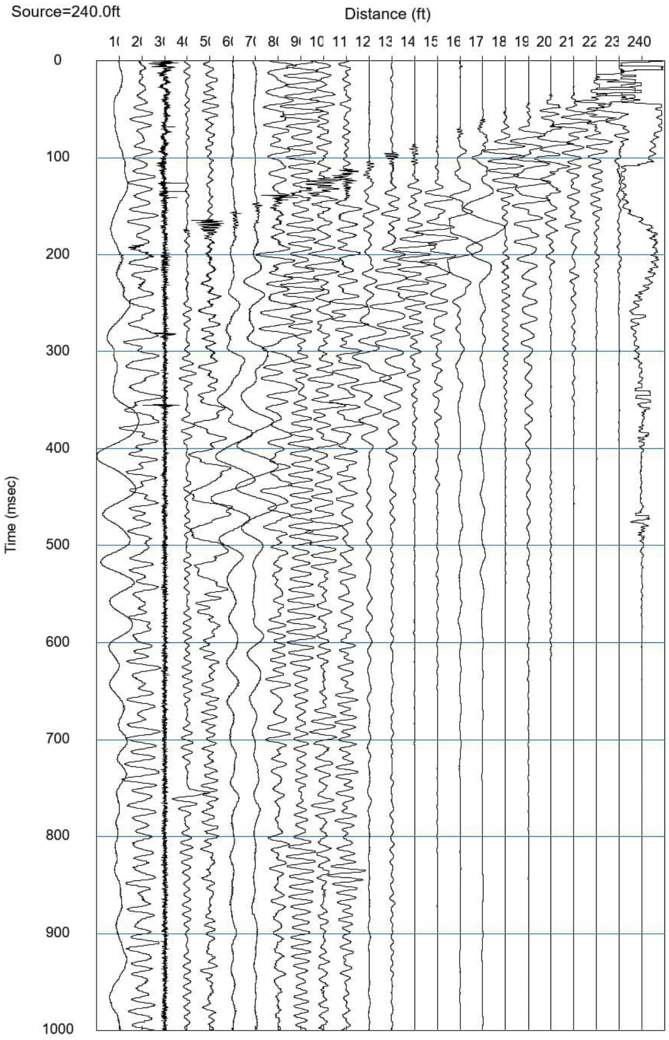
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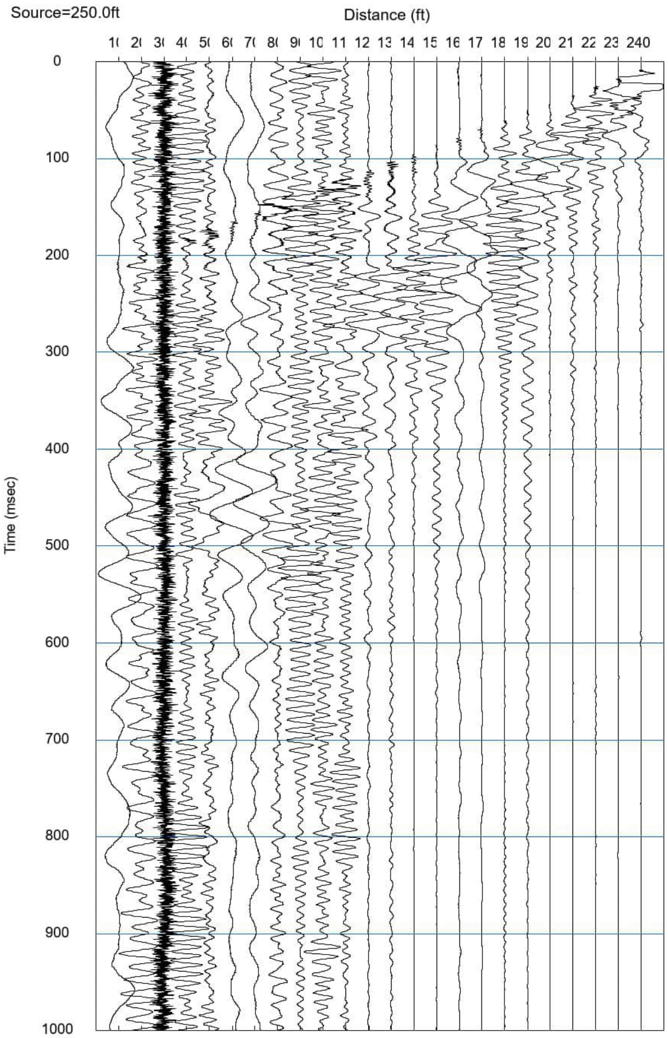
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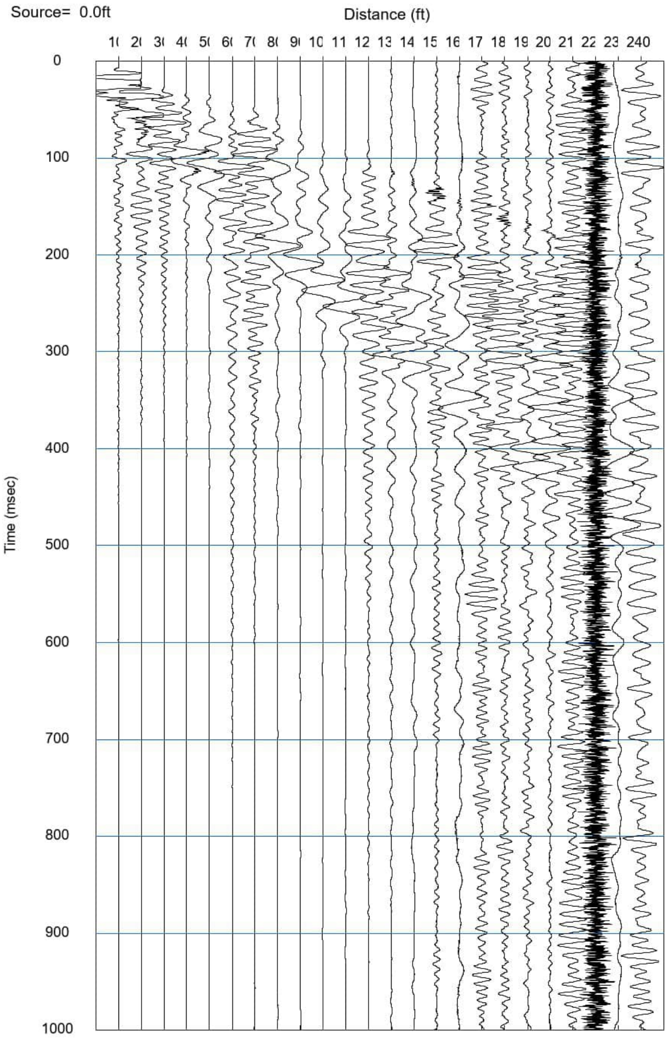
Line 5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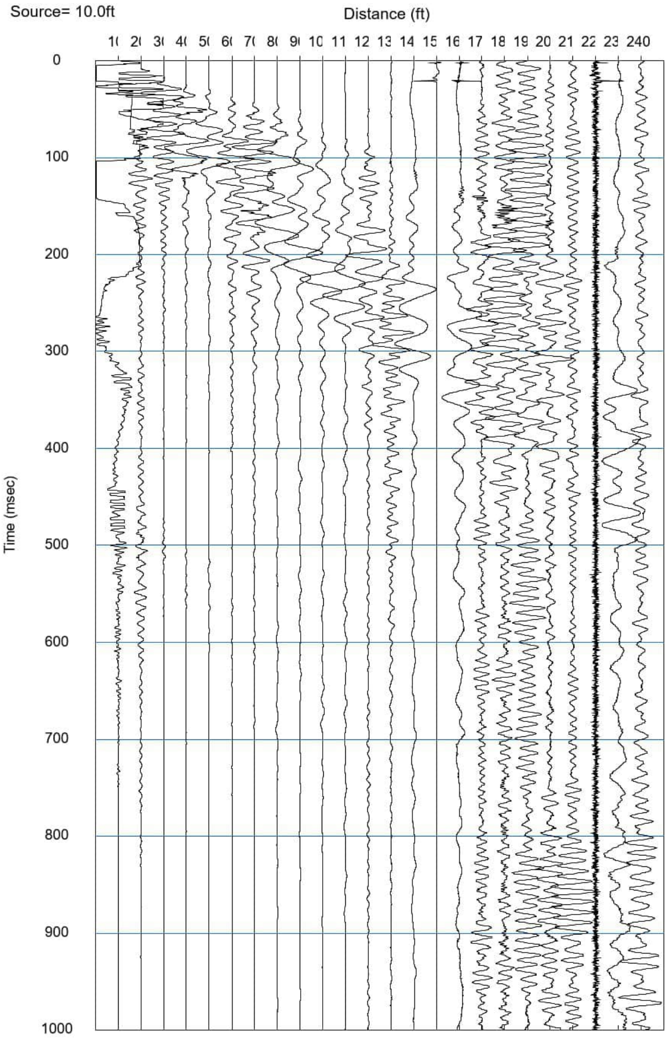
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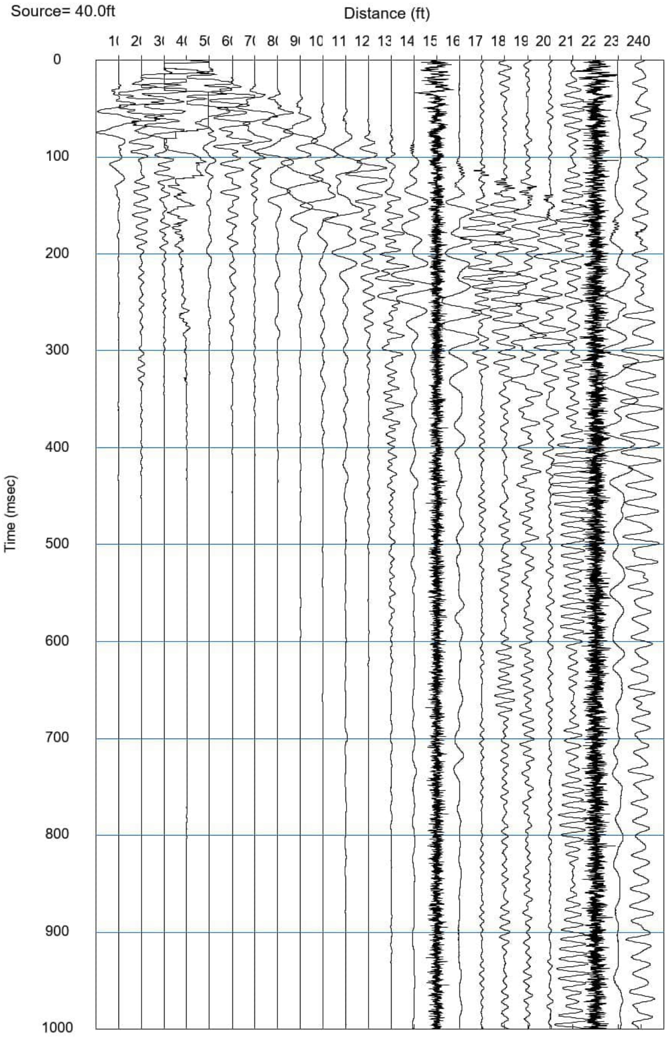
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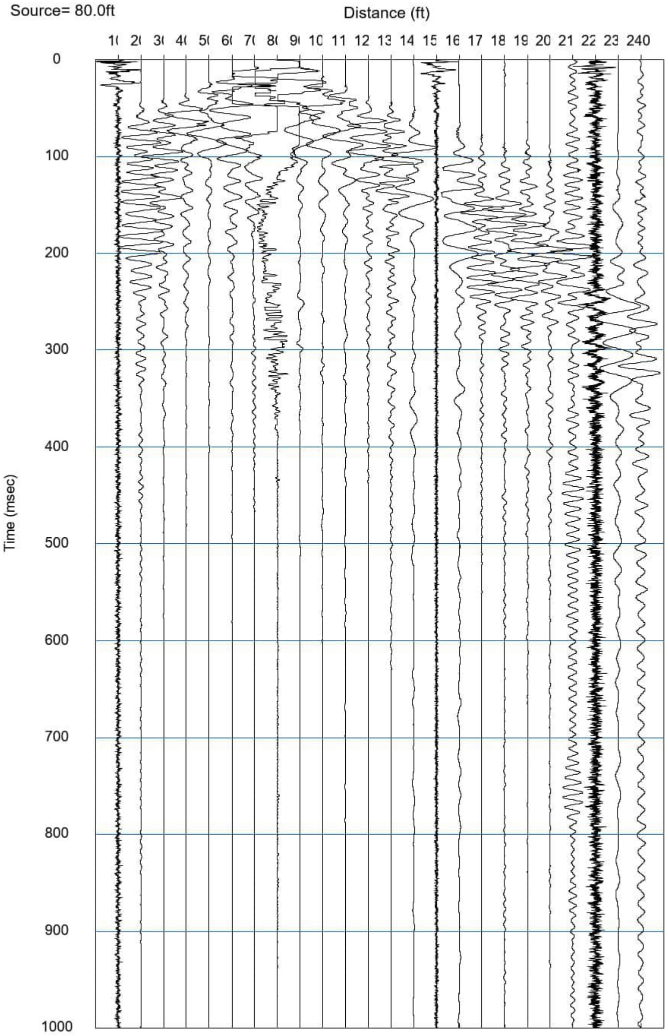
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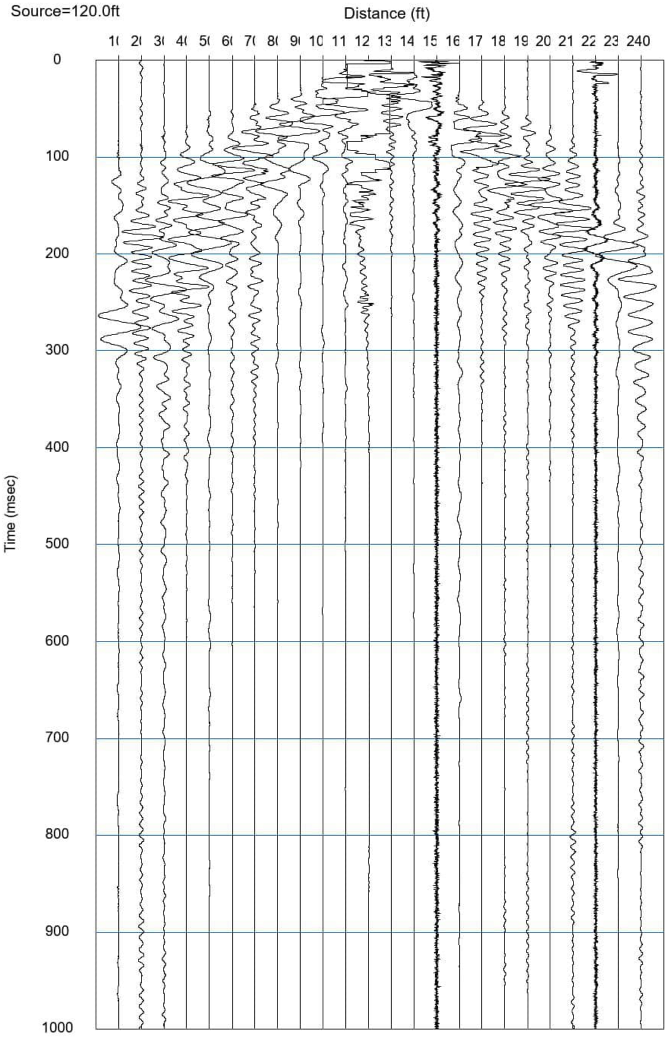
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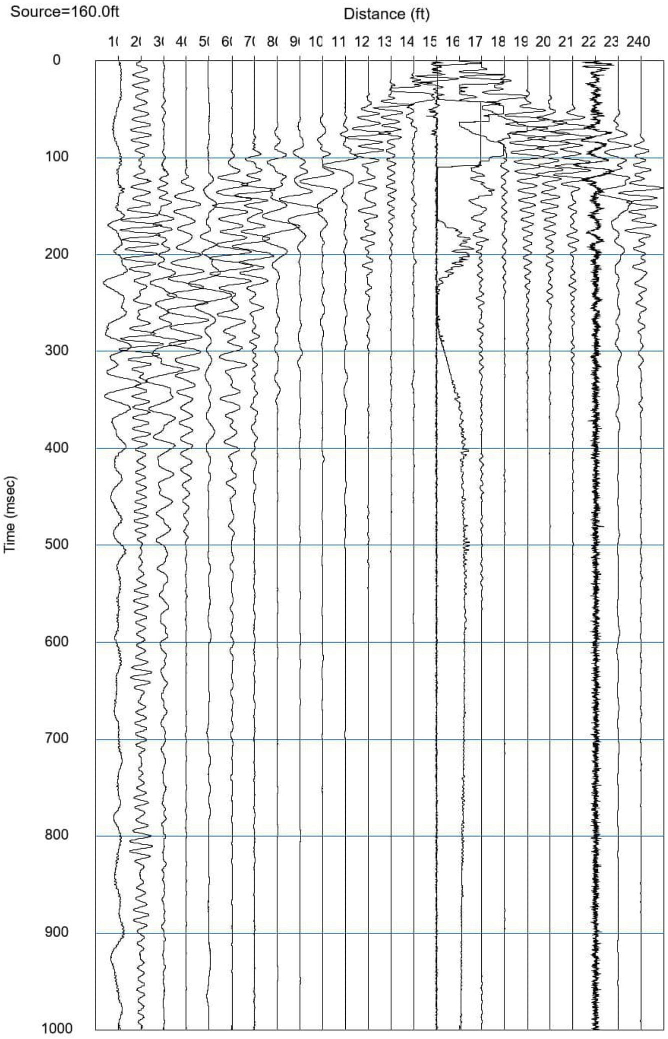
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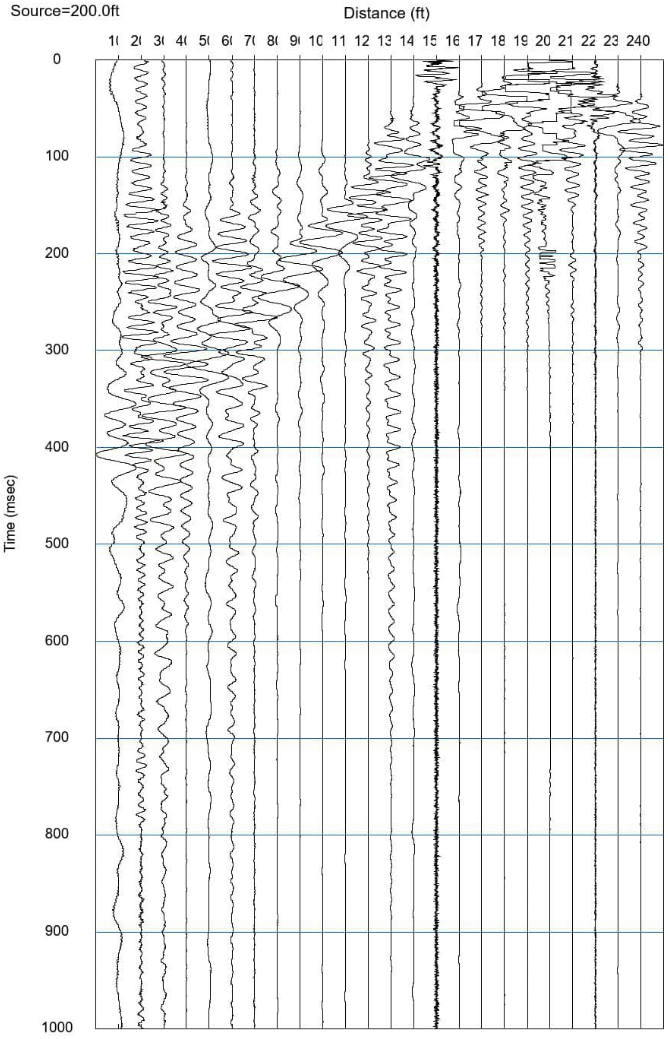
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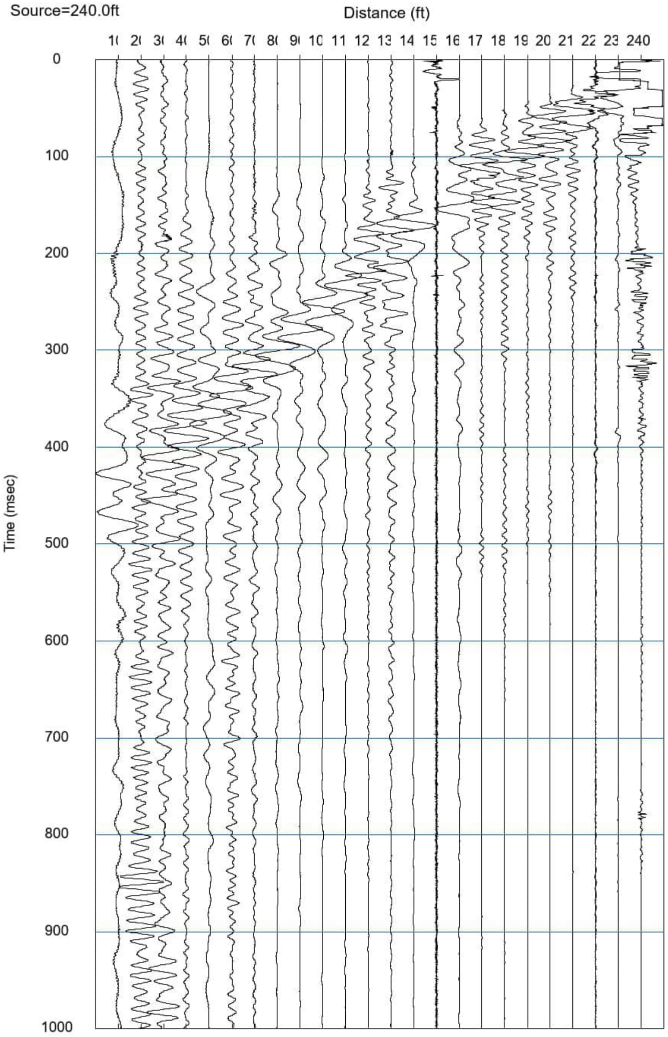
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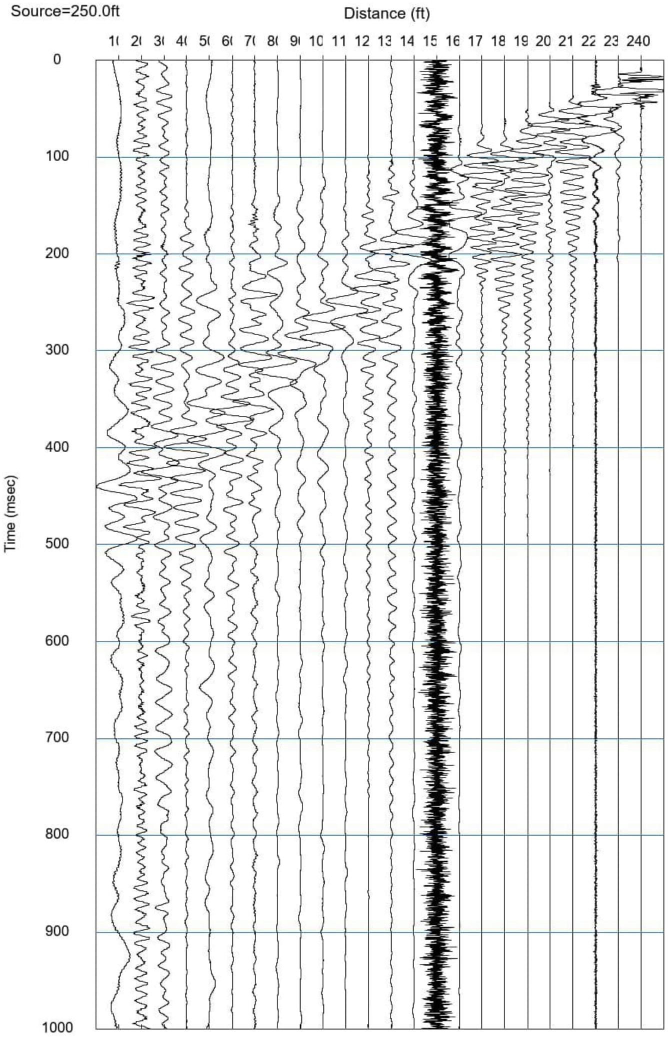
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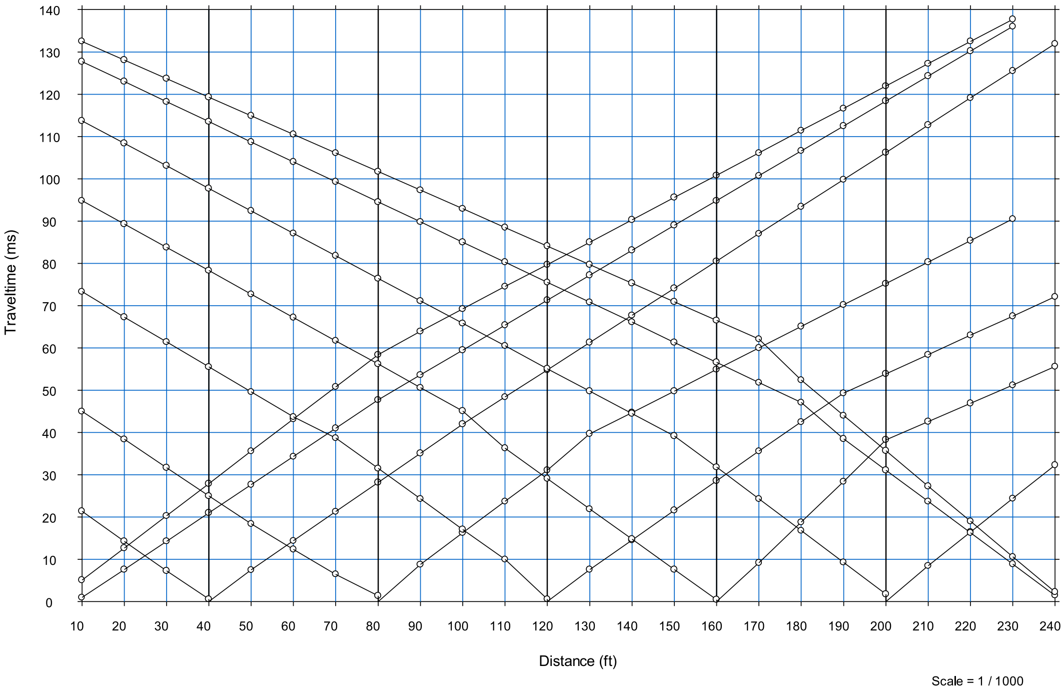
Line 1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60
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80
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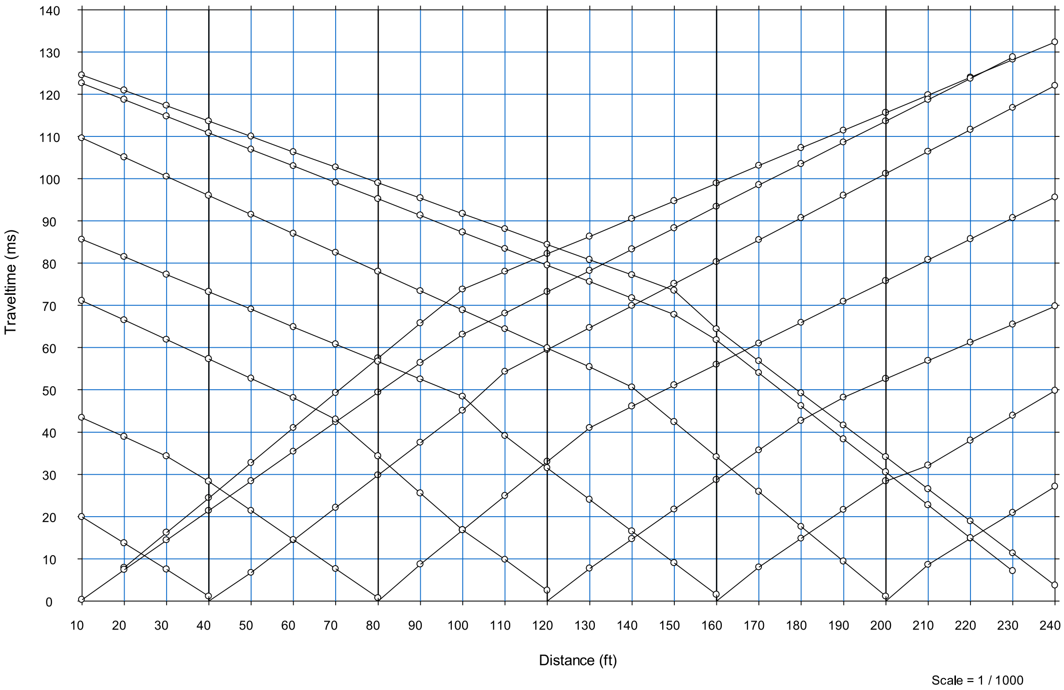
200
210
220
230
240
Distance (ft)
Scale = 1 / 1000

Line 2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80
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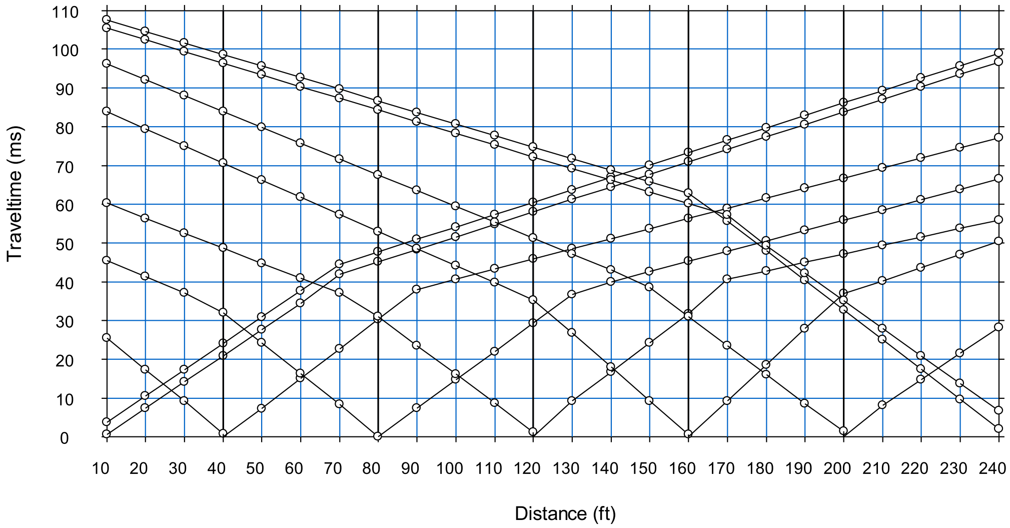
Distance (ft)
Scale = 1 / 1000

Line 4



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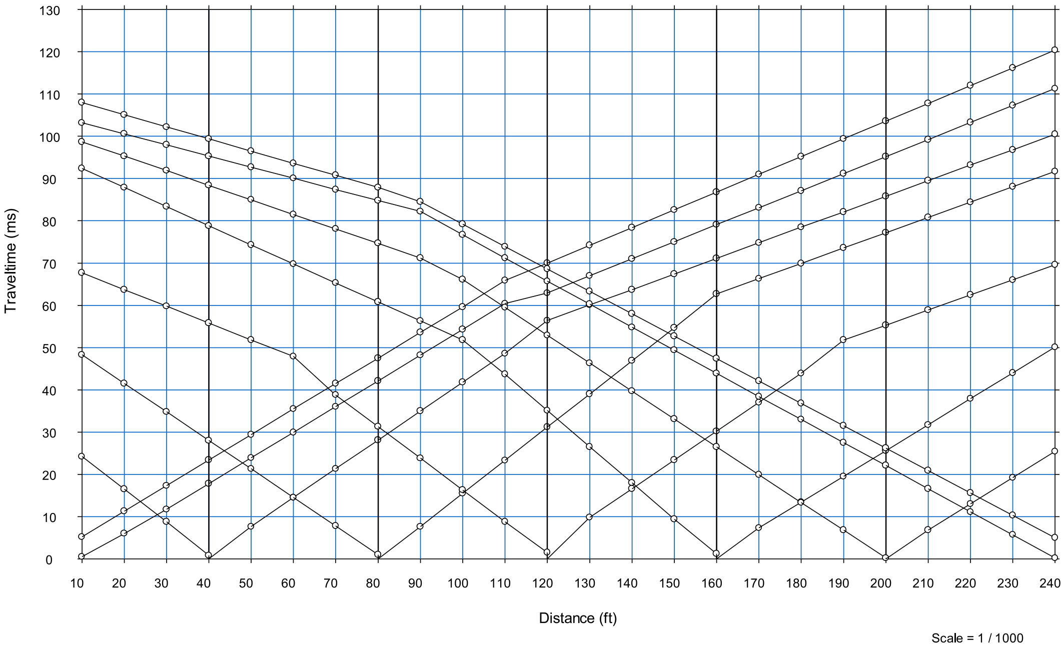
Line 5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10
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Traveltime (ms)
10
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60
70
80
90
100
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140
150
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170
180
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210
220
230
240
Distance (ft)
Scale = 1 / 1000

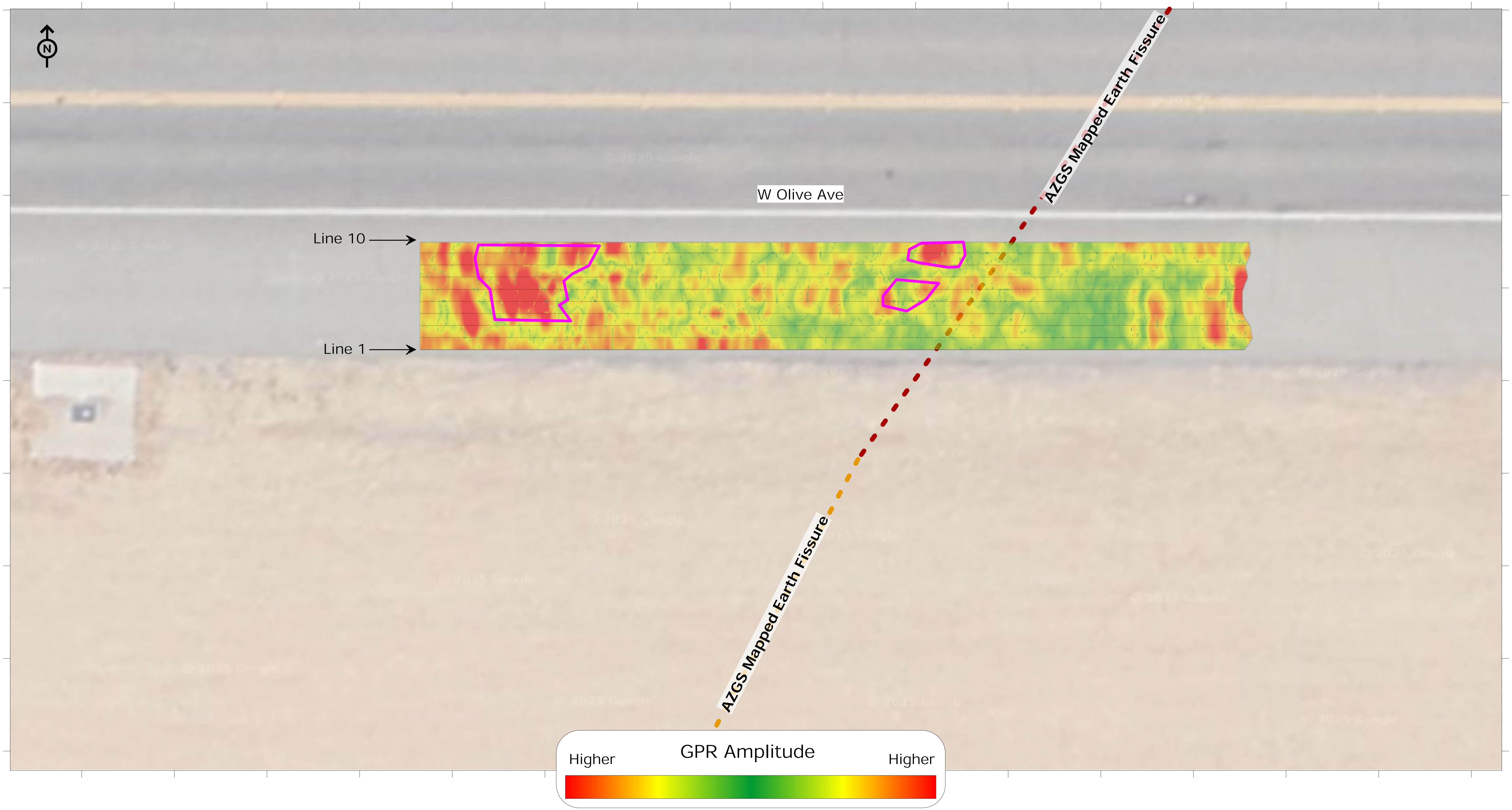


Exhibit 4 - Combined GPR Amplitude Response - 1 to 3 ft

Legend

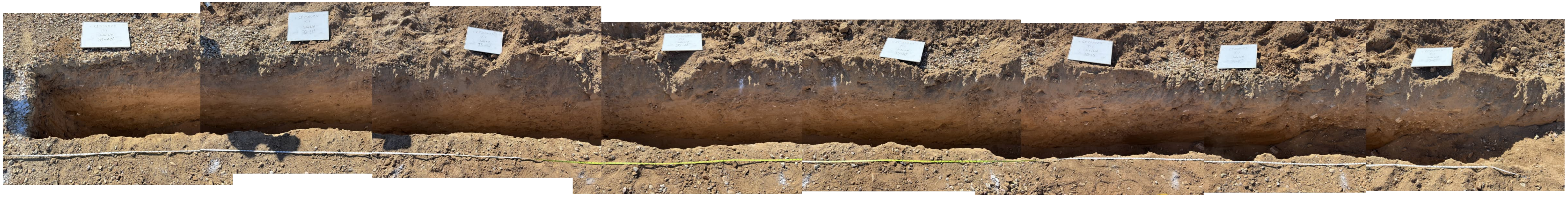
⬠ Anomalous Zone

Notes

1. 2025 aerial imagery acquired from Google and may not reflect current site conditions.
2. Map scale: 1" = 10'.
3. GPR scan extents were centered over the historically mapped earth fissure.
4. Mapped fissure location provided by AZGS.

Project: Olive Avenue Roadway Improvements
Location: Waddell, AZ
Client: Maricopa County DOT
Project No.: CP255023
Date: October 14, 2025

T-1



T-2

Legend

▬ Trench Location and Extents

Notes

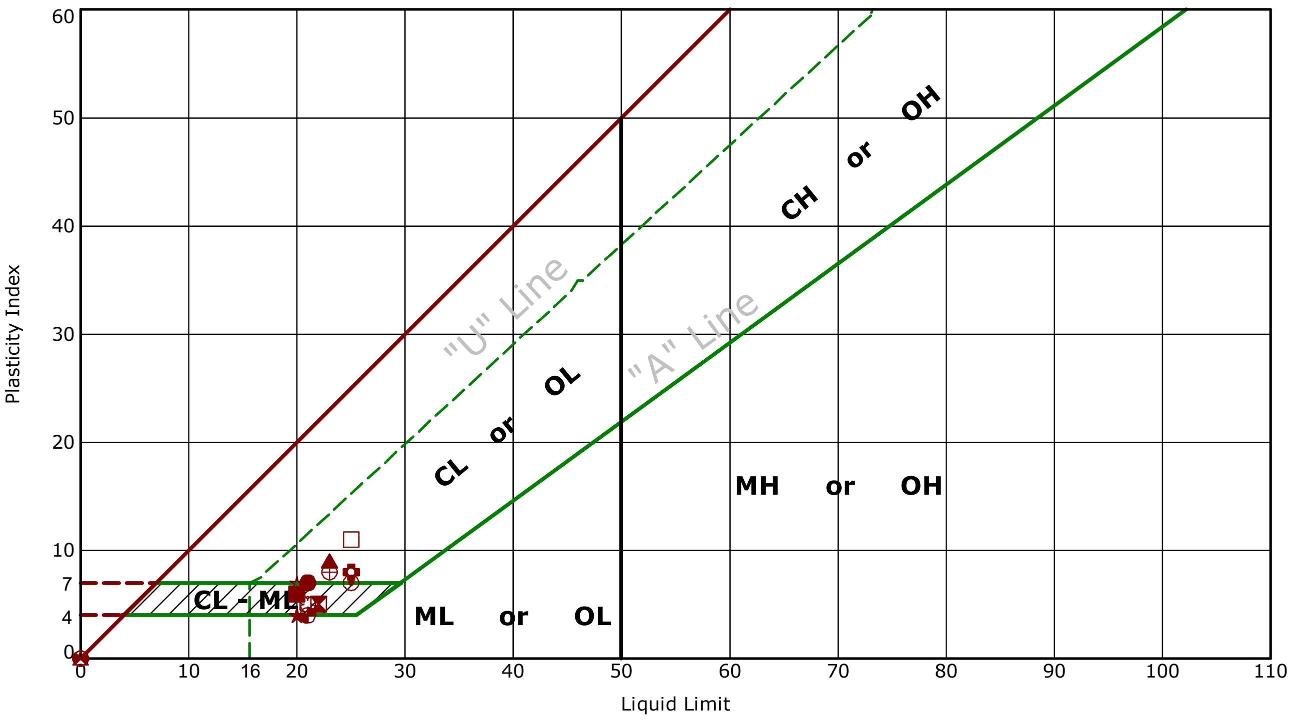
1. 2025 aerial imagery acquired from Google and may not reflect current site conditions.
2. Map Scale: 1" = 40'.
3. Earth fissure mapped by AZGS.

Exhibit 5 - Trench Photography Log and Locations

Project: Olive Avenue Roadway Improvments
Location: Surprise, AZ
Client: AZDOT
Project No.:CP255023
Date: October 14, 2025

Atterberg Limit Results

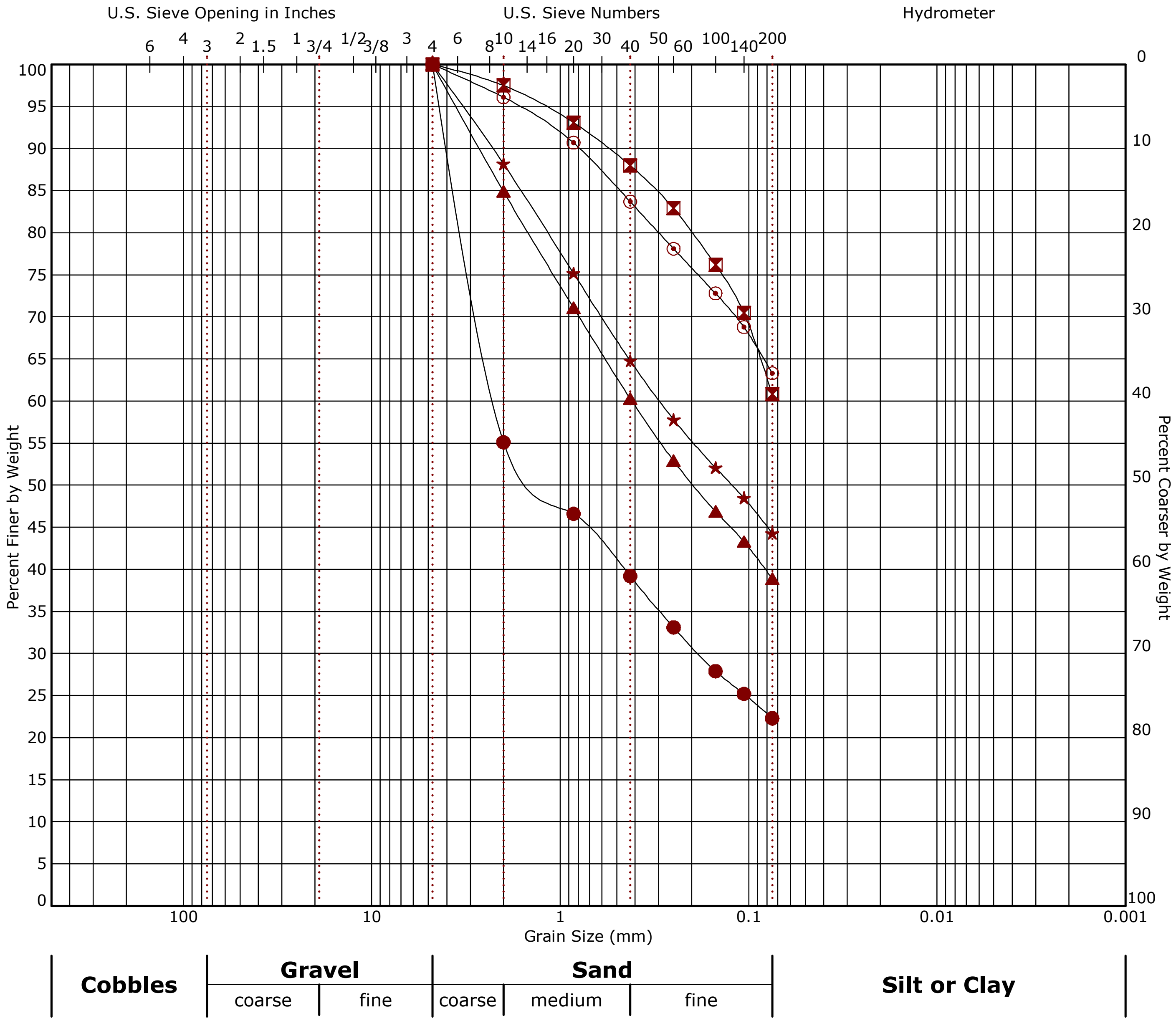
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	AASHTO	Description
●	R-101	0 - 4	21	14	7	22.3	A-2-4 (0)	FILL: SILTY, CLAYEY SAND
⊠	R-102	0 - 5	22	17	5	60.8	A-4 (1)	SANDY SILTY CLAY
▲	R-103	0 - 4	23	14	9	38.9	A-4 (0)	CLAYEY SAND
★	R-104	0 - 5	20	16	4	44.3	A-4 (0)	SILTY, CLAYEY SAND
⊙	R-105	0 - 0.8	25	18	7	63.3	A-4 (2)	SANDY SILTY CLAY
✿	R-106	0 - 5	25	17	8	48.0	A-4 (1)	CLAYEY SAND
○	S-101	0 - 5	21	16	5	47.3	A-4 (0)	SILTY, CLAYEY SAND
△	S-102	4 - 9	NP	NP	NP	26.7	A-2-4 (0)	SILTY SAND with GRAVEL
⊗	S-103	0 - 5	NP	NP	NP	33.7	A-2-4 (0)	SILTY SAND
⊕	S-104	5 - 10	23	15	8	37.1	A-4 (0)	CLAYEY SAND
□	S-105	0 - 5	25	14	11	52.7	A-6 (3)	SANDY LEAN CLAY
✖	S-106	5 - 10	NP	NP	NP	27.5	A-2-4 (0)	SILTY SAND
◕	D-101	0 - 5	21	17	4	31.8	A-2-4 (0)	SILTY, CLAYEY SAND
☆	D-102	0 - 5	20	13	7	49.4	A-4 (0)	FILL: SILTY, CLAYEY SAND
❀	D-103	0 - 5	21	16	5	43.4	A-4 (0)	SILTY, CLAYEY SAND
■	D-104	0 - 5	20	14	6	58.9	A-4 (1)	SANDY SILTY CLAY

Grain Size Distribution

ASTM D422 / ASTM C136

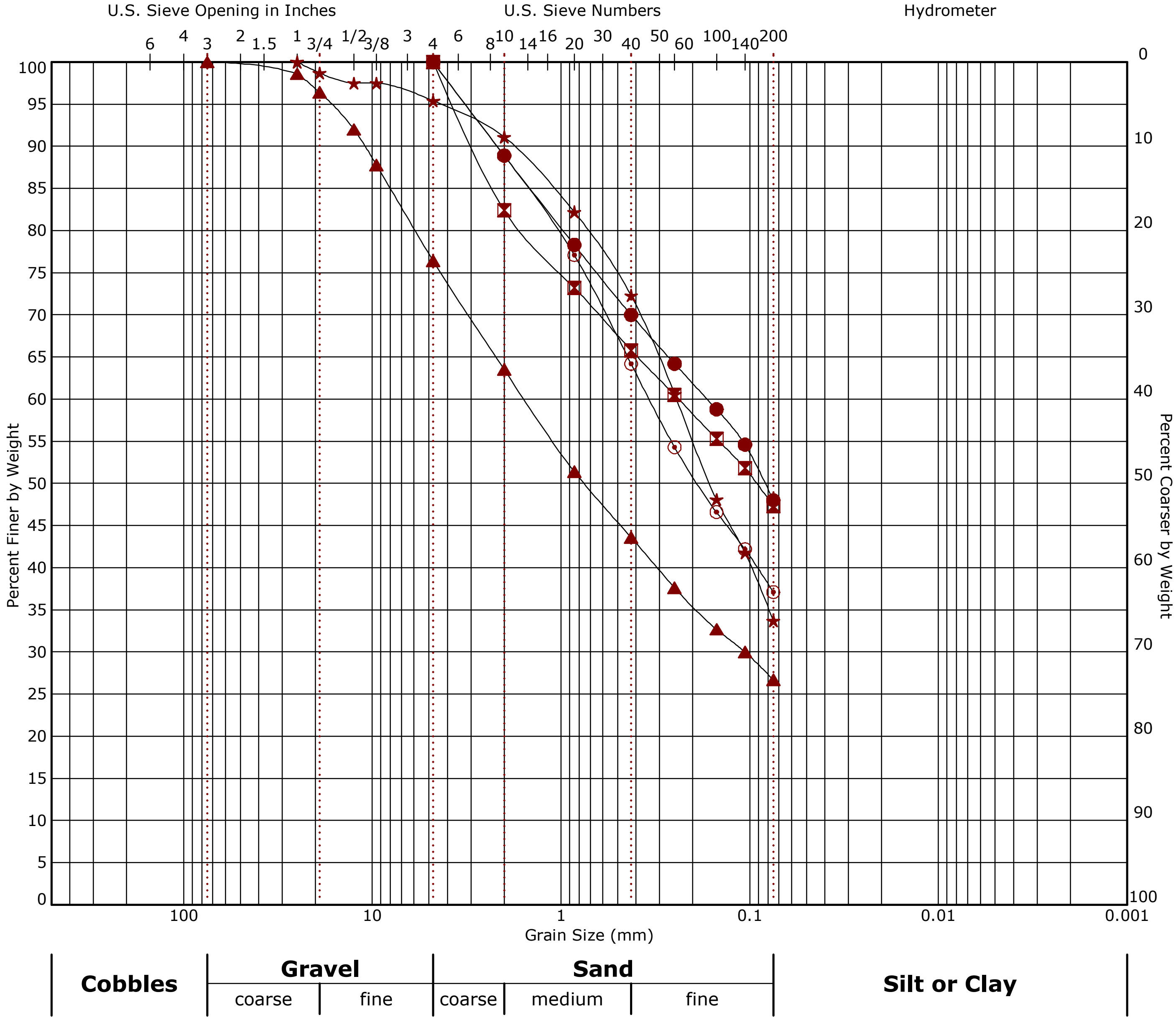


Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● R-101	0 - 4	FILL: SILTY, CLAYEY SAND	SC-SM	A-2-4 (0)	21	14	7		
☒ R-102	0 - 5	SANDY SILTY CLAY	CL-ML	A-4 (1)	22	17	5		
▲ R-103	0 - 4	CLAYEY SAND	SC	A-4 (0)	23	14	9		
★ R-104	0 - 5	SILTY, CLAYEY SAND	SC-SM	A-4 (0)	20	16	4		
⊙ R-105	0 - 0.8	SANDY SILTY CLAY	CL-ML	A-4 (2)	25	18	7		

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● R-101	0 - 4	4.75	2.198	0.184		0.0	0.0	77.7	22.3		
☒ R-102	0 - 5	4.75				0.0	0.0	39.2	60.8		
▲ R-103	0 - 4	4.75	0.416			0.0	0.0	61.1	38.9		
★ R-104	0 - 5	4.75	0.295			0.0	0.0	55.7	44.3		
⊙ R-105	0 - 0.8	4.75				0.0	0.0	36.7	63.3		

Grain Size Distribution

ASTM D422 / ASTM C136

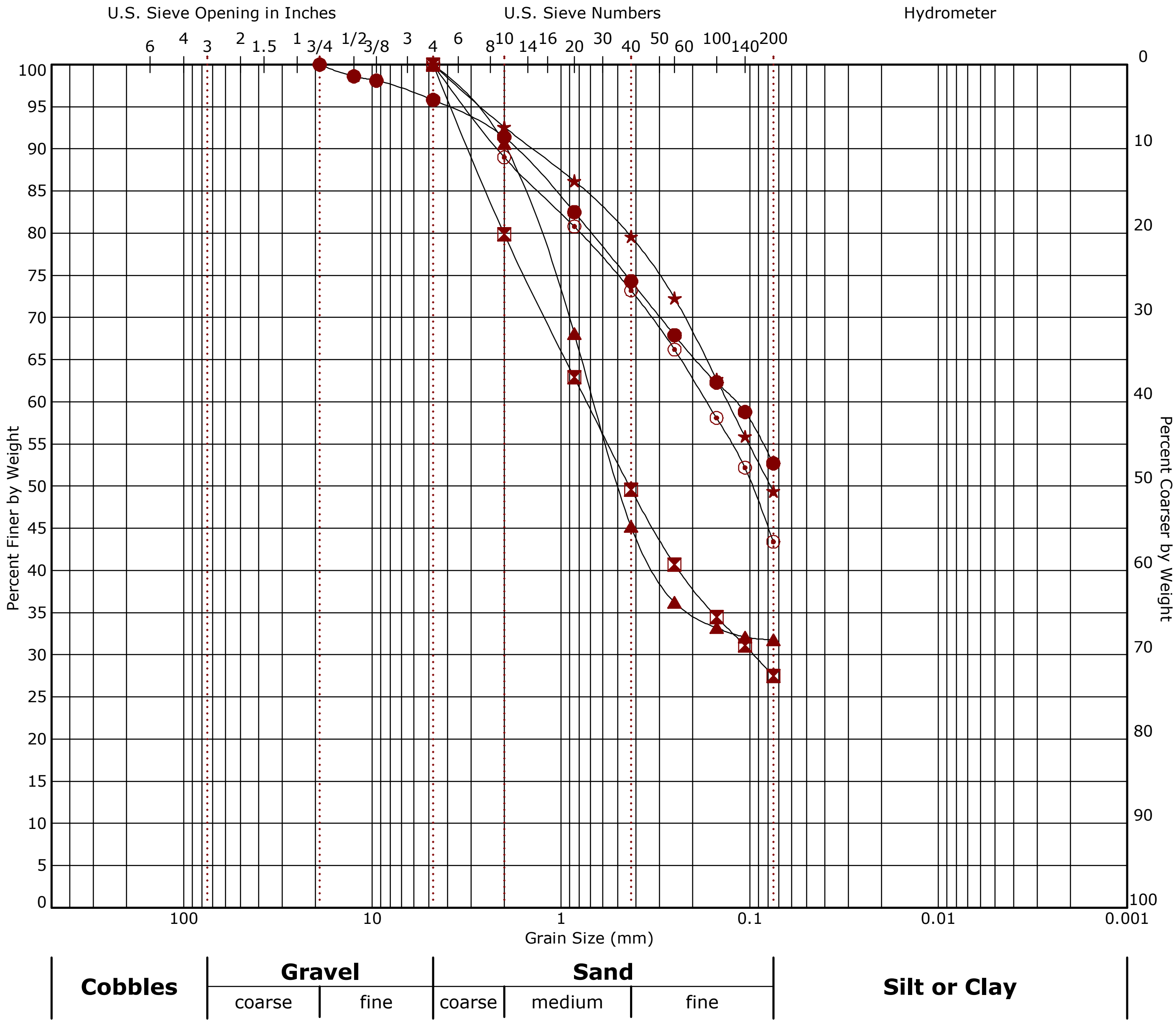


Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● R-106	0 - 5	CLAYEY SAND	SC	A-4 (1)	25	17	8		
⊠ S-101	0 - 5	SILTY, CLAYEY SAND	SC-SM	A-4 (0)	21	16	5		
▲ S-102	4 - 9	SILTY SAND with GRAVEL	SM	A-2-4 (0)	NP	NP	NP		
★ S-103	0 - 5	SILTY SAND	SM	A-2-4 (0)	NP	NP	NP		
⊙ S-104	5 - 10	CLAYEY SAND	SC	A-4 (0)	23	15	8		

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● R-106	0 - 5	4.75	0.168			0.0	0.0	52.0	48.0		
⊠ S-101	0 - 5	4.75	0.238			0.0	0.0	52.7	47.3		
▲ S-102	4 - 9	75	1.561	0.106		0.0	23.6	49.7	26.7		
★ S-103	0 - 5	25	0.244			0.0	4.6	61.7	33.7		
⊙ S-104	5 - 10	4.75	0.339			0.0	0.0	62.9	37.1		

Grain Size Distribution

ASTM D422 / ASTM C136

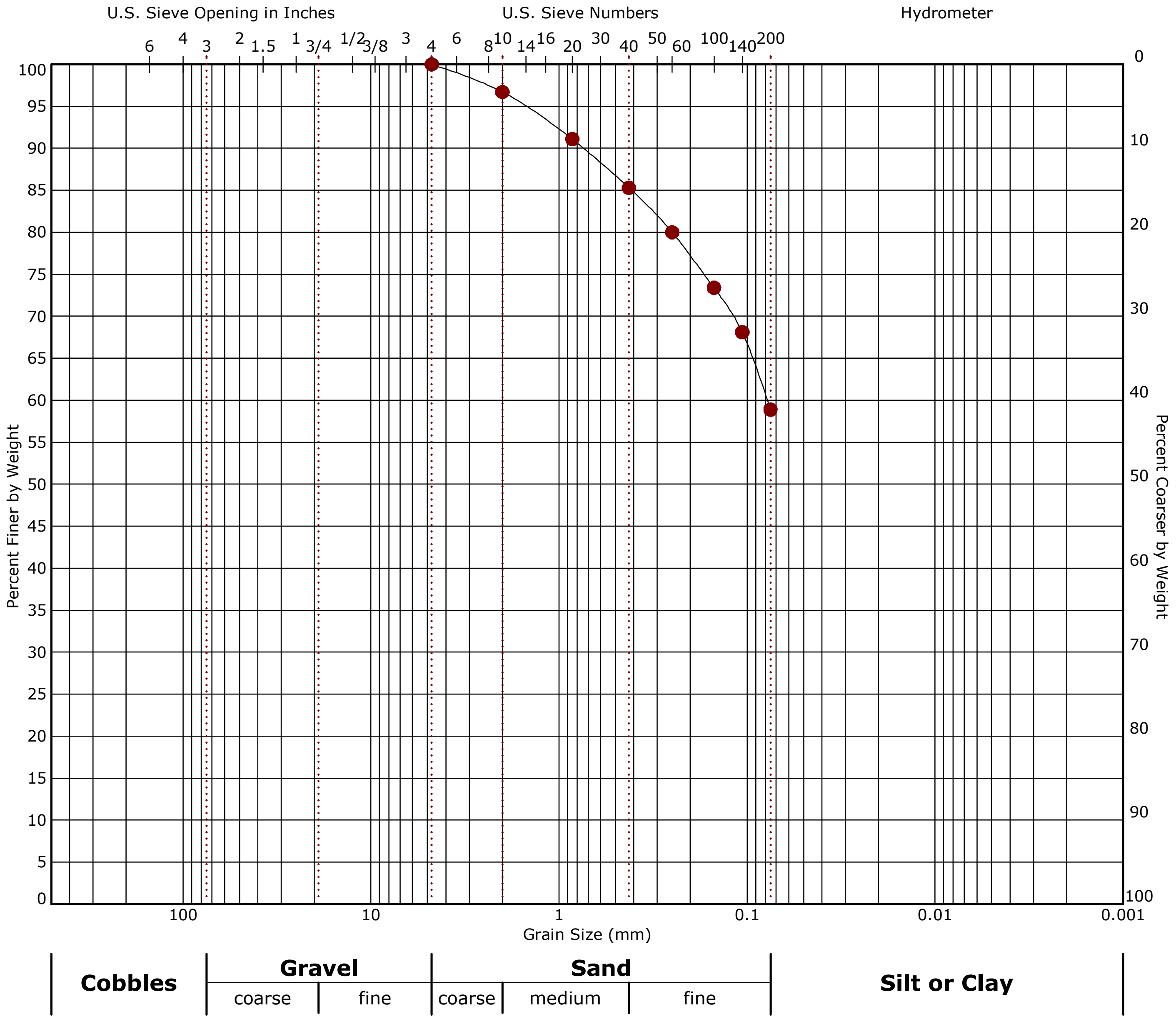


Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● S-105	0 - 5	SANDY LEAN CLAY	CL	A-6 (3)	25	14	11		
⊠ S-106	5 - 10	SILTY SAND	SM	A-2-4 (0)	NP	NP	NP		
▲ D-101	0 - 5	SILTY, CLAYEY SAND	SC-SM	A-2-4 (0)	21	17	4		
★ D-102	0 - 5	FILL: SILTY, CLAYEY SAND	SC-SM	A-4 (0)	20	13	7		
⊙ D-103	0 - 5	SILTY, CLAYEY SAND	SC-SM	A-4 (0)	21	16	5		

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● S-105	0 - 5	19	0.119			0.0	4.2	43.1	52.7		
⊠ S-106	5 - 10	4.75	0.731	0.095		0.0	0.0	72.5	27.5		
▲ D-101	0 - 5	4.75	0.665			0.0	0.0	68.2	31.8		
★ D-102	0 - 5	4.75	0.131			0.0	0.0	50.6	49.4		
⊙ D-103	0 - 5	4.75	0.169			0.0	0.0	56.6	43.4		

Grain Size Distribution

ASTM D422 / ASTM C136

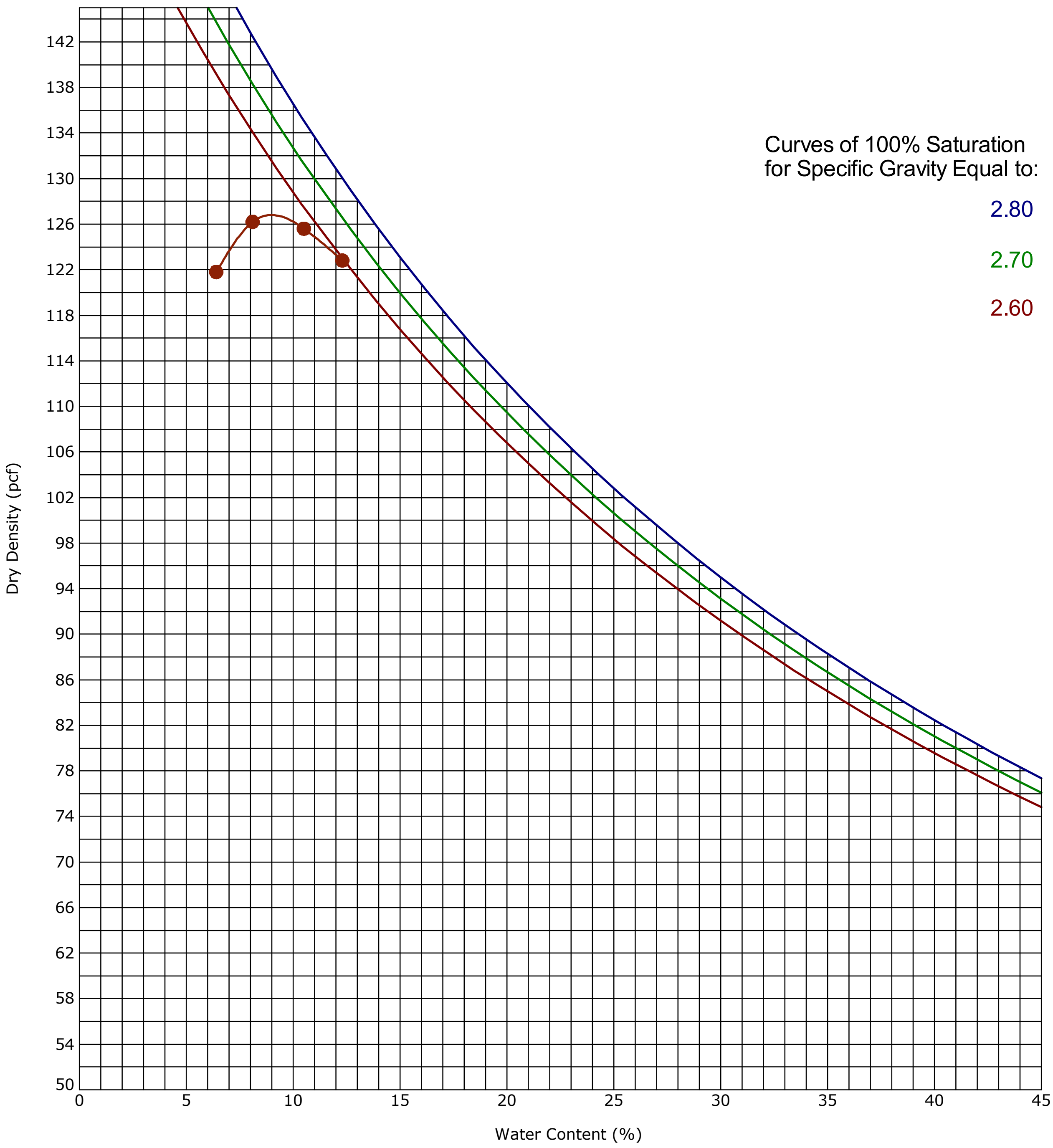


Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● D-104	0 - 5	SANDY SILTY CLAY	CL-ML	A-4 (1)	20	14	6		

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● D-104	0 - 5	4.75	0.078			0.0	0.0	41.1	58.9		

Moisture-Density Relationship

ASTM D698-Method A

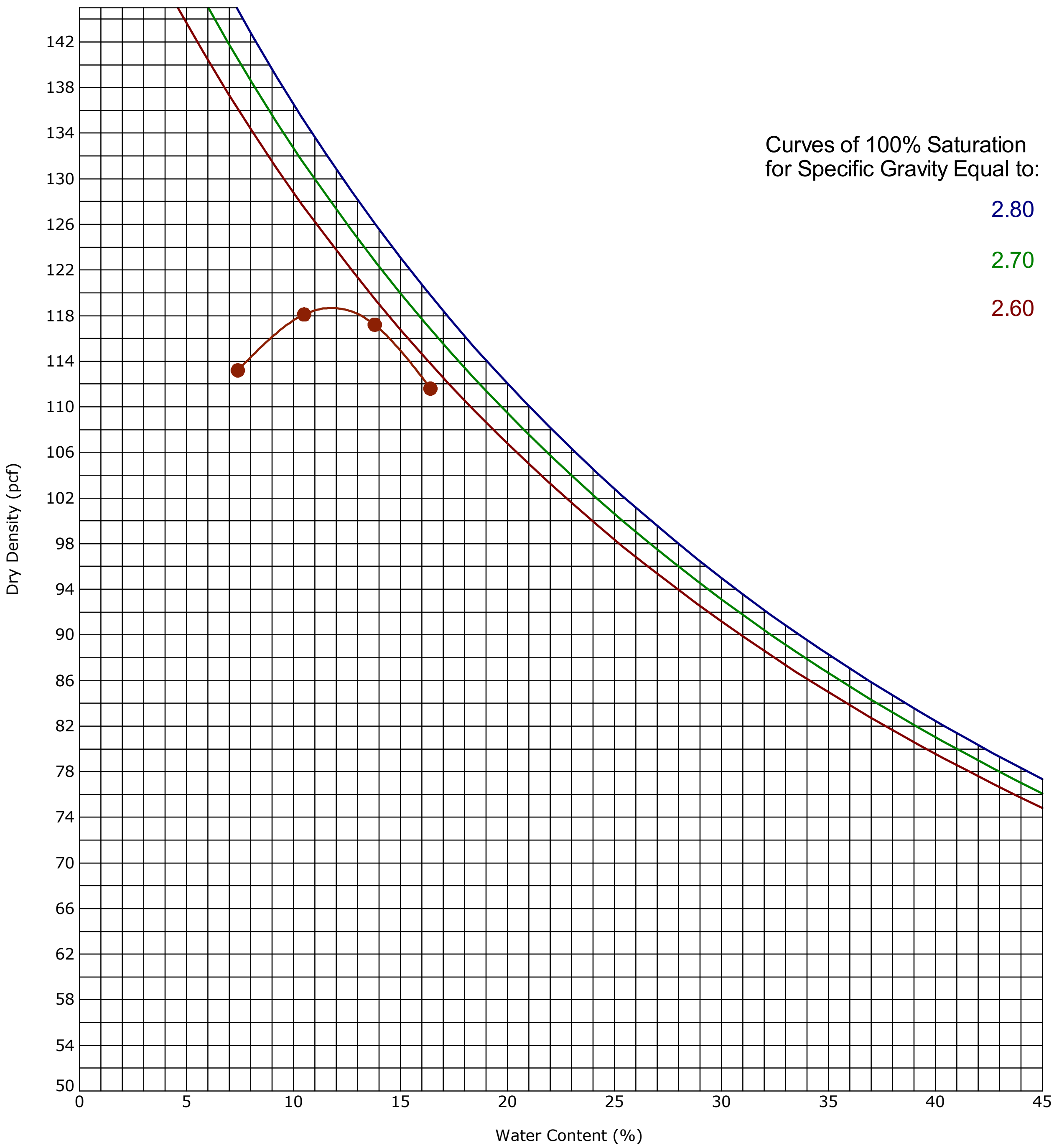


Boring ID	Depth (Ft)	Description of Materials
R-101	0 - 4	FILL: SILTY, CLAYEY SAND(SC-SM)

Fines (%)	Fraction >4.75 mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
22	0.0	21	14	7	ASTM D698-Method A	126.8	9.0

Moisture-Density Relationship

ASTM D698-Method A

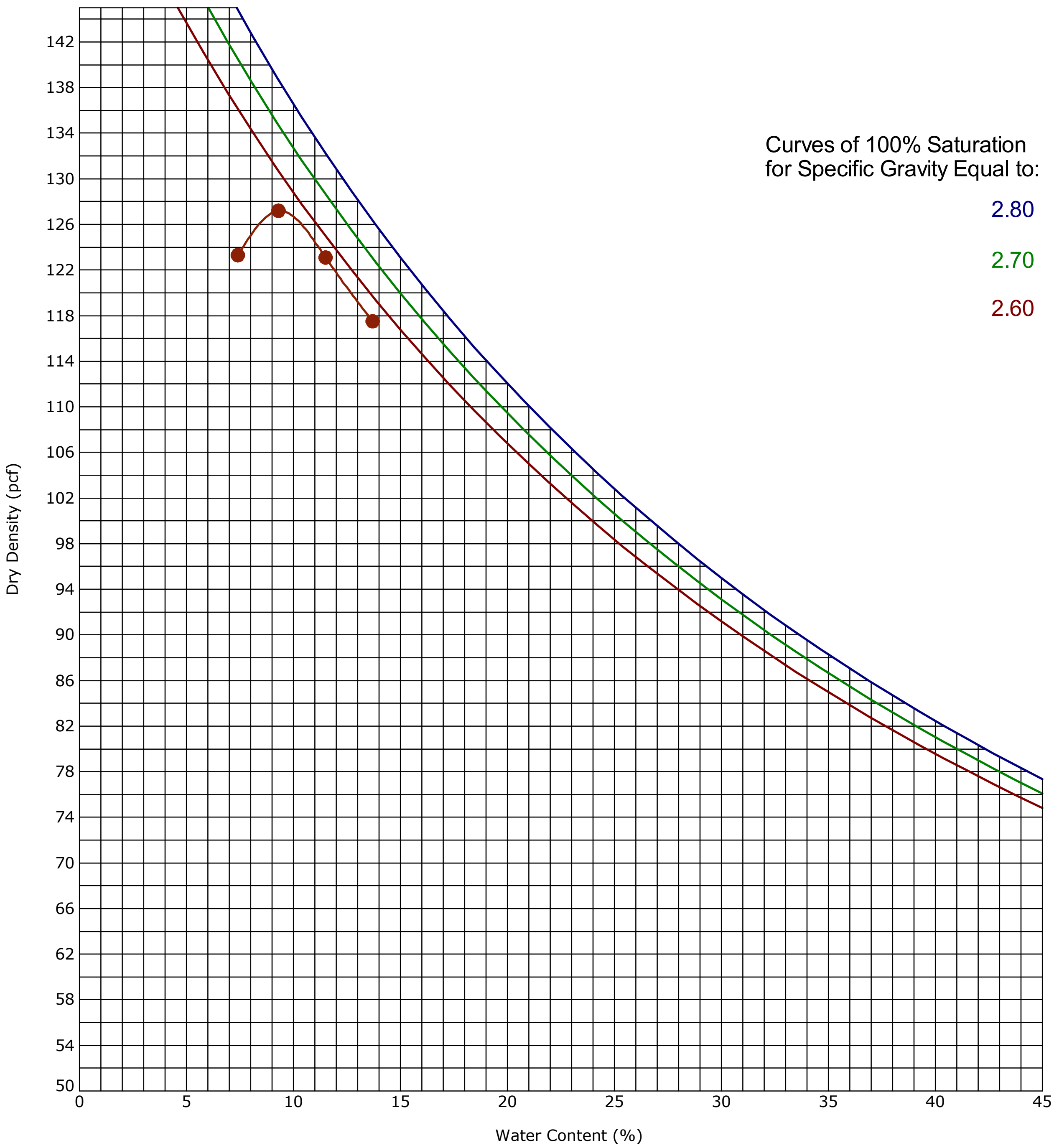


Boring ID	Depth (Ft)	Description of Materials
R-102	0 - 5	SANDY SILTY CLAY(CL-ML)

Fines (%)	Fraction >4.75 mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
61	0.0	22	17	5	ASTM D698-Method A	118.7	11.7

Moisture-Density Relationship

ASTM D698-Method A

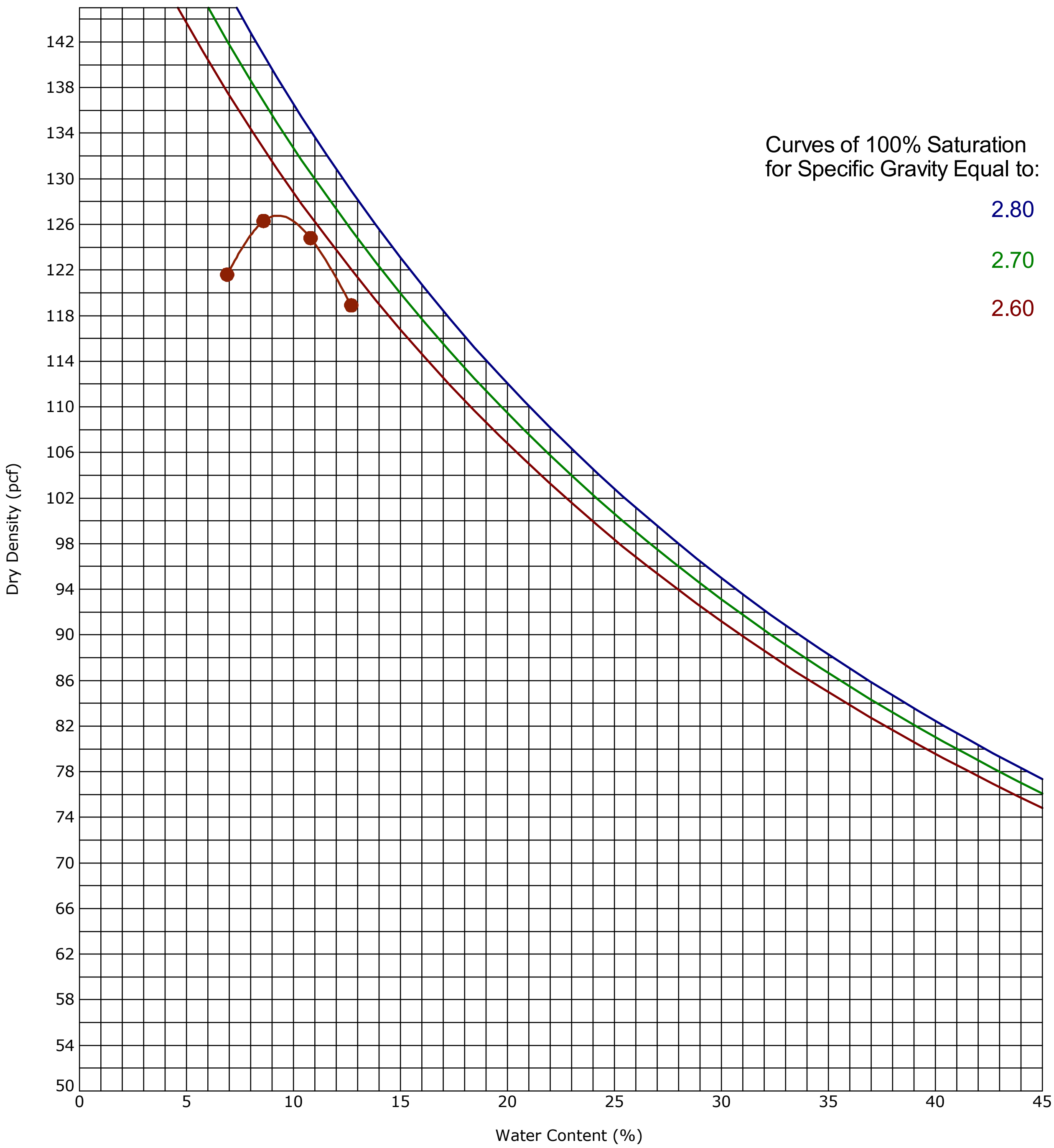


Boring ID	Depth (Ft)	Description of Materials
R-103	0 - 4	CLAYEY SAND(SC)

Fines (%)	Fraction >4.75 mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
39	0.0	23	14	9	ASTM D698-Method A	127.2	9.4

Moisture-Density Relationship

ASTM D698-Method A

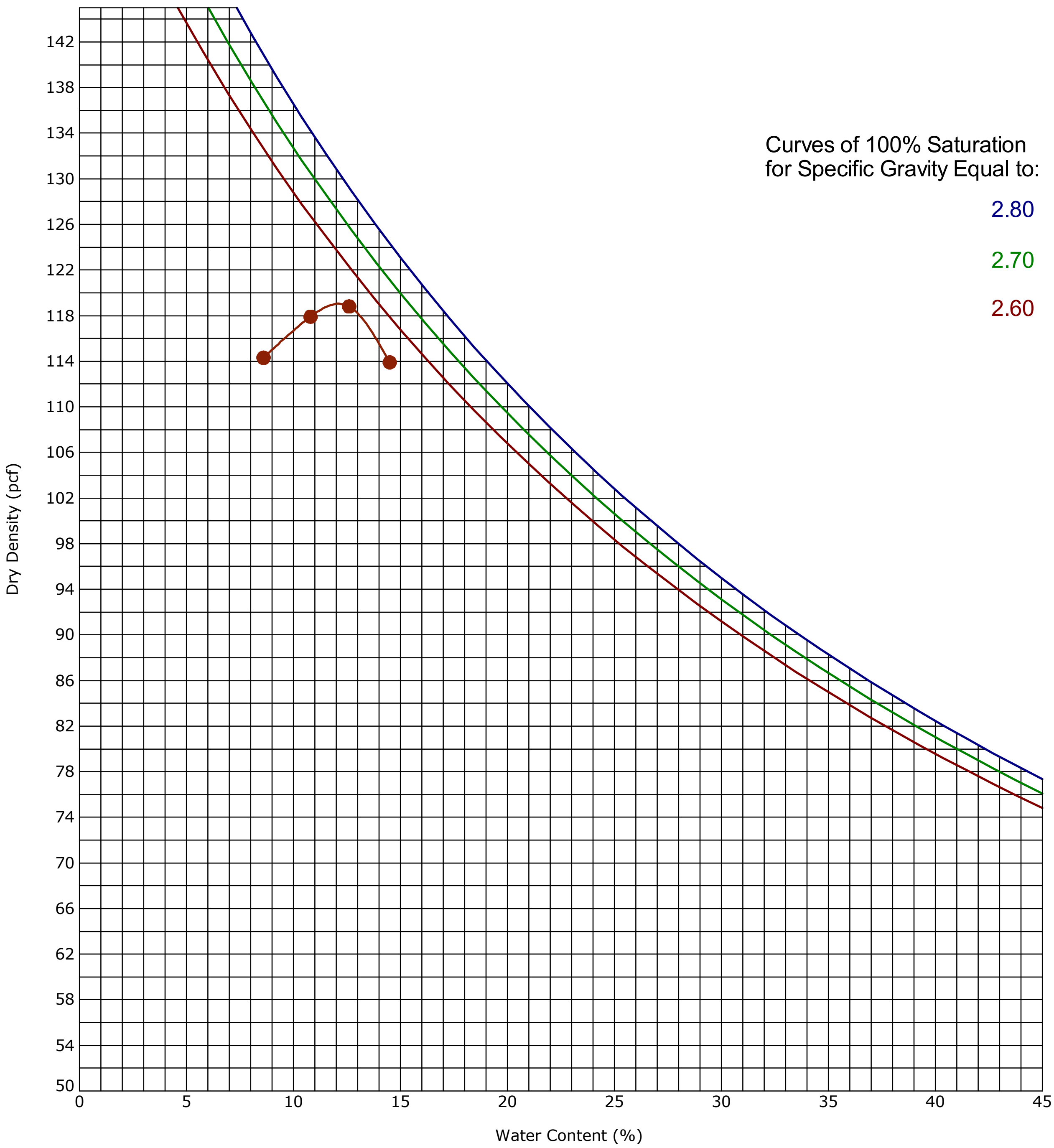


Boring ID	Depth (Ft)	Description of Materials
R-104	0 - 5	SILTY, CLAYEY SAND(SC-SM)

Fines (%)	Fraction >4.75 mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
44	0.0	20	16	4	ASTM D698-Method A	126.8	9.3

Moisture-Density Relationship

ASTM D698-Method A

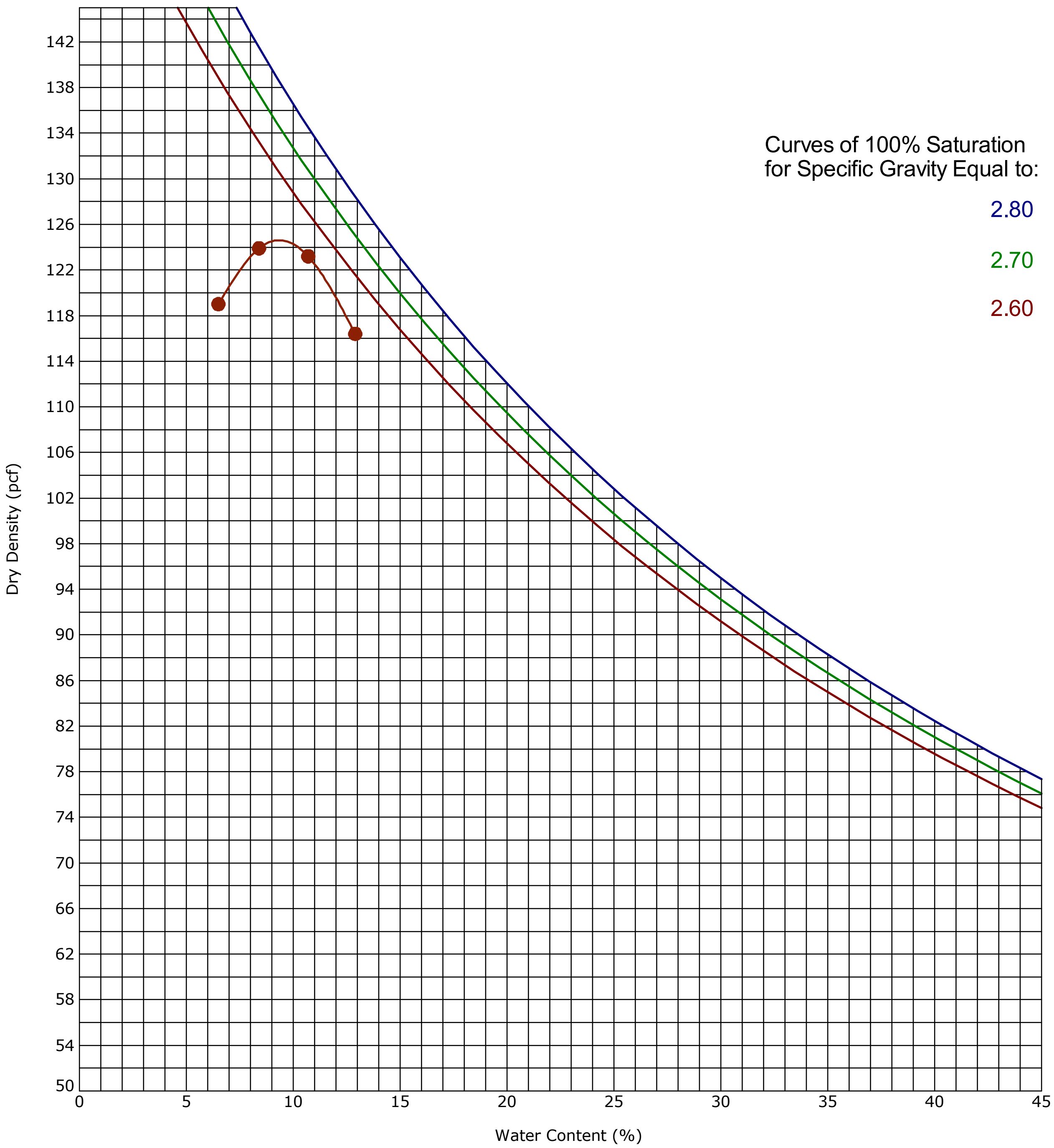


Boring ID	Depth (Ft)	Description of Materials
R-105	0 - 0.75	SANDY SILTY CLAY(CL-ML)

Fines (%)	Fraction >4.75 mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
63	0.0	25	18	7	ASTM D698-Method A	119.0	12.1

Moisture-Density Relationship

ASTM D698-Method A

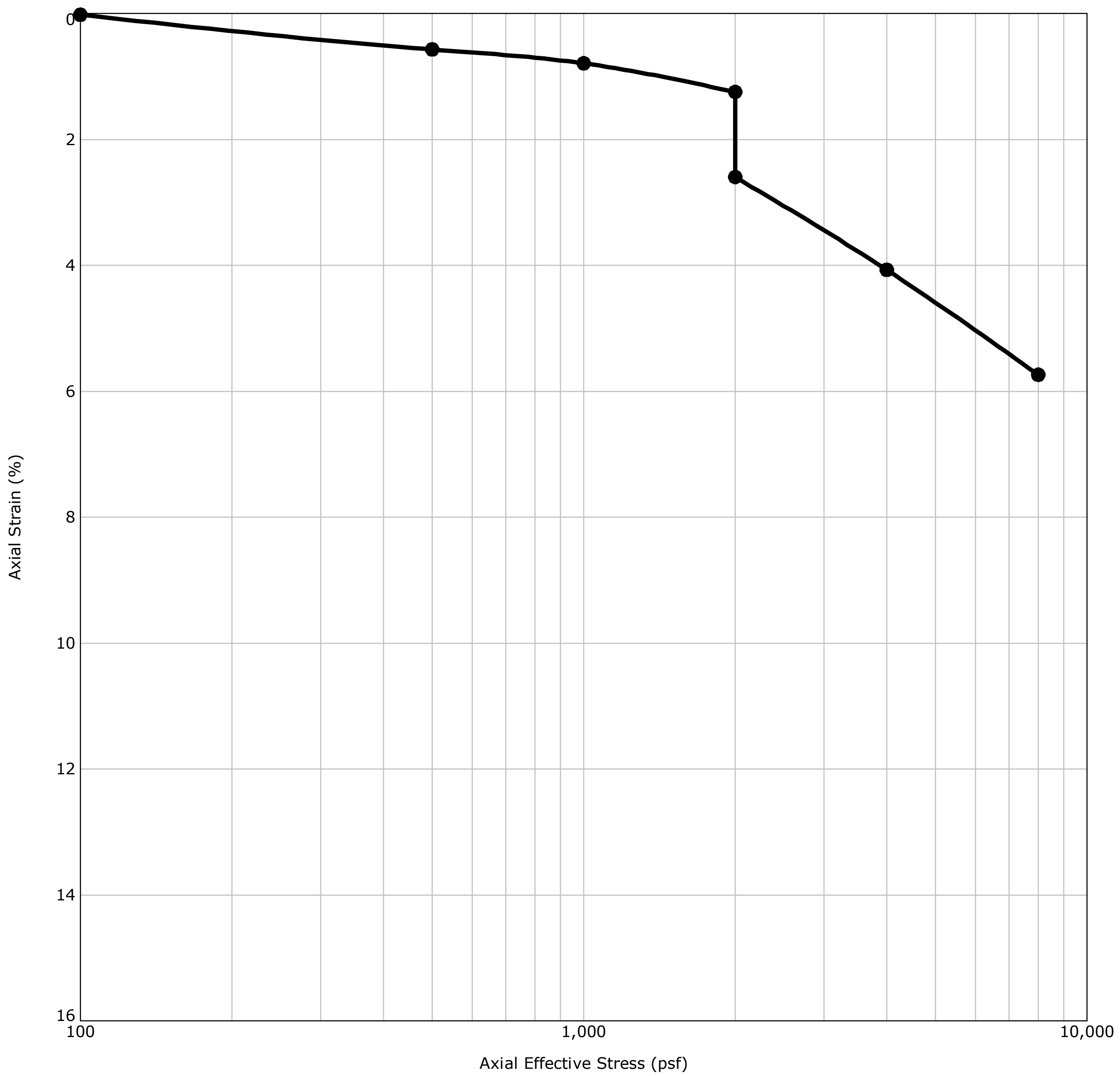


Boring ID	Depth (Ft)	Description of Materials
R-106	0 - 5	CLAYEY SAND(SC)

Fines (%)	Fraction >4.75 mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
48	0.0	25	17	8	ASTM D698-Method A	124.6	9.4

One-Dimensional Consolidation Test

ASTM D2435



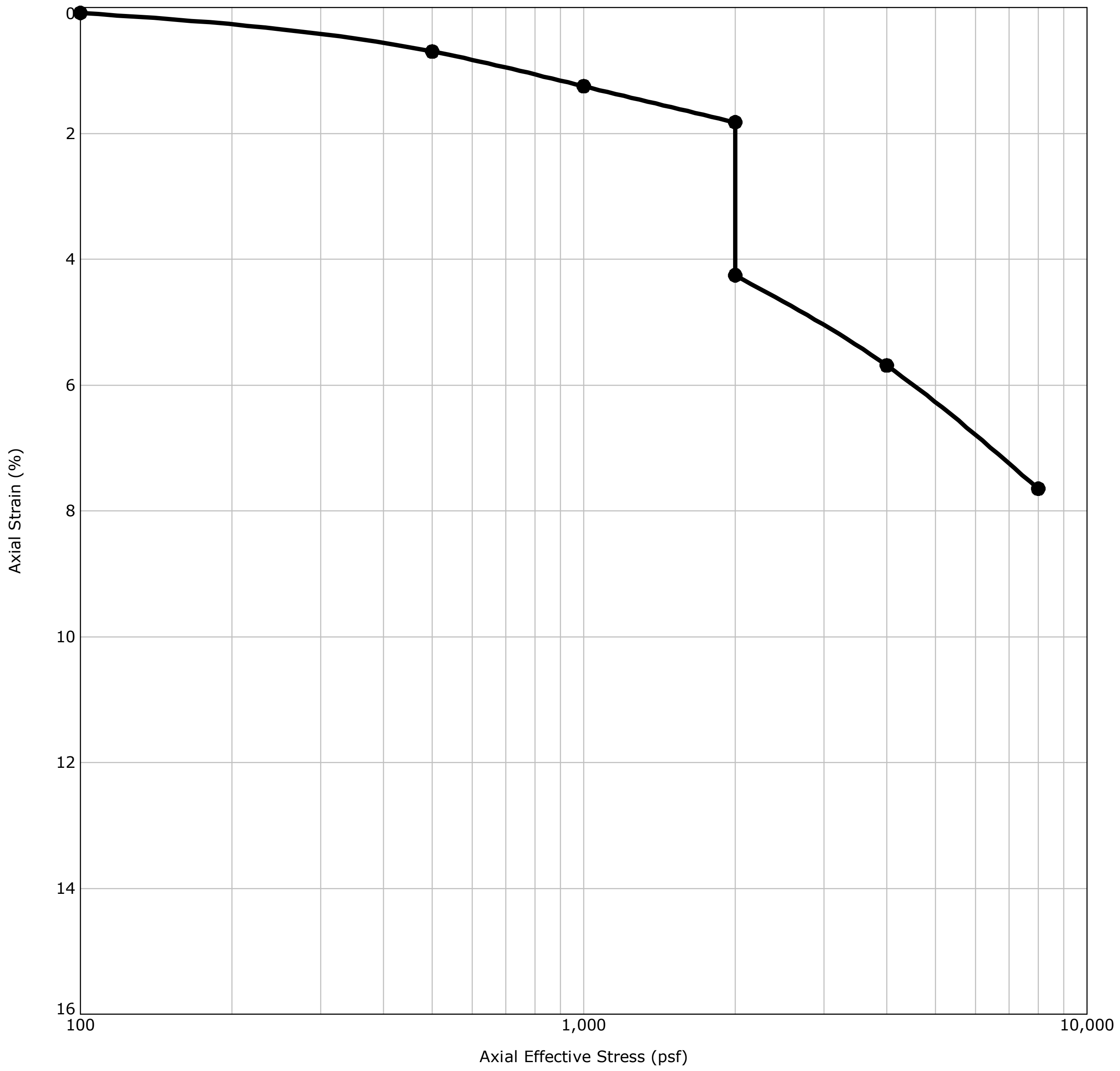
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-101	4 - 5		SILTY, CLAYEY SAND	SC-SM	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	3.7	108.3								

Notes: Water added at 2000 psf.

One-Dimensional Consolidation Test

ASTM D2435



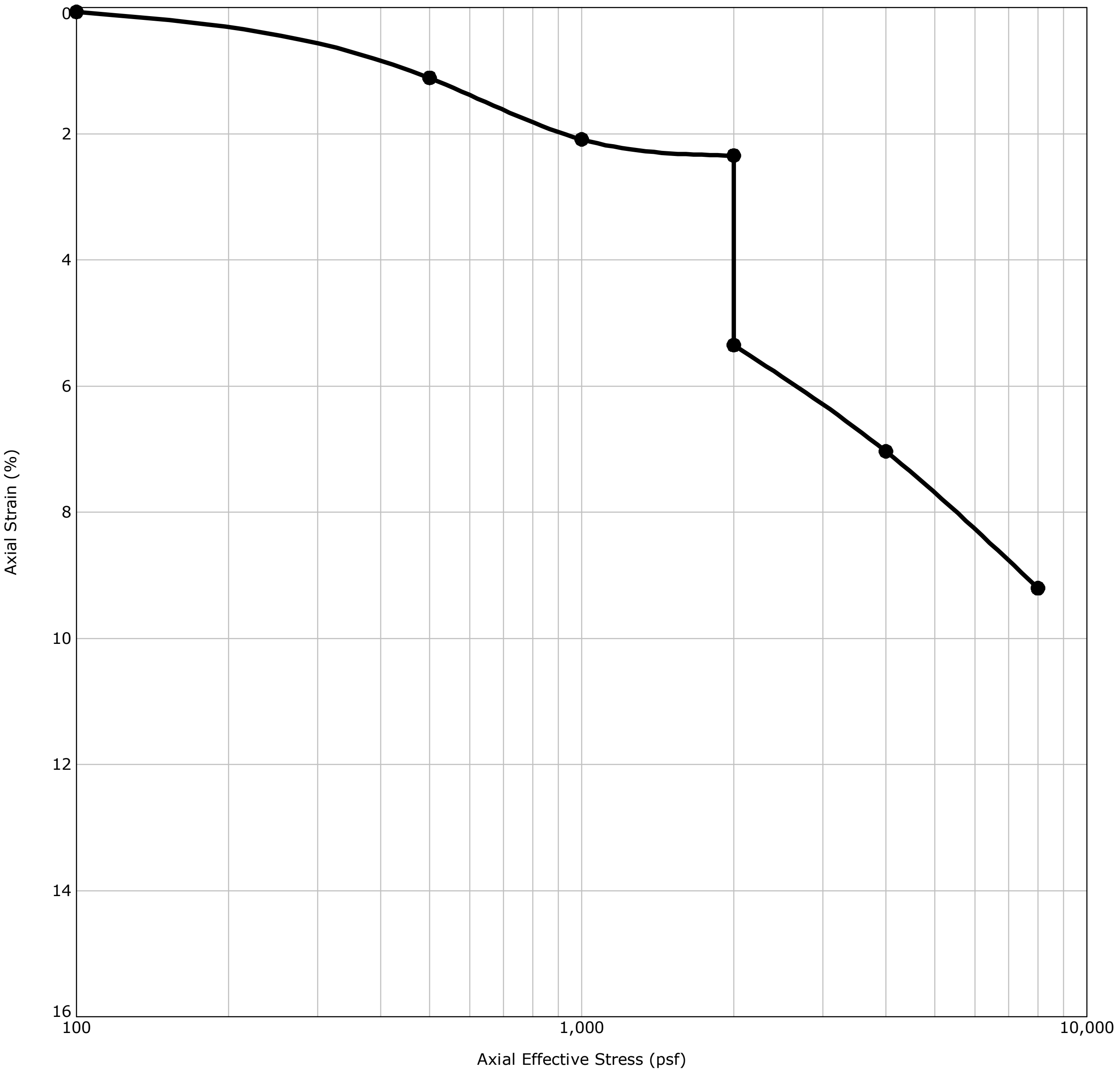
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-102	7 - 8		SILTY SAND with GRAVEL	SM	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	4.4	101.7								

Notes: Water added at 2000 psf.

One-Dimensional Consolidation Test

ASTM D2435



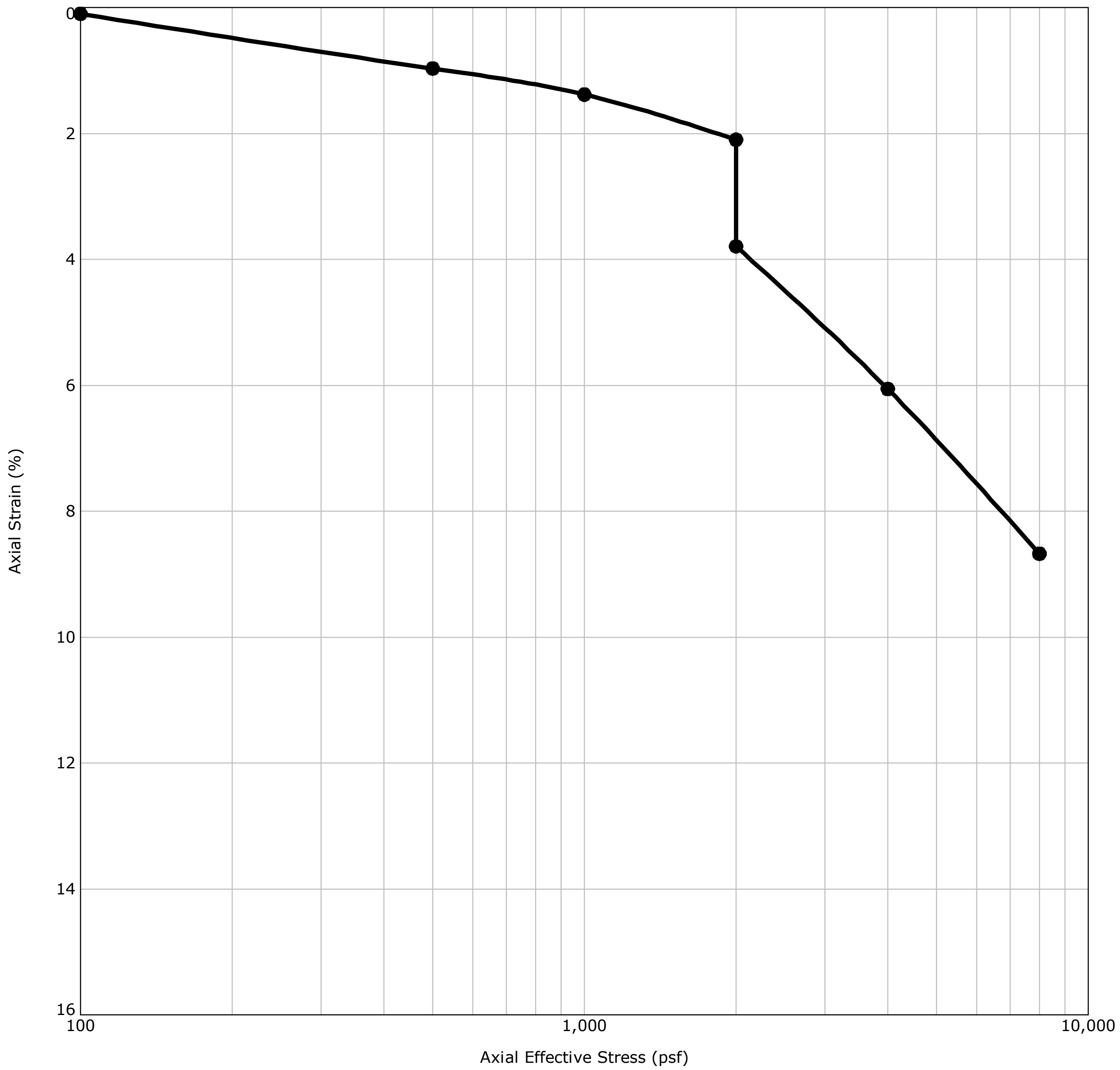
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-103	4 - 5		SILTY SAND	SM	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	7.5	93.8								

Notes: Water added at 2000 psf.

One-Dimensional Consolidation Test

ASTM D2435



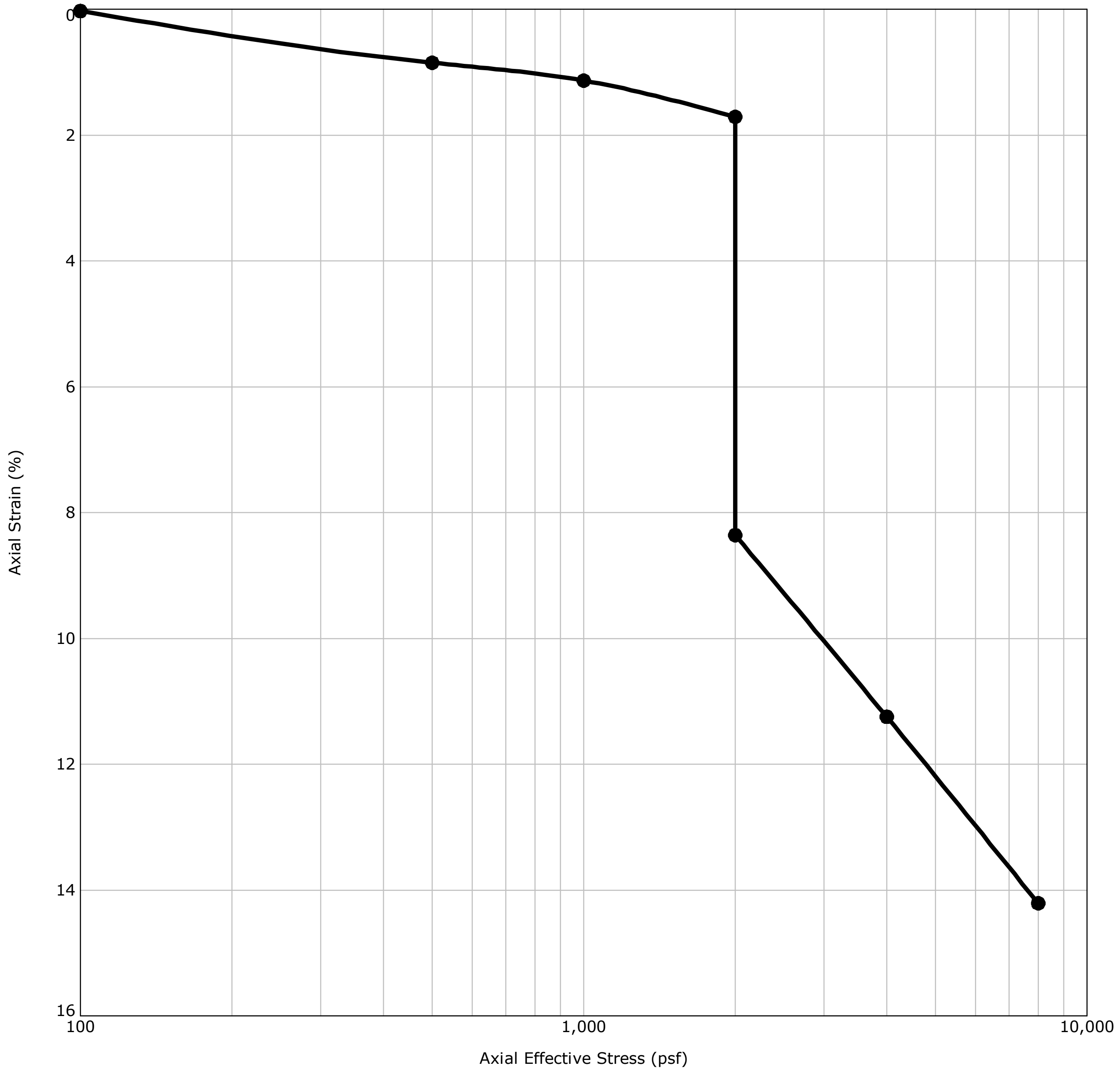
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-103	9 - 10		SANDY LEAN CLAY	CL	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	11.6	105.2								

Notes: Water added at 2000 psf.

One-Dimensional Consolidation Test

ASTM D2435



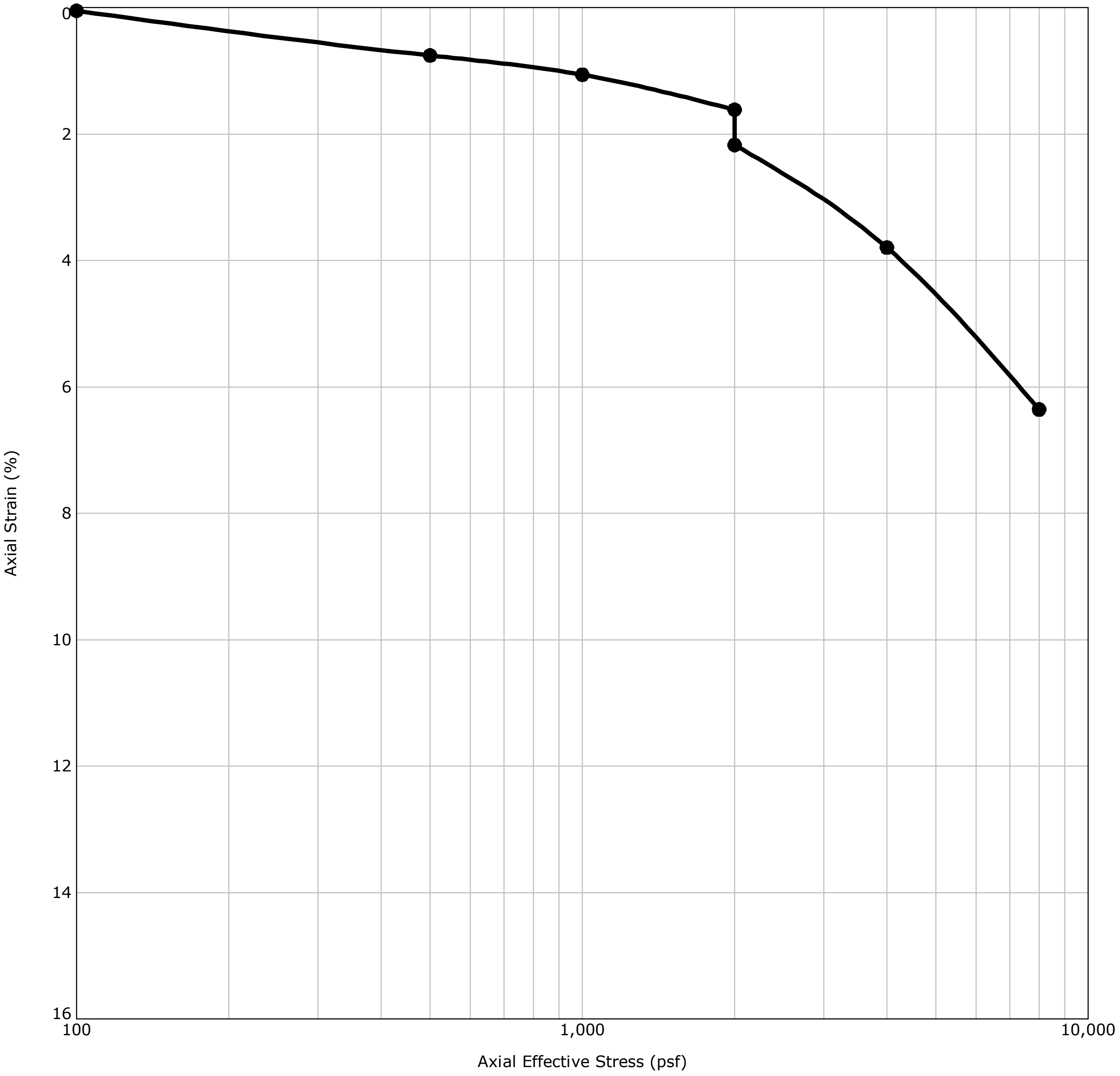
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-104	4 - 5		SANDY LEAN CLAY	CL	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	6.2	101.9								

Notes: Water added at 2000 psf.

One-Dimensional Consolidation Test

ASTM D2435



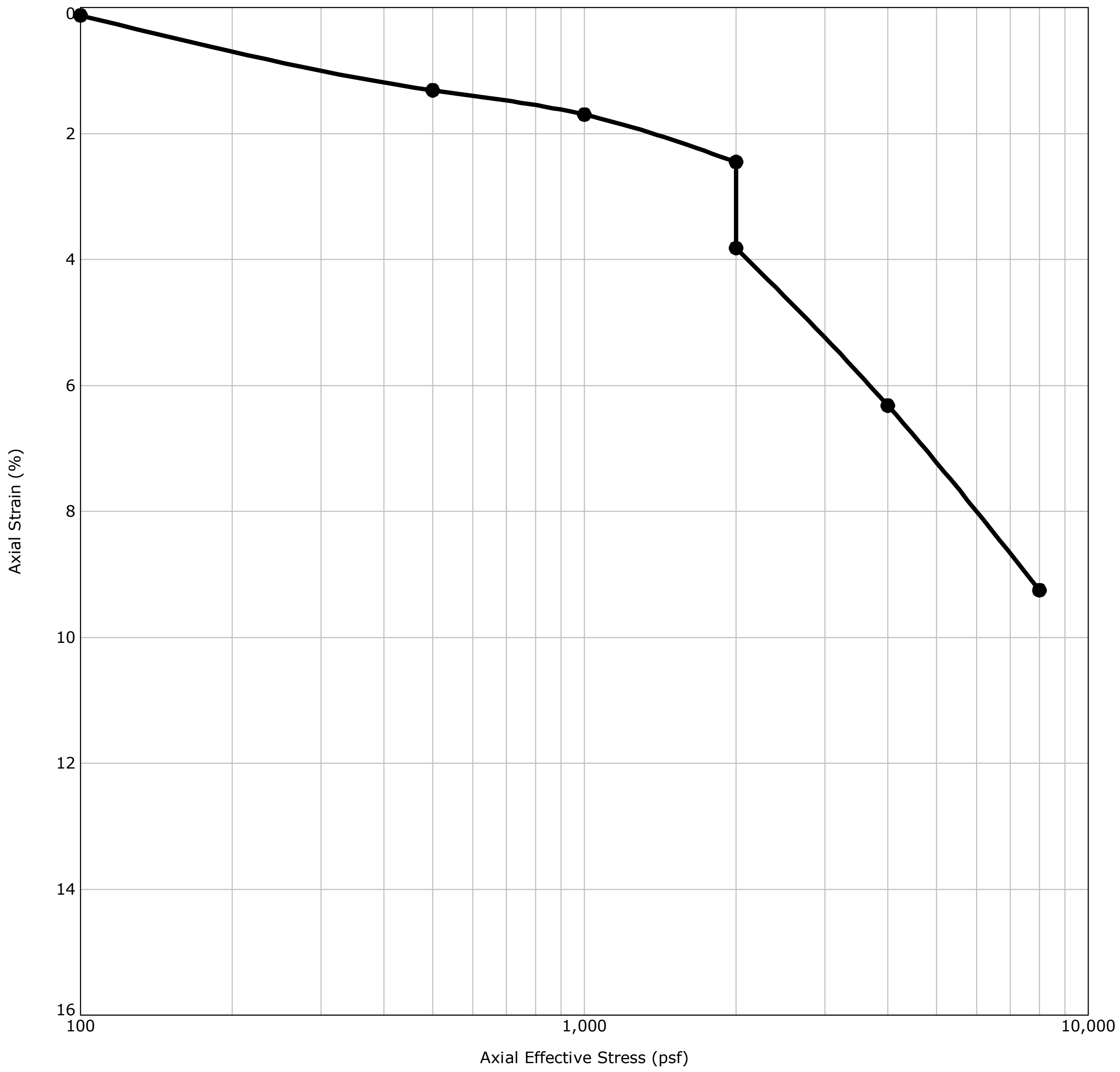
Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-105	7 - 8		SANDY LEAN CLAY	CL	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	11.2	92.4								

Notes: Water added at 2000 psf.

One-Dimensional Consolidation Test

ASTM D2435



Boring ID	Depth (Ft)	Specimen #	Material Description	USCS	AASHTO
S-106	7 - 8		SILTY SAND	SM	

Natural		Initial Dry Density (pcf)	LL	PI	Specific Gravity	Overburden (psf)	P_c (psf)	C_c (% / log stress)	C_r (% / log stress)	Initial Void Ratio
Saturation (%)	Moisture (%)									
	10.9	99.4								

Notes: Water added at 2000 psf.

Terracon
4685 S Ash Ave, Ste H-4
Tempe, AZ 85282-6767

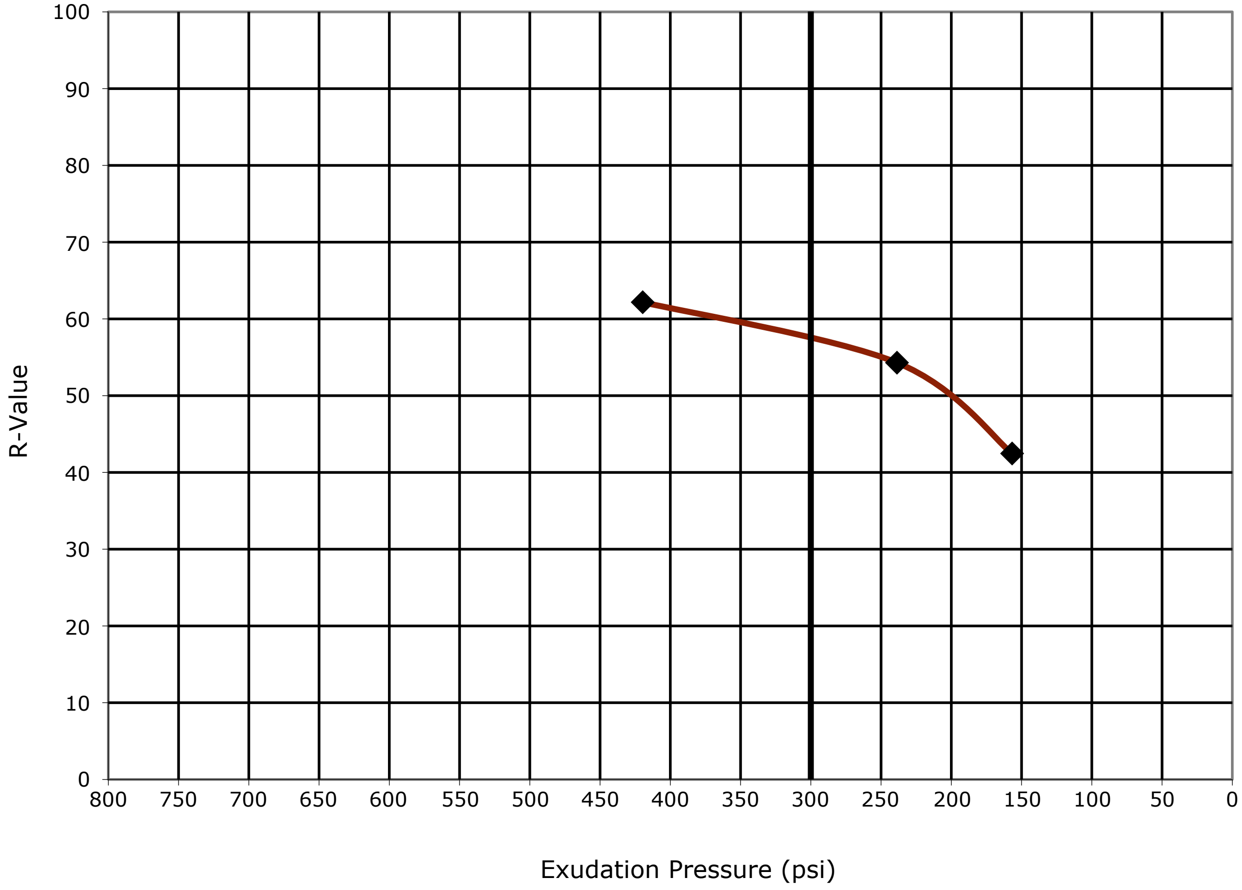
Resistance R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Material Description:	FILL: Silty Clayey Sand
Sample Location:	R- 101 @ 0' - 4'
Sample Source:	
Remarks:	

Specimen ID:	A	B	C
Compaction Pressure (psi):	100	225	350
Specimen Height (in):	2.46	2.49	2.42
Dry Density (pcf):	134.7	136.0	136.8
Horizontal Pressure @ 1000 lbs (psi):	31	23	18
Horizontal Pressure @ 2000 lbs (psi):	64	48	36
Displacement (turns):	5.08	4.91	4.84
Expansion Pressure (psi):	0	0	0
Exudation Pressure (psi):	157	239	420
R-Value:	42.5	54.3	62.2

R-Value at	**300**	**psi**	**57**

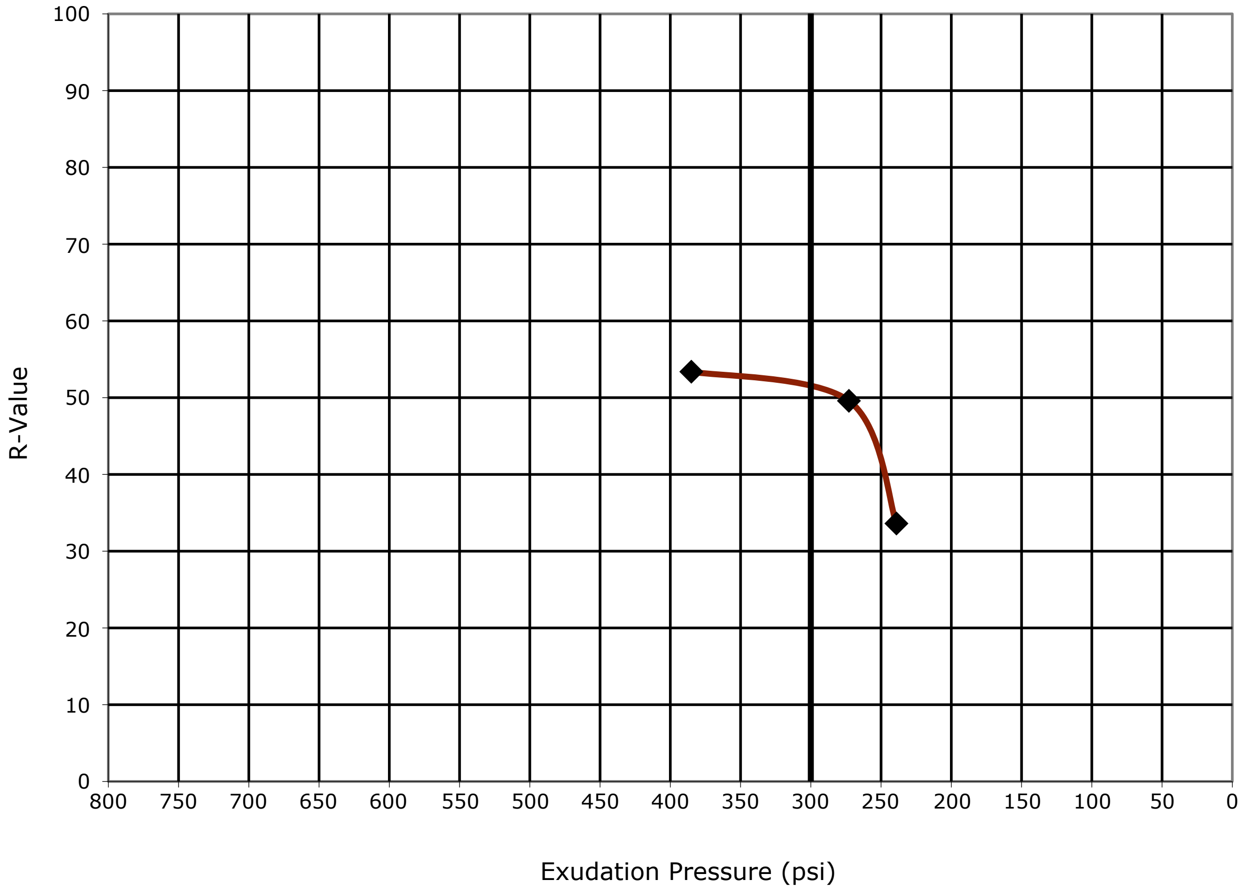


Resistance R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Material Description:	Sandy Silty Clay		
Sample Location:	R- 102 @ 0′- 5′		
Sample Source:			
Remarks:			
Specimen ID:	A	B	C
Compaction Pressure (psi):	175	300	350
Specimen Height (in):	2.52	2.53	2.52
Dry Density (pcf):	124.9	125.6	126.7
Horizontal Pressure @ 1000 lbs (psi):	38	29	25
Horizontal Pressure @ 2000 lbs (psi):	70	48	46
Displacement (turns):	6.35	5.93	5.41
Expansion Pressure (psi):	0	0	0
Exudation Pressure (psi):	239	273	385
R-Value:	33.6	49.6	53.4

R-Value at	**300**	**psi**	**52**

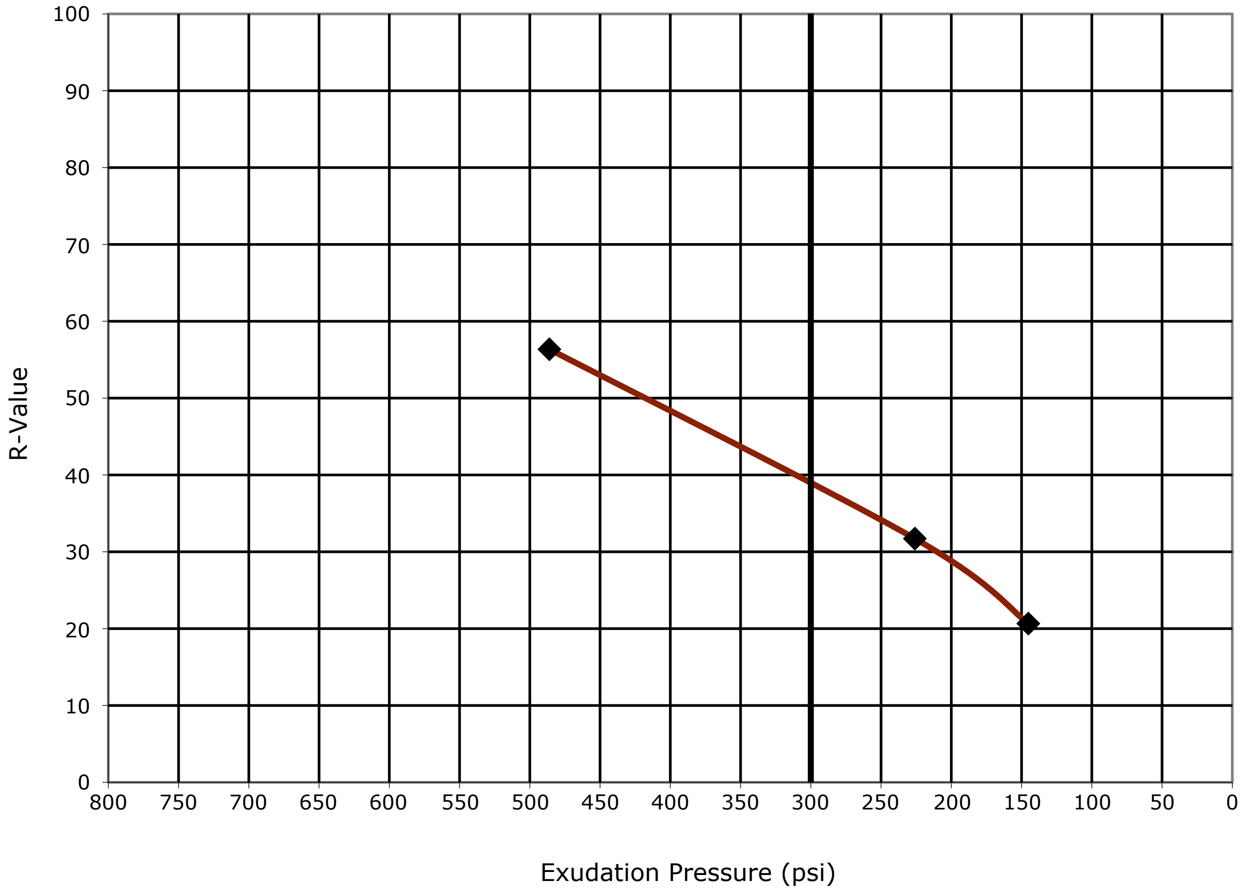


Resistance R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Material Description:	Clayey Sand		
Sample Location:	R-103 @ 0'-4'		
Sample Source:			
Remarks:			
Specimen ID:	A	B	C
Compaction Pressure (psi):	75	150	350
Specimen Height (in):	2.46	2.44	2.4
Dry Density (pcf):	131.4	133.4	135.9
Horizontal Pressure @ 1000 lbs (psi):	49	40	22
Horizontal Pressure @ 2000 lbs (psi):	104	78	43
Displacement (turns):	5.17	5.325	4.77
Expansion Pressure (psi):	0	0	0
Exudation Pressure (psi):	145	226	486
R-Value:	20.7	31.7	56.4

R-Value at	**300**	**psi**	**38**



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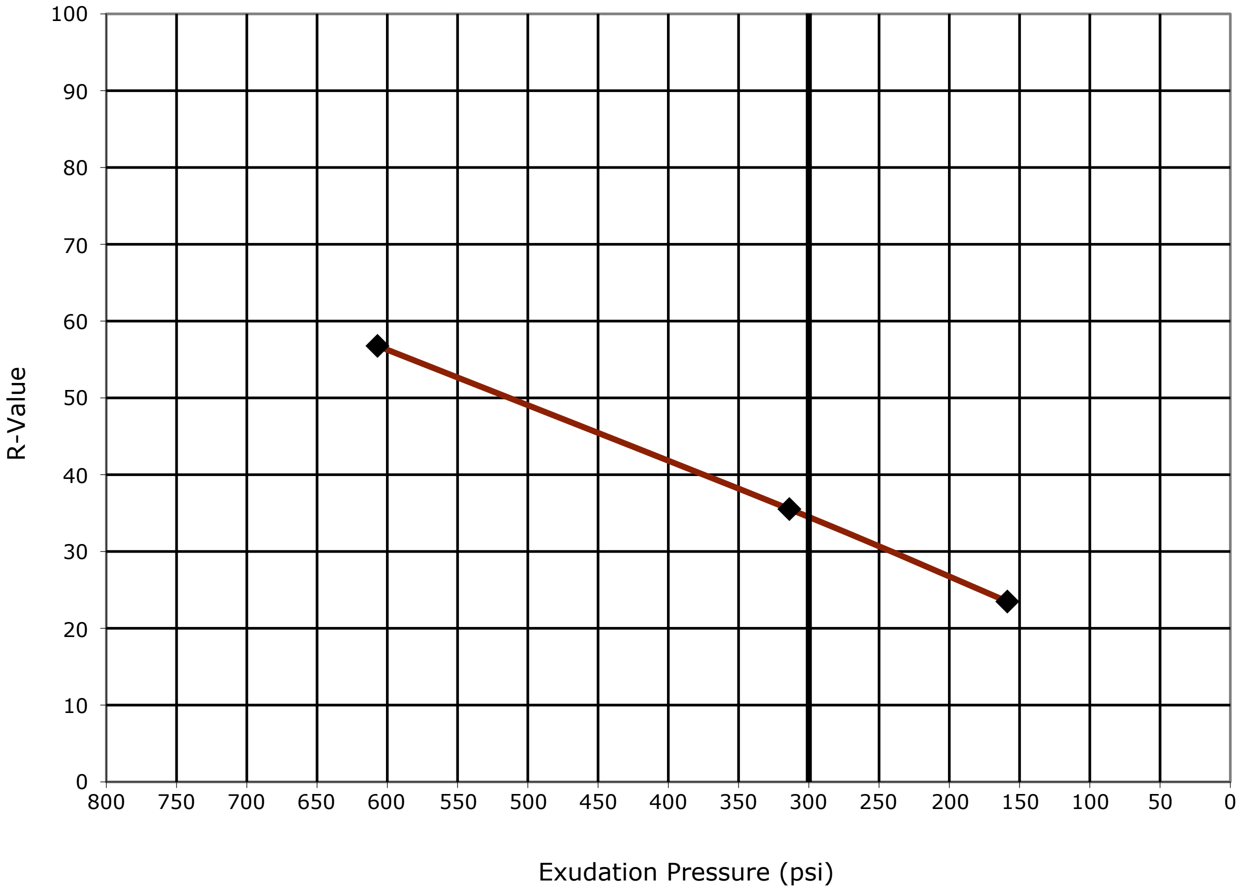
4685 S Ash Ave, Ste H-4
Tempe, AZ 85282-6767

Resistance R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Material Description:	Silty Clayey Sand		
Sample Location:	R-104 @ 0'-5'		
Sample Source:			
Remarks:			
Specimen ID:	A	B	C
Compaction Pressure (psi):	75	175	350
Specimen Height (in):	2.45	2.44	2.49
Dry Density (pcf):	131.2	132.2	133.2
Horizontal Pressure @ 1000 lbs (psi):	47	34	22
Horizontal Pressure @ 2000 lbs (psi):	97	72	43
Displacement (turns):	5.29	5.22	5.18
Expansion Pressure (psi):	0	0	0
Exudation Pressure (psi):	159	314	607
R-Value:	23.5	35.5	56.8

R-Value at	**300**	**psi**	**35**



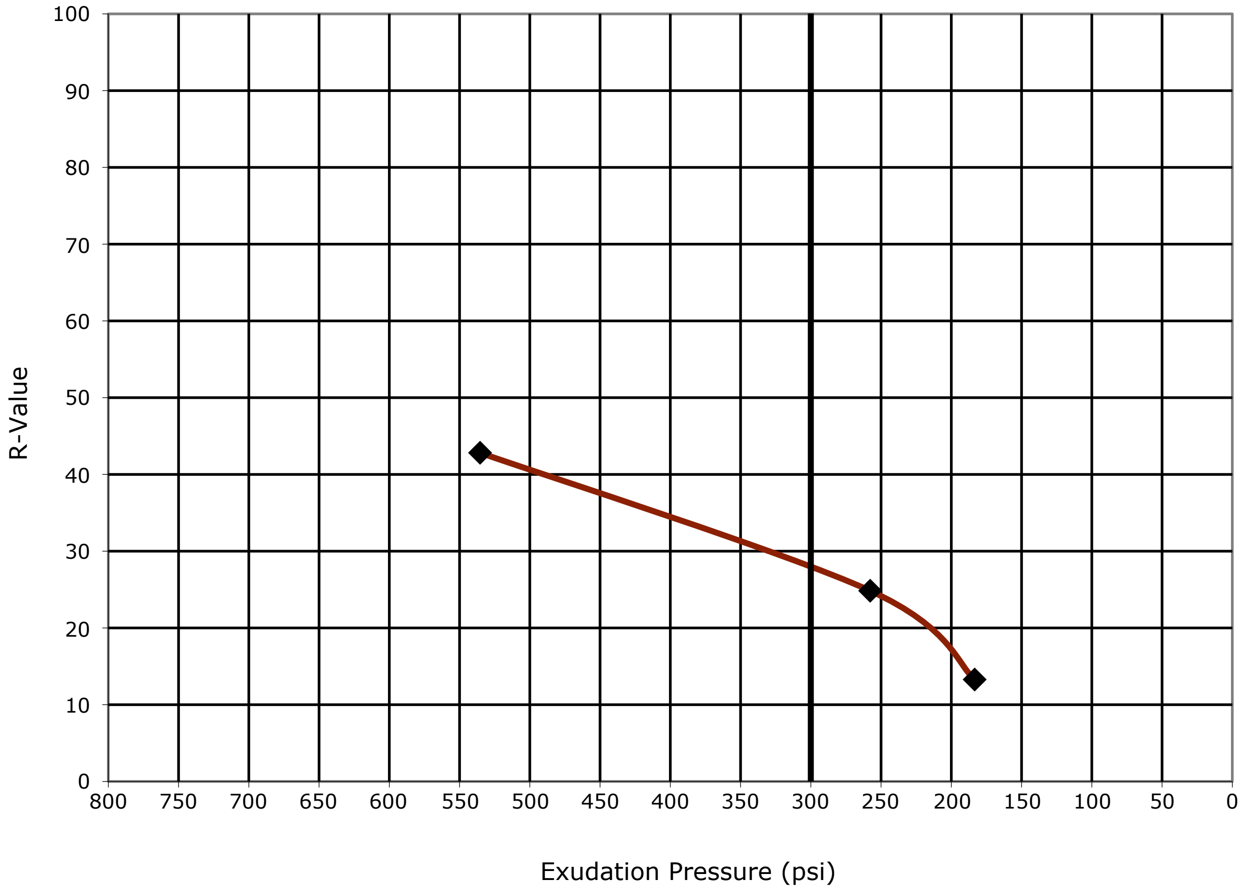
4685 S Ash Ave, Ste H-4
Tempe, AZ 85282-6767

Resistance R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Material Description:	Sandy Silty Clay		
Sample Location:	R-105 @ 0’- 0.75'		
Sample Source:			
Remarks:			
Specimen ID:	A	B	C
Compaction Pressure (psi):	75	125	275
Specimen Height (in):	2.53	2.49	2.51
Dry Density (pcf):	118.0	121.2	125.0
Horizontal Pressure @ 1000 lbs (psi):	60	47	33
Horizontal Pressure @ 2000 lbs (psi):	124	102	72
Displacement (turns):	4.74	4.3	4.08
Expansion Pressure (psi):	0	0	0
Exudation Pressure (psi):	183	258	535
R-Value:	13.3	24.8	42.8

R-Value at **300** **psi** **28**



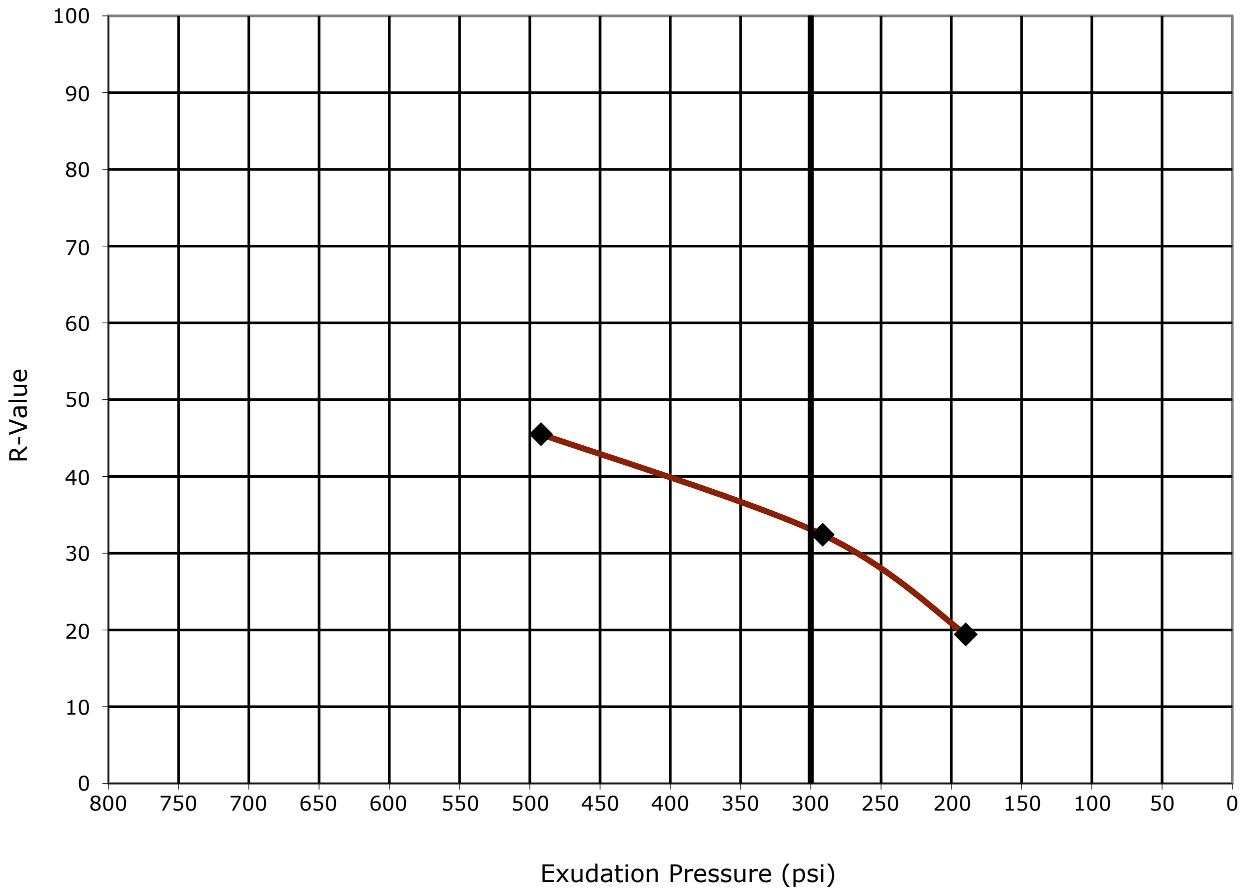
Resistance R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Material Description:	Clayey Sand
Sample Location:	R- 106 @ 0' - 5'
Sample Source:	
Remarks:	

Specimen ID:	A	B	C
Compaction Pressure (psi):	75	150	275
Specimen Height (in):	2.51	2.5	2.46
Dry Density (pcf):	125.2	127.3	130.7
Horizontal Pressure @ 1000 lbs (psi):	39	34	30
Horizontal Pressure @ 2000 lbs (psi):	103	78	61
Displacement (turns):	5.74	5.48	4.86
Expansion Pressure (psi):	0	0	0
Exudation Pressure (psi):	190	292	492
R-Value:	19.4	32.4	45.5

R-Value at	**300**	**psi**	**33**



MOTZZ LABORATORY, INC.

Report: 957793
Reported: 9/26/2025
Received: 9/19/2025
PO: CP255023

Laboratory Analysis Report

Terracon
Rajesh Dangi
4685 S. Ash Ave Suite H4
Tempe, AZ 85282

Project: CP255023

Lab Number	Sample ID
957793-1	S-106 (5-10')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.6	SU
Minimum Resistivity	ARIZ 236e	2349	ohm-cm
Sulfate	ASTM C1580	104	mg/kg
Chloride	ASTM D512c	45	mg/kg

Lab Number	Sample ID
957793-2	R-102 (0-5')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.3	SU
Minimum Resistivity	ARIZ 236e	2147	ohm-cm
Sulfate	ASTM C1580	51	mg/kg
Chloride	ASTM D512c	18	mg/kg

Lab Number	Sample ID
957793-3	S-101 (0-5')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.7	SU
Minimum Resistivity	ARIZ 236e	3221	ohm-cm
Sulfate	ASTM C1580	121	mg/kg
Chloride	ASTM D512c	8	mg/kg

Lab Number	Sample ID
957793-4	S-102 (0-4')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.6	SU
Minimum Resistivity	ARIZ 236e	2013	ohm-cm
Sulfate	ASTM C1580	129	mg/kg
Chloride	ASTM D512c	16	mg/kg

MOTZZ LABORATORY, INC.

Report: 957793
Reported: 9/26/2025
Received: 9/19/2025
PO: CP255023

Laboratory Analysis Report

Terracon
Rajesh Dangi
4685 S. Ash Ave Suite H4
Tempe, AZ 85282

Project: CP255023

Lab Number	Sample ID
957793-5	S-103 (0-5')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.6	SU
Minimum Resistivity	ARIZ 236e	2214	ohm-cm
Sulfate	ASTM C1580	160	mg/kg
Chloride	ASTM D512c	51	mg/kg

Lab Number	Sample ID
957793-6	S-104 (5-10')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.3	SU
Minimum Resistivity	ARIZ 236e	1476	ohm-cm
Sulfate	ASTM C1580	144	mg/kg
Chloride	ASTM D512c	68	mg/kg

Lab Number	Sample ID
957793-7	S-105 (0-5')

Test Parameter

Test	*Method*	*Result*	*Units*
pH (ARIZ 236e)	ARIZ 236e	8.4	SU
Minimum Resistivity	ARIZ 236e	939	ohm-cm
Sulfate	ASTM C1580	173	mg/kg
Chloride	ASTM D512c	75	mg/kg

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits LL	PL	PI	Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI_{50}	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
R-101	0.0 - 4.0	SC-SM			22	21	14	7	121	6.0	100	0.5						
R-101	2.0 - 3.0	SC-SM	109	2														1, 2
R-101	4.0 - 5.0	SM	101	2														1, 2
R-102	0.0 - 5.0	CL-ML			61	22	17	5	113	8.6	100	0.7		8.3	2147	51	18	
R-102	2.0 - 3.0	CL-ML	96	4														1, 2
R-102	4.0 - 5.0	CL-ML	98	4														1, 2
R-102	9.0 - 10.0	CL-ML	110	7														1, 2
R-103	0.0 - 4.0	SC			39	23	14	9	121	6.1	100	1.0						
R-103	2.0 - 3.0	SC	117	9														1, 2
R-103	4.0 - 5.0	SM	105	3														1, 2
R-103	9.0 - 10.0	SM	106	12														1, 2
R-104	0.0 - 5.0	SC-SM			44	20	16	4	120	6.1	100	1.0						
R-104	2.0 - 3.0	SC-SM	111	6														1, 2
R-104	4.0 - 5.0	SC-SM	106	3														1, 2
R-105	0.0 - 0.8	CL-ML			63	25	18	7	113	9.1	100	1.6						
R-106	0.0 - 5.0	SC			48	25	17	8	119	6.2	100	1.5						
S-101	0.0 - 5.0	SC-SM			47	21	16	5						8.7	3221	121	8	
S-101	2.0 - 3.0	SC-SM	116	11														1, 2
S-101	4.0 - 5.0	SC-SM	105	2														1, 2
S-101	9.0 - 10.0	CL	104	11														1, 2
S-102	0.0 - 4.0	SC-SM												8.6	2013	129	16	2
S-102	1.5 - 2.5	SC-SM	105	9														1, 2
S-102	4.0 - 9.0	SM			27	NP	NP	NP										
S-102	7.0 - 8.0	SM	100	9														1, 2
S-102	14.0 - 15.0	CL	106	4														1, 2

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: Olive Avenue Roadway Improvements

SITE: Olive Ave from Loop 303 to Reems Rd
Waddell/Glendale, Arizona

Terracon
1050 N Fairway Dr Ste G103
Avondale, AZ
PH. 480-897-8200 FAX.

PROJECT NUMBER: CP255023

CLIENT: Maricopa County DOT
Phoenix, Arizona

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI_{50}	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
S-103	0.0 - 5.0	SM			34	NP	NP	NP						8.6	2214	160	51	
S-103	1.5 - 2.5	SM	116	4														1, 2
S-103	4.0 - 5.0	SM	99	6														1, 2
S-103	9.0 - 10.0	CL	112	10														1, 2
S-104	1.5 - 2.5	CL	118	4														1, 2
S-104	4.0 - 5.0	CL	104	5														1, 2
S-104	5.0 - 10.0	SC			37	23	15	8						8.3	1476	144	68	
S-104	9.0 - 10.0	CL	107	13														1, 2
S-104	14.0 - 15.0	CL	114	12														1, 2
S-105	0.0 - 5.0	CL			53	25	14	11						8.4	939	173	75	
S-105	2.0 - 3.0	CL	108	8														1, 2
S-105	7.0 - 8.0	CL	91	12														1, 2
S-105	9.0 - 10.0	CL	100	13														1, 2
S-106	1.5 - 2.5	SM	118	7														1, 2
S-106	5.0 - 10.0	SM			28	NP	NP	NP						8.6	2349	104	45	
S-106	7.0 - 8.0	SM	101	11														1, 2
S-106	9.0 - 10.0	SM	103	8														1, 2
D-101	0.0 - 5.0	SC-SM			32	21	17	4										
D-101	2.0 - 3.0	SC-SM		2														2
D-101	4.0 - 5.0	ML	101	2														1, 2
D-101	9.0 - 10.0	CL	110	10														1, 2
D-102	0.0 - 5.0	SC-SM			49	20	13	7										
D-102	2.0 - 3.0	SC-SM	104	3														1, 2
D-102	4.0 - 5.0	SC-SM	102	5														1, 2
D-102	9.0 - 10.0	CL	105	11														1, 2

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: Olive Avenue Roadway Improvements

SITE: Olive Ave from Loop 303 to Reems Rd
Waddell/Glendale, Arizona

Terracon
1050 N Fairway Dr Ste G103
Avondale, AZ
PH. 480-897-8200 FAX.

PROJECT NUMBER: CP255023

CLIENT: Maricopa County DOT
Phoenix, Arizona

SUMMARY OF LABORATORY RESULTS

Borehole No.	Depth (ft.)	USCS Soil Class.	In-Situ Properties		Classification				Expansion Testing					Corrosivity				Remarks
			Dry Density (pcf)	Water Content (%)	Passing #200 Sieve (%)	Atterberg Limits			Dry Density (pcf)	Water Content (%)	Surcharge (psf)	Expansion (%)	Expansion Index EI_{50}	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	
						LL	PL	PI										
D-103	0.0 - 5.0	SC-SM			43	21	16	5										
D-103	2.0 - 3.0	SC-SM	103	3														1, 2
D-103	9.0 - 10.0	SC	108	12														1, 2
D-104	0.0 - 5.0	CL-ML			59	20	14	6										
D-104	2.0 - 3.0	CL-ML	102	6														1, 2
D-104	4.0 - 5.0	CL-ML	96	10														1, 2
D-104	9.0 - 10.0	CL-ML	99	15														1, 2

REMARKS

1. Dry Density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Expansion Index in accordance with ASTM D4829-95.
5. Air-Dried Sample

PROJECT: Olive Avenue Roadway Improvements

SITE: Olive Ave from Loop 303 to Reems Rd
Waddell/Glendale, Arizona

Terracon
1050 N Fairway Dr Ste G103
Avondale, AZ

PH. 480-897-8200 FAX.

PROJECT NUMBER: CP255023

CLIENT: Maricopa County DOT
Phoenix, Arizona

Note: The laboratory test results shown on this page were extracted from the following report: Geotechnical Investigation, Olive Avenue Widening, Olive Avenue from Citrus Road to El Mirage Road, MCDOT Job No.: TT404, MCDOT Contract No.: 2010-042; report prepared by AMEC, AMEC Project No. 17-2012-4015, report dated May 23, 2012.

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Project Location	Boring Number	Depth (ft)		USCS/Group Symbol	Percent Fines (minus 200)	Liquid Limit	Plasticity Index	Correlated R-Value	Tested R-Value (at 300 psi)[1]	Moisture Content (%)	In Place Dry Density (pcf)[2]	Collapse (%) [Swell (+) / Collapse (-)]	One Dimensional Swell or Settlement Potential Performed (ASTM D4546)	Optimum Moisture Content (%) (by ASTM D698A)	Maximum Dry Density (pcf) (by ASTM D698A or D698C)	Chlorides (ppm)[3]	Soluble Sulfates (ppm)[3]	pH	Resistivity (ohm-cm)
		Begin	End																
Olive Avenue	B-1	0.0	5.0	CL	65	36.0	19.0	17	27				4.4	14.1	115.6	26	49	8.6	1,850
Olive Avenue	B-1	1.0	2.0							11.5	89.3	-2.3							
Olive Avenue	B-1	9.5	10.5							12.0	106.5								
Olive Avenue	B-2	0.0	5.0	CL	55	26.0	8.0	35											
Olive Avenue	B-2	1.0	2.0							10.7	114.6								
Olive Avenue	B-3	0.0	5.0	CL	60	32.0	13.0	25	34				0	13.2	116.8				
Olive Avenue	B-3	1.0	2.0							7.1	89.6								
Olive Avenue	B-4	0.0	5.0	CL-ML	51	23.0	6.0	41											
Olive Avenue	B-5	0.0	5.0	CL-ML	62	24.0	6.0	36	15					11.1	119.8				
Olive Avenue	B-5	1.0	2.0							4.5	99.6								
Olive Avenue	B-5	9.5	10.5							7.8	90.0								
Olive Avenue	B-6	0.0	5.0	SM	37	NV	NP	70											
Olive Avenue	B-6	1.0	2.0							2.9	101.7								
Olive Avenue	B-7	0.0	5.0	CL	53	30.0	14.0	25					0.1						
Olive Avenue	B-8	0.0	5.0	SM	27	NV	NP	70	75					9.0	129.1	11	122	8.8	3,425
Olive Avenue	B-8	1.0	2.0							7.2	111.3								
Olive Avenue	B-9	0.0	5.0	SC-SM	40	22.0	5.0	50						11.1	126.2				
Olive Avenue	B-9	0.0	5.0						32										
Olive Avenue	B-9	9.5	10.5							18.7	107.7	0.0							
Olive Avenue	B-10	0.0	5.0	CL-ML	59	25.0	6.0	37											
Olive Avenue	B-10	1.0	2.0							16.1	109.1								
Olive Avenue	B-11	0.0	5.0	SC-SM	43	21.0	4.0	51	30					10.1	124.2	29	117	7.9	1,439
Olive Avenue	B-11	1.0	2.0							5.8	108.4								
Olive Avenue	B-12	0.0	5.0	SC-SM	49	22.0	6.0	42											
Olive Avenue	B-12	1.0	2.0							4.1	107.9								
Olive Avenue	B-13	0.0	5.0	SC	43	29.0	15.0	26	32				2.8	12.5	118.4				
Olive Avenue	B-13	1.0	2.0							7.3	97.9	-3.4							
Olive Avenue	B-14	0.0	5.0	SC	28	31.0	15.0	31					0.2						
Olive Avenue	B-14	1.0	2.0							7.4	111.5								
Olive Avenue	B-15	0.0	5.0	SC	48	29.0	15.0	25	17					13.3	117.8	12	36	8.3	4,179
Olive Avenue	B-15	1.0	2.0							9.4	104.4	-3.9							
Olive Avenue	B-16	0.0	5.0	SM	24	19.0	3.0	70											
Olive Avenue	B-16	1.0	2.0							10.0	105.1								
Olive Avenue	B-17	0.0	5.0	SC-SM	22	22.0	6.0	59	47					9.8	126.9				
Olive Avenue	B-17	1.0	2.0							4.0	115.6								
Olive Avenue	B-18	0.0	5.0	SC-SM	20	22.0	6.0	60											

Notes: 1(psi) = pounds per square inch
2(pcf) = pounds per cubic foot
3(ppm) = parts per million

Supporting Information

Contents:

General Notes

Sampling	Water Level	Field Tests
▯ Bulk Sample ☒ Ring Sampler ☒ Standard Penetration Test	▽ Water Initially Encountered ▼ Water Level After a Specified Period of Time ▽ Water Level After a Specified Period of Time ▨ Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			**Consistency of Fine-Grained Soils** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (psf)**	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**
Very Loose	0 - 3	0 - 5	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	6 - 14	Soft	500 to 1,000	2 - 4	3 - 6
Medium Dense	10 - 29	15 - 44	Medium Stiff	1,000 to 2,000	4 - 8	7 - 12
Dense	30 - 50	45 - 75	Stiff	2,000 to 4,000	8 - 15	13 - 23
Very Dense	> 50	> 75	Very Stiff	4,000 to 8,000	15 - 30	24 - 45
			Hard	> 8,000	> 30	> 45

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above “A” line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay [K, L, M]
			PI plots below “A” line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.