GEOTECHNICAL REPORT

ADOT Project No. 089A YV 362 F0624 01D

Federal Reference Project No. A89-B(225)T

SR 89A & PAGE SPRINGS RD



November 13, 2025

Prepared by

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ARIZONA DEPARTMENT OF TRANSPORTATION

BRIDGE GROUP

GEOTECHNICAL SERVICES

November 13, 2025

Subject:
Geotechnical Report
SR 89A & PAGE SPRINGS RD
ADOT Project No. 089A YV 262 F0624 01D

This report presents the results of our geotechnical engineering services to support the intersection improvements located on SR 89A from milepost (MP) 362.18 to 362.76 (southbound) and MP 362.24 to 362.91 (northbound). The project is located on the Prescott-Flagstaff Highway in Yavapai County, within the Arizona Department of Transportation (ADOT) Northcentral District.

The proposed project will reconfigure the existing SR 89A and Page Springs Road Intersection.

The geotechnical field investigation included four test pits to depths ranging of approximately three to ten feet below the ground surface and performing one refraction seismic survey line. The results of the field and laboratory investigation as well as design recommendations for the proposed construction are presented in this report.

Should there be any questions regarding the contents of this report or its appropriate incorporation into designs, please do not hesitate to contact us.

Sincerely,

Registered Professional Engineer (Civil)
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Date Signed 11/13/2025
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Reviewed by:

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TABLE OF CONTENTS

1.0 INTRODUCTION 3
1.1 Project Description 3
1.2 Site Description 3
1.3 Site Geology 3
2.0 SUBSURFACE INVESTIGATION 3
2.1 Subsurface Test Pit Investigation 3
2.2 Refraction Seismic Survey 4
2.3 Laboratory Testing 4
3.0 SUBSURFACE CONDITIONS 5
3.1 Soil and Bedrock Conditions 5
3.2 Groundwater Conditions 5
4.0 RECOMMENDATIONS 5
4.1 General Discussion 5
4.2 Refraction Seismic Survey Results 6
4.3 Rippability 6
4.4 Embankment Fill Slopes 7
4.4.1 Embankment Construction and Post-Construction Settlement 7
4.5 Excavation 7
4.6 Pavement Design Information 7
4.7 Earthwork Factors 8
4.8 Slopes 8
4.9 Water Requirements 8
4.10 Borrow Information 9
5.0 TEST PIT (SUBGRADE) LOG LIMITATIONS 9
6.0 REFERENCES 9

Table 1: Refraction Seismic Survey Details 4
Table 2: Laboratory Test Methods Applied for Representative Soil Samples 5
Table 3: Refraction Seismic Survey Results 6
Table 4: General Classification of Rock Rippability 6
Table 5: Recommended R-Values 8
Table 6: Earthwork Factors 8

Appendix A Site Plans
Appendix B Test Pit Logs
Appendix C Laboratory Test Summary
Appendix D Seismic Refraction Survey Results

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services to support the intersection improvements located on SR 89A from milepost (MP) 362.18 to 362.76 (southbound) and MP 362.24 to 362.91 (northbound). The project is located on the Prescott-Flagstaff Highway in Yavapai County, within the Arizona Department of Transportation (ADOT) Northcentral District.

The purpose of this report is to provide information and recommendations regarding:

- Pavement design
- Earthwork factors

1.1 Project Description

The proposed project will reconfigure the existing SR 89A and Page Springs Road Intersection.

1.2 Site Description

The project site for the geotechnical exploration areas is located within the ADOT Northcentral District on SR 89A between milepost 362.24 to 362.91. The general project area is described as undulating terrain with elevations ranging from approximately 3,733 to 3,764 feet mean sea level (MSL). Vegetation at the site consists of generally low to moderate growth of native grasses, bushes, and trees.

1.3 Site Geology

The Geologic Map of Arizona (AGS, 2000) indicates that this section is Late to middle Miocene basaltic rocks (Middle to Late Miocene). Mostly dark, mesa-forming basalt deposited as lava flows. Rocks of this unit are widely exposed south of Camp Verde (Hickey Formation basalts), in the Mohon Mountains north of Bagdad, "The Mesa" east of Parker, and at other scattered locations in western Arizona. Rocks of this unit were not tilted by middle-Tertiary normal faulting except in a narrow belt from north of Phoenix to the northwest corner of the state (8-16 Ma).

2.0 SUBSURFACE INVESTIGATION

2.1 Subsurface Test Pit Investigation

A geotechnical field investigation was performed on October 7, 2025. The field investigation included the completion of four (4) test pits (designated TP-1 through TP-4). The backhoe test pits were excavated to depths of three (3) to ten (10) feet below the ground surface (bgs). The test pits were excavated with a CAT 420 backhoe using a two-foot wide bucket. The sampled material was delivered to the ADOT Construction and Material Group Central Laboratory for testing. The investigation was performed by the ADOT Geotechnical Operations field crew with Omied Arianejad, P.E. serving as the field engineer.

The test pits were located in the field using a hand-held, global positioning system (GPS) instrument in conjunction with Google Earth images, and project plans. Site plans showing the test pit locations and seismic refraction line are presented in Appendix A of this report. Test Pit logs are presented in Appendix B of this report.

In-place density and moisture tests were performed at the locations of TP-1 and TP-3 to compare the in-situ conditions versus the laboratory tested maximum dry density and optimum moisture results. The tests were using the nuclear density (ASTM D6938) method. The in-situ density test location and results are included in the Laboratory Testing Summary under Field Tests in Appendix C.

2.2 Refraction Seismic Survey

Refraction seismic survey lines were performed at one location at the project site by Omied Arianejad, P.E., and Michael R. Simpson on October 7, 2025 to assess geologic and geotechnical conditions. The refraction seismic survey was performed to aid in characterizing the subsurface geotechnical profile, provide general strength parameters for the subsurface materials, assist with developing earthwork factors, and evaluate excavation conditions. Table 1 presents details on the location and purpose of the survey.

Table 1: Refraction Seismic Survey Details

Location	Station/Offset 1	Station/Offset 2	Elevation Range (MSL)
SL-1	527+45, 60’ L NB CL	528+50, 137’L NB CL	3,761 to 3,762 ft.

The refraction seismic survey lines were conducted using a 24-channel, signal enhancement seismograph (Geometrics SmartSeis Model SE-24) and a sledgehammer served as the energy source for the surveys. The survey line was 125 feet long and geophones were placed at 5-foot intervals. Data was retrieved using hammer impacts at 5-foot foreshot and backshot offsets from the ends of the seismic line array, in addition to shots at the midpoint of the array. Several impacts are added together at each individual shot location to increase the total signal to obtain the seismic record. The results of the refraction seismic surveys provide additional subsurface data to depths ranging on the order of approximately 17 to 19 feet bgs. Results of the seismic survey are included in Appendix D.

The refraction seismic surveys were performed in general conformance with the guidelines presented in ASTM D5777-95 Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation for refraction using compression waves.

2.3 Laboratory Testing

The soil samples obtained during the field investigation were delivered to ADOT Construction and Materials Group Central Laboratory. Select samples were tested in general conformance with the procedures listed in the following table.

Table 2: Laboratory Test Methods Applied for Representative Soil Samples

Geotechnical Test	Test Procedure	Number of Tests
Sieve Analysis (Grain Size)	ARIZ 201d	4
Atterberg Limits (Plasticity)	AASHTO T 89 and T 90	4
Maximum Density and Optimum Moisture of Soils	ARIZ 225b	2
R-Value	AASHTO T 190	2

A summary of all laboratory test results is presented in Appendix C of this report.

3.0 SUBSURFACE CONDITIONS

3.1 Soil and Bedrock Conditions

The subsurface investigation encountered native residual soils, fill soils, and bedrock materials consisting of varying amounts of sand, gravel, and fine grained soils (clay/silts) detailed in the boring logs in Appendix B. The soils had plasticities in the high range, and calcium carbonate cementation (caliche) was not evident.

Bedrock and cemented soil were encountered at three of the test pit locations. The native rocks were classified as weathered basalt rock. Bedrock was observed at varying elevations through the project site.

3.2 Groundwater Conditions

No free groundwater was observed in any of the test pits at the time of our investigation. Moisture conditions can be expected to fluctuate seasonally. The observed moisture conditions indicated on the logs are as recorded at the time of exploration. These moisture conditions may vary considerably, with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent upon the duration of and methods used in the exploration program.

4.0 RECOMMENDATIONS

4.1 General Discussion

Based on field observations, and laboratory tests performed on bulk samples of the existing soils, and seismic refraction surveys, the subsurface geotechnical conditions are not favorable for the intersection improvements. It is recommended to excavate enough surficial soil to allow for three feet of suitable imported fill material. If bedrock is encountered, or if the soil requires between three to five feet of fill, no excavation is needed. For any areas that require more than five feet of fill, please refer to section 4.4.1.

4.2 Refraction Seismic Survey Results

A series of refraction seismic survey lines were performed along sections of the proposed construction cut slope locations for the project. Stratigraphic interpretation at the survey location was developed from the refraction seismic survey data, laboratory test results, and observations made of the site geology. This data provides the basis to define the qualitative excavatability soils encountered at the project refraction seismic survey locations. The results of the refraction seismic survey data and field investigation data are summarized in the table below. A subsurface P-wave velocity model interpretation of the refraction seismic data is presented in Appendix D of this report.

Table 3: Refraction Seismic Survey Results

Survey Line	Station/ Offset 1	Station/ Offset 2	Elevation Range (MSL in ft.)	Layer	Depth Range (ft.)	Average Seismic Velocity (ft./sec.)	Interpreted Geological Description
SL-1	527+45, 60' L NB CL	528+50, 137' L NB CL	3,761 to 3,762	1	0 to 3	1,114	Decomposed Basalt
				2	3 to 19	6,803	Weathered Basalt

4.3 Rippability

P-wave velocities of ground materials have been correlated to the amount of effort that will be required to excavate these materials. Caterpillar, Inc. has compiled these correlations in the Caterpillar Performance Handbook (Caterpillar, 2018) which provides guidance on which type of equipment will be required for effective excavation. The table below presents general guidance to the ease of excavation or rippability of subsurface materials. This table assumes that a Caterpillar D8R dozer equipped with a single shank ripper can be used for excavation.

Table 4: General Classification of Rock Rippability

P-wave Velocity Range (ft/sec)	Rippability
Less than 2,000	Easy
2,000 to 4,000	Moderately difficult
4,000 to 5,500	Difficult, possible blasting
5,500 to 7,000	Very difficult, probable blasting
Greater than 7,000	Blasting generally required

These rippability values may be conservative and may depend on the prevailing structure of underlying rock materials. The fracture spacing and orientation can greatly affect the effectiveness of heavy equipment.

More detailed ranges of rippability for rock materials with different equipment configurations are published in the Caterpillar Performance Handbook (Caterpillar, 2018). The rippability

classification scheme shall be used with discretion where a contractor's experience and equipment can and will influence the effectiveness of excavation efforts.

4.4 Embankment Fill Slopes

It is anticipated that the planned embankment fills will be constructed using locally available materials derived from borrow sources. In general, permanent slopes in roadway fill and embankment slopes for the project should be no steeper than 2H:1V.

4.4.1 Embankment Construction and Post-Construction Settlement

Settlement of the planned fill embankments and of the near surface native soils is expected to occur in response to embankment construction, with the majority of the settlement expected to occur during construction of the embankments. Based on the results of the field investigation and laboratory testing, the ground surface within embankment fill areas greater than five feet in height should be overexcavated, moisture conditioned, and recompacted two feet below existing grade. This is to minimize the potential for excessive post-construction settlements. Soil placed within three feet of the finished subgrade elevation in pavement areas should meet the construction control R-value discussed in Section 4.6 of this report.

The potential for future, post construction settlement will also be minimized by providing the following:

- The embankments are constructed at or near the optimum moisture content for the fill within the limits of one percent below to three percent above optimum moisture content.
- Larger particles (cobble and/or boulder-size) are isolated within such fills such that nesting is not permitted, the interstitial spaces between these particles are filled with finer-grained material such that the presence of voids is minimized.
- Otherwise, embankment construction shall be performed in accordance with the ADOT Standard Specifications for Road and Bridge Construction (2021).

4.5 Excavation

The majority of the existing surface and subsurface soils encountered at the site consisted of native soils, decomposed basalt, and weathered basalt.

The contractor shall review all available information and provide their own assessment to determine the equipment and technical requirements that will be used to construct this project according to the plans and specifications for this project.

4.6 Pavement Design Information

Test pit samples were retrieved and tested according to the ADOT Geotechnical Project Development Manual (GPDM, 2024). The laboratory test results are tabulated in Appendix C. Statistical analyses of the laboratory correlated R-values were performed in accordance with the

procedure presented in Section 202.02(G) of the ADOT Pavement Design Manual (PD Manual, 2017). Correlated R-value results ranged from 14 to 32, with an average correlated R-value of 22. TP-1 and TP-3 had a tested R-Value of 20 and 18, respectively. The recommended R-values are presented in the table below.

Table 5: Recommended R-Values

Recommended R-Values		
Station	R-mean	R-control
Entire project	20	20

R-mean should be used to design pavement structure. R-control values should be used to develop the Subgrade Acceptance Chart. Material that is excavated within the project limits and is used as a fill material within three feet below the finished subgrade elevation shall meet the Subgrade Acceptance Chart. Recommendations for pavement design are presented in separate Materials Design Report (MDR) and Pavement Design Summary (PDS) prepared by ADOT Roadway Group - Pavement Design Section.

4.7 Earthwork Factors

Earthwork factors are dependent on the existing soil conditions, contractor methods of handling the materials, wind losses and compaction achieved during construction. Potential bidders should consider these factors in preparing the estimates and are encouraged to review all available data and make their own conclusions regarding excavation conditions. For the purpose of design volume estimation, Earthwork Factors are recommended in the table below.

Table 6: Earthwork Factors

Earthwork Factors		
Material	Ground Compaction	Excavation Factor
Soils (Entire Project)	0.1 feet	10% shrink (soil)

4.8 Slopes

The slopes within the affected construction area should be constructed in conformance to ADOT standard construction drawings C-02.20. The slope within the affected construction should be constructed in accordance with the standard specifications.

4.9 Water Requirements

Approximately 75 gallons of water per cubic yard may be estimated for compaction of base and subgrade materials. This estimate is based on the tested optimum compaction moisture content and includes a conservative overrun for losses due to seepage, evaporation, inadequate mixing, spillage, etc. Precipitation before and/or during construction may also reduce the required amount of water significantly.

4.10 Borrow Information

There is no Department-furnished source for borrow on this project. Borrow shall be as specified in Section 203-9 of the Standard Specifications. Borrow placed within three feet of finished subgrade shall meet the following requirements. The Plasticity Index (PI) and the percent passing the #200 sieve (Minus 200), when used in the equation below, shall give a value of X that does not exceed 116.

X= (Minus 200) + [2.83 (PI)]

5.0 TEST PIT (SUBGRADE) LOG LIMITATIONS

General soil strata descriptions and indicated boundaries are based on engineering interpretation of available subsurface information by the geotechnical engineer and may not reflect actual variation in subsurface conditions between test pit and sample locations. The locations of the contacts between strata shown on the logs are approximate, and changes between material types may be gradual rather than abrupt. Classification of soil materials is in general accordance with ASTM D2488 and is based on field observation unless accompanied by mechanical analysis.

The observed groundwater levels and/or moisture conditions indicated on the logs are as recorded at the time of exploration. These groundwater levels and/or moisture conditions may vary considerably, with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent upon the duration of and methods used in the exploration program.

Sound engineering judgment was exercised in preparing the subsurface information presented on the subgrade logs. This information was prepared for and is intended for design and preliminary quantity estimate purposes. Its presentation on the plans or elsewhere is for the purpose of providing intended users with access to the same information as the State and its designers. This subsurface information and interpretation is presented in good faith and is not intended as a substitute for independent investigation, interpretation or judgment of the contractor or other users of this report.

6.0 REFERENCES

AASHTO (2011). **Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 31st Edition**. American Association of State Highway and Transportation Officials, Washington, D.C.

ADOT (2016). **Materials Testing Manual, Sampling and Testing Procedures.** Arizona Department of Transportation, Phoenix, AZ.

ADOT (2017). **Pavement Design Manual**. Arizona Department of Transportation, Phoenix, AZ

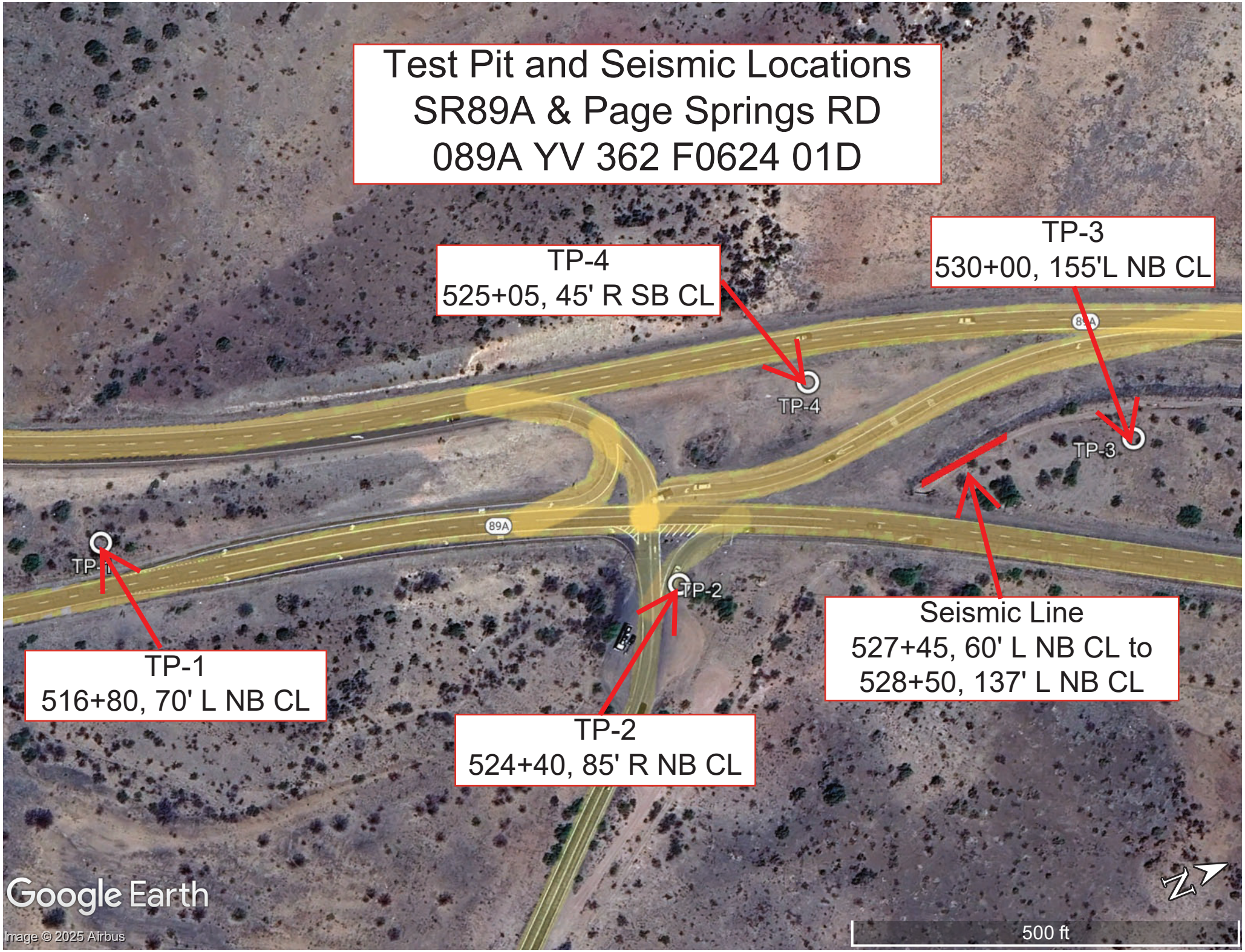
ADOT (2021). **Standard Specifications for Road and Bridge Construction**. Arizona Department of Transportation, Phoenix, AZ.

ADOT (2024). **Geotechnical Project Development Manual**. Arizona Department of Transportation, Phoenix, AZ.

AGS (2000). **Geologic Map of Arizona - Map 35**. Arizona Geological Survey, Tucson, AZ.

APPENDIX A

Site Plans


Test Pit and Seismic Locations
SR89A & Page Springs RD
089A YV 362 F0624 01D
TP-4
525+05, 45' R SB CL
TP-3
530+00, 155'L NB CL
TP-1
516+80, 70' L NB CL
TP-2
524+40, 85' R NB CL
Seismic Line
527+45, 60' L NB CL to
528+50, 137' L NB CL
89A
Google Earth
Image © 2025 Airbus
500 ft

APPENDIX B

Test Pit Logs

Project Name	SR 89A & Page Springs Rd	**Test Pit**	
Project No.	089A 362 F062401D		
Location	SR89A MP 362.43	**TP-1**	
Station, Offset	516+80 70' L NB CL		
Lat/Long, elev	34.79131, -111.91750, at 3733'		
Field Engineer	Omied Arianejad	Date	10/07/2025
Field Operator	ADOT Geotechncial Operations	Backhoe	CAT 420

Depth (ft)	Elevation (ft)	Graphic Log	Sample Type	Visual Classification	Lab				Samples	
					% Gravel	% Sand	% Fines	Atterberg Limits (LL-PL-PI)	In-Situ Dry Density (PCF)	In-Situ Moisture Content (%)
1 2	3730		Bulk	**LEAN CLAY** (**CL**): dark brown; high plasticity; no cementation; slightly damp.	15	26	59	44-25-19	94.3	9.1
3				3.0						

Backhoe refusal at 3 feet. Cemented soil and weathered bedrock encountered. No groundwater encountered in test pit.



Project Name	SR 89A & Page Springs Rd	**Test Pit**	
Project No.	089A 362 F062401D		
Location	SR89A MP 362.57	**TP-2**	
Station, Offset	524+40 85' R NB CL		
Lat/Long, elev	34.79319, -111.91639, at 3750'		
Field Engineer	Omied Arianejad	Date	10/07/2025
Field Operator	ADOT Geotechncial Operations	Backhoe	CAT 420

Depth (ft)	Elevation (ft)	Graphic Log	Sample Type	Visual Classification	Lab: % Gravel	Lab: % Sand	Lab: % Fines	Lab: Atterberg Limits (LL-PL-PI)
0				**GRAVELLY FILL**:				
1.0								
1			Bulk	**CLAYEY SAND** (**SC**): brown; high plasticity; no cementation; slightly damp.	9	57	34	38-21-17
2								
3								
4								
5	3745							
6				6.0				

Stopped test pit excavation at 6 feet. No groundwater encountered in test pit.



Project Name	SR 89A & Page Springs Rd	**Test Pit**	
Project No.	089A 362 F062401D		
Location	SR89A MP 362.61	**TP-3**	
Station, Offset	530+00 155' L NB CL		
Lat/Long, elev	34.79489, -111.91625, at 3764'		
Field Engineer	Omied Arianejad	Date	10/07/2025
Field Operator	ADOT Geotechncial Operations	Backhoe	CAT 420

Depth (ft)	Elevation (ft)	Graphic Log	Sample Type	Visual Classification	Lab				Samples	
					% Gravel	% Sand	% Fines	Atterberg Limits (LL-PL-PI)	In-Situ Dry Density (PCF)	In-Situ Moisture Content (%)
1			Bulk	**LEAN CLAY** (**CL**): brown; high plasticity; weak cementation; slightly damp.						
2										
3										
4	3760									
5					12	32	56	43-22-21	102.8	15.5
6										
7										
8										
9	3755									
10				10.0						

Backhoe refusal at 10 feet. Cemented soil and weathered bedrock encountered. No groundwater encountered in test pit.



Project Name	SR 89A & Page Springs Rd	**Test Pit**	
Project No.	089A 362 F062401D		
Location	SR89A MP 362.69	**TP-4**	
Station, Offset	525+05 45' R SB CL		
Lat/Long, elev	34.79389, -111.91700, at 3757'		
Field Engineer	Omied Arianejad	Date	10/07/2025
Field Operator	ADOT Geotechncial Operations	Backhoe	CAT 420

Depth (ft)	Elevation (ft)	Graphic Log	Sample Type	Visual Classification	Lab: % Gravel	Lab: % Sand	Lab: % Fines	Lab: Atterberg Limits (LL-PL-PI)
1 2 3 4 5	3755		Bulk	**FAT CLAY** (**CH**): brown; high plasticity; no to weak cementation; slightly damp. 5.0	14	26	60	52-23-29

Backhoe refusal at 5 feet. Cemented soil and weathered bedrock encountered.
No groundwater encountered in test pit.



APPENDIX C

Laboratory Test Summary

089A 362 F0624 01D, SR 89A & Page Springs Rd

LABORATORY TEST SUMMARY																											
Test Location	Station, Offset	Depth (feet)	Sample Source	MECHANICAL PROPERTIES																		FIELD TESTS		PARTICLE SIZE PERCENTAGE				Test Location
				Percent Passing							PI	LL	USCS	R-Value		Corrosivity		Chemistry		Moisture/Density		In-situ Moisture/Density		Particle Type				
				3"	1½"	¾"	#4	#8	#40	#200				Corr.	Tested	pH	Minimum Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	Max. Dry Density (pcf)	Opt. Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)	Cobbles	Gravel	Sands	Fines (Clay/Silt)	
TP-1	516+80, 70' L NB CL	0.0 - 3.0	Bulk	100	94	90	85	81	72	59.5	19	44	CL	21	20	7.7	805	20	80	105.7	21.9	94.3	9.1	0	15	26	60	TP-1
TP-2	524+40, 85' R NB CL	1.0 - 6.0	Bulk	100	99	98	91	82	58	34.1	17	38	SC	32										0	9	57	34	TP-2
TP-3	530+00, 155' L NB CL	0.0 - 10.0	Bulk	100	99	96	88	83	68	56.2	21	43	CL	20	18	8.0	750	20	140	107.8	18.1	102.8	15.5	0	12	32	56	TP-3
TP-4	525+05, 45' R SB CL	0.0 - 5.0	Bulk	100	100	97	86	81	71	59.8	29	52	CH	14										0	14	26	60	TP-4

APPENDIX D

Seismic Refraction Survey Results

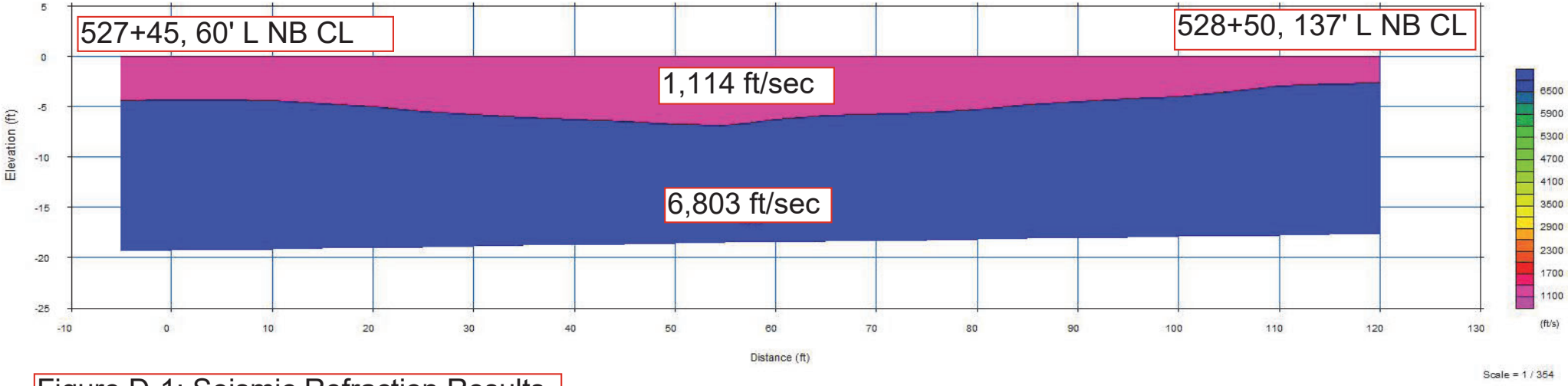


Figure D-1: Seismic Refraction Results