Appendix E

Geotechnical Scoping Report

Geotechnical Scoping Report

Phase I-A/B Corridor Study

I-40 Arizona State Line to Atrisco Vista Boulevard Interchange

MP 0 to 150

CN 6101580

McKinley, Cibola, and Bernalillo Counties, New Mexico

Revision No. 1

May 2, 2024

Terracon Project No. 66215219

Prepared for:

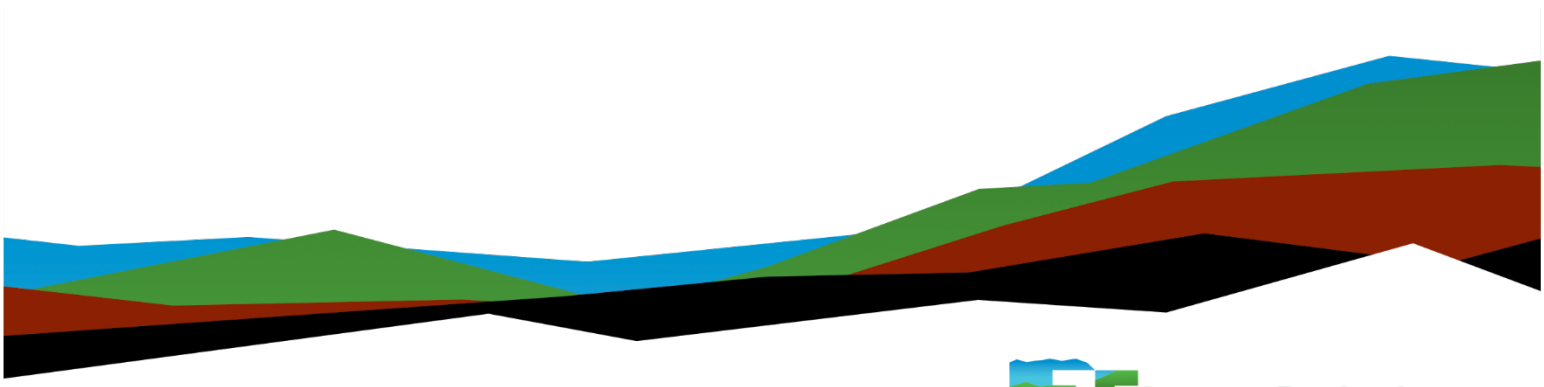
Parametrix

Albuquerque, New Mexico

Prepared by:

Terracon Consultants, Inc.

Albuquerque, New Mexico



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May 2, 2024

Parametrix
9600 San Mateo Boulevard NE
Albuquerque, New Mexico 87113

Attn: Ms. Stephanie Miller
P: (720) 412-6646
E: SMiller@parametrix.com

Re: Geotechnical Scoping Report
Phase IA/B Corridor Study
I-40 Arizona state Line to Atrisco Vista Boulevard
CN 6101580
McKinley, Cibola, and Bernalillo Counties, New Mexico
Terracon Project No. P66215219 Revision No. 1

Dear Ms. Miller:

Terracon Consultants, Inc. (Terracon) has completed the Geotechnical Scoping Report for the above referenced project. These services were performed in general accordance with our Proposal Number P66215219 dated January 28, 2022 and Parametrix Subconsultant Agreement for Professional Services dated May 4, 2022. This geotechnical report presents the results of the literature research, review of as-built plans, review of Terracon's geotechnical data, site reconnaissance, and provides preliminary geotechnical information and recommendations concerning the evaluation and conceptual and preliminary design of the geotechnical-related phases of the project.

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 Consultants, Inc.

For Stenson D. Lee
Staff Engineer

Michael E. Anderson, P.E.
Principal

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EXECUTIVE SUMMARY

This geotechnical executive summary should be used in conjunction with the entire report for conceptual and preliminary design purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

A geologic and geotechnical literature search, review of as-built plans, and site reconnaissance have been performed and a Geotechnical Scoping Report prepared for the I-40 AZ State Line to Atrisco Vista Boulevard corridor study project CN 6101580, located in McKinley, Cibola, and Bernalillo Counties, New Mexico. Based on the information obtained from our literature search and site reconnaissance, it is our opinion that the project is suitable for the planned improvements. The following geotechnical considerations were identified:

Site Soils and Bedrock: The site surface and subsurface conditions will likely consist of interbedded clays, silts, sands, and gravels in alluvial and piedmont deposits. Bedrock is anticipated to be encountered at depths as shallow as 1 foot to greater than about 100 feet below existing site grade. The surface and shallow subsurface soils at the project site will likely exhibit a tendency for low to moderate compression and/or none to low expansion with increasing load and when elevated in moisture content. We anticipate the shallow soils will exhibit low to moderate bearing capacity. The deeper soils and bedrock are anticipated to exhibit moderate to high load bearing capability. The shallow soils may be recompacted to increase bearing capacity and reduce settlement. It is our opinion that the soils will have very poor to good quality pavement support characteristics.

Groundwater: Groundwater along most of the project alignment is anticipated to be encountered at depths greater than about 50 to 100 feet below existing site grade, excluding areas located within and adjacent to existing drainages. Regional groundwater is anticipated to have significant seasonal variations and may be encountered at depths near the ground surface when drainages, arroyos, and irrigation canals are flowing. In addition, due the relatively shallow clays and bedrock along most of the project alignment, development of perched groundwater conditions is likely with seasonal variations.

Construction and Excavation: On-site well/poorly graded sands and silty sands and gravels are anticipated to be suitable for use as structural backfill beneath the bridge structures, wingwalls, MSE or cast-in-place retaining walls, and pavements. On-site clays (if encountered) will not be suitable for use as structural backfill. Shallow excavations into the on-site soils are expected to be accomplished with conventional earthwork equipment. Caving soils should be anticipated due to loose, granular soil conditions. Dense to very dense gravels or very hard bedrock may be encountered and may require additional effort, heavy-duty, and/or specialized equipment for excavation and deep foundation construction/installation. Rock excavation will likely be needed during construction/improvements along the central and western portions of the project alignment where strongly cemented sandstones and igneous basalt bedrock are exposed at the ground surface or exposed in existing highway cut slopes.

Slopes: For permanent slopes in compacted fill and cut areas with maximum heights of less than about 20 feet, recommended preliminary maximum configurations for on-site soils and bedrock materials range from 0.5:1 to 3:1 (horizontal: vertical).

Foundations: The bridge structures are anticipated to be supported on shallow footings/foundations or deep foundations consisting of driven piles or drilled shafts. Dense to very dense soils and gravel and very hard bedrock will likely impede pile driving installation and require pre-drilling for installation. Very hard bedrock will likely impact drilled shaft construction and require specialized equipment and tooling for installation. Supporting the bridge structures on footings bearing on mechanically stabilized earth (MSE) abutments could also be considered depending upon the magnitude of long-term settlement/consolidation

of existing subsurface soils. The wing walls, cast-in-place retaining walls and other ancillary structures are anticipated to bear on shallow foundations bearing on native undisturbed soils or structural backfill.

Pavement: Based upon review of the 2021 and 2022 pavement data, the Pavement Condition Ratings (PCR) along I-40 indicated values range from to Very Poor to Very Good pavement condition. Overall, the PCR typically ranges from Fair to Very Good along the alignment of I-40. However, there are several areas of Very Poor to Poor pavement condition (PCR 0 to 45).

Per NMDOT, the suggested pavement treatment for a PCR of Very Poor (PCR 0 to 25) is pavement reconstruction. For a PCR rating of Poor (26 to 45), the NMDOT suggested pavement treatment consists of major rehabilitation. However, due to the time frame that will likely occur for start of new construction projects along the I-40 corridor, and the further deterioration of the pavements addressed in NMDOT's 2022 and 2023 Pavement Condition Assessment Reports (PCARs), consideration should also be given to reconstruction in areas currently identified as Poor (PCR = 26 to 45) pavement condition rating. Rehabilitation measures would generally be considered applicable for areas exhibiting PCR ranging from At Risk to Fair (PCR 46 to 65) at the time of future evaluation.

Pavement reconstruction recommendations are based on NMDOT's *Pavement Condition Assessment Report* (PCAR) dated September 26, 2023. For purposes of this analysis:

Reconstruction Recommended
No = PCR of At Risk (PCR of 46) or higher
Probable = PCR of 26 to 45
Yes [1] = PCR of 0 to 25
1. Includes PCRs at the boundary of Very Poor and Poor

For areas identified as requiring Probable Reconstruction, these areas fall into the Poor PCR category and will likely deteriorate to Very Poor PCR category within a short (few years) period of time. Therefore, for budget, planning, and constructability purposes, the "Probable Reconstruction" areas should be considered and included in the total length of pavement reconstruction. As indicated from review of the data outlined in the two (2) Pavement Condition Assessment Reports performed within about a 1 year period, pavement conditions can change rapidly and recommendations need to be assessed regularly. The pavement recommendations do not reflect pavement rehabilitation that occurred after NMDOT's 2023 pavement assessment from MP 9.2 to 16, MP 89 to 95.5, and spot locations from MP 95.5 to MP 132 or other maintenance activities.

Based on a review of NMDOT's *Pavement Condition Assessment Report* from 2022 (based on 2021 data) and NMDOT's updated *Pavement Condition Assessment Report* from 2023 (based on 2022 data), the PCR values for the areas listed below substantially improved. It is assumed that pavement maintenance and rehabilitation may have occurred in these areas between 2021 and 2022:

- MP 89 to 90, Eastbound
- MP 97 to 98, Westbound
- MP 102 to MP 104, Eastbound and Westbound
- MP 139 to 141, Eastbound and Westbound

I-40 Westbound:

As summarized in the table below, pavement reconstruction (highlighted in red) or probable reconstruction (highlighted in orange) is recommended for approximately 39 miles of the existing I-40 mainline in the westbound direction.

I-40 Mainline Approximate Mile Post Interval Location	Direction (WB = Westbound)	Reconstruction Recommended
0 to 8	WB	No
8 to 12	**WB**	**Yes**
12 to 26	WB	No
26 to 27	WB	Probable
27 to 30	WB	No
30 to 31	WB	Probable
31 to 38	WB	No
38 to 39	WB	Probable
39 to 50	WB	No
50 to 51	WB	Probable
51 to 56	WB	No
56 to 57	**WB**	**Yes**
57 to 58	WB	Probable
58 to 66	WB	No
66 to 67	WB	Probable
67 to 78	WB	No
78 to 80	WB	Probable
80 to 81	**WB**	**Yes**
81 to 92	WB	No
92 to 93	WB	Probable
93 to 95	WB	No
95 to 96	WB	Probable

I-40 Mainline Approximate Mile Post Interval Location	Direction (WB = Westbound)	Reconstruction Recommended
96 to 105	WB	No
105 to 106	**WB**	**Yes**
106 to 109	WB	Probable
109 to 116	WB	No
116 to 118	WB	Probable
118 to 119	**WB**	**Yes**
119 to 124	WB	Probable
124 to 125	**WB**	**Yes**
125 to 132	WB	Probable
132 to 136	WB	No
136 to 138	WB	Probable
138 to 148	WB	No
148 to 149	**WB**	**Yes**
149 to 150	WB	No

I-40 Eastbound:

As summarized in the table below, pavement reconstruction (highlighted in red) or probable reconstruction (highlighted in orange) is recommended for approximately 36 miles of the existing I-40 mainline in the eastbound direction.

I-40 Mainline Approximate Mile Post Interval Location	Direction (EB = Eastbound)	Reconstruction Recommended
0 to 8	EB	No
8 to 12	**EB**	**Yes**
12 to 26	EB	No
26 to 27	EB	Probable
27 to 54	EB	No
54 to 55	**EB**	**Yes**
55 to 56	EB	No

I-40 Mainline Approximate Mile Post Interval Location	Direction (EB = Eastbound)	Reconstruction Recommended
56 to 57	EB	Probable
57 to 61	EB	No
61 to 63	EB	Probable
63 to 82	EB	No
82 to 85	EB	Probable
85 to 93	EB	No
93 to 94	**EB**	**Yes**
94 to 99	EB	No
99 to 100	**EB**	**Yes**
100 to 106	EB	No
106 to 107	**EB**	**Yes**
107 to 116	EB	No
116 to 119	EB	Probable
119 to 122	**EB**	**Yes**
122 to 124	EB	Probable
124 to 126	**EB**	**Yes**
126 to 131	EB	Probable
131 to 132	**EB**	**Yes**
132 to 137	EB	Probable
137 to 150	EB	No

I-40 Frontage Roads:

As summarized in the table below, probable reconstruction (highlighted in red) is recommended for approximately 9 miles of the existing I-40 frontage roads based on areas identified with poor observed pavement condition based on a field reconnaissance conducted in 2022. More detailed analysis is recommended to confirm these field observations.

I-40 Frontage Roads/Ramps Approximate Mile Post Interval Location	Reconstruction Recommended
0 to 4	No
4 to 8	No
8 to 9	Probable
9 to 12	Probable
12 to 24.5	No
24.5 to 25	No
25 to 30	Probable
30 to 37	No
47 to 56	No
56 to 65	No
65 to 80	No
80 to 90	No
90 to 96	No
96 to 105	No
105 to 114.5	No
141 to 150	No

Refer to report for detailed information.

The anticipated new pavement thickness along the project corridor will be based upon the subgrade materials and traffic types and volumes along the project alignment. Thicker pavement sections will be associated with poorer quality subgrades associated with clays (A-6 to A-7) along the project alignment. Thinner pavement sections will be associated with higher quality subgrades associated with well/poorly graded to silty sands and gravels (A-1 to A-4). In areas of very poor to poor quality subgrade soils, chemical stabilization, mechanical stabilization, geogrid, and/or replacement with higher quality subgrade soils should be considered to reduce pavement section thickness, enhance long-term pavement performance, and reduce pavement maintenance. The preliminary recommended new pavement sections have been included in this report.

Terracon should be retained to provide supplemental geotechnical services and review the preliminary design plans and specifications, so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the preliminary design and specifications.

GEOTECHNICAL SCOPING REPORT
PHASE I-A/B CORRIDOR STUDY
AZ STATE LINE TO ATRISCO VISTA BOULEVARD
MP 0 to 150
CN 6101580
MCKINLEY, CIBOLA, AND BERNALILLO COUNTIES, NEW MEXICO

Terracon Project No. 66215219 Revision No. 1
May 2, 2024, 2024

1.0 INTRODUCTION

This report presents the results of our geotechnical scoping report performed as part of the Phase 1-A/B Corridor Study, CN 6101580, located in McKinley, Cibola, and Bernalillo Counties, New Mexico. The report addresses the following:

- Geologic conditions
- Existing pavement section thickness
- Existing pavement condition and observations
- Subsurface soil and/or bedrock conditions
- Excavation difficulties
- Existing structure information
- Groundwater conditions/levels
- Geologic and geotechnical conditions that could impact the proposed alignment and proposed structures
- Possible impacts, effects, and possible mitigation measures associated with improvements within the project area
- Earthwork and slopes
- Preliminary foundation design and construction considerations
- Pavement considerations
- Pavement reconstruction and/or rehabilitation recommendations
- Preliminary new pavement design and construction considerations
- Subgrade stabilization
- Fill embankment settlement
- Concrete and metal corrosion
- Seismic considerations and AASHTO Site Classification
- Erosion and scour

The scope of the work performed for this project included site reconnaissance by a Terracon geotechnical engineer, a search of available geologic literature, review of as-built plans, and review of geotechnical data from previous projects performed by Terracon within or near the project alignment area.

2.0 PROJECT INFORMATION

2.1 Site Location and Description

ITEM	DESCRIPTION
Location	The project alignment is along I-40 and located between the AZ State Line starting at McKinley County and MP 0.0 and extending eastward through Cibola County, New Mexico to the Atrisco Vista Boulevard Interchange in Bernalillo County, New Mexico. The corridor study also includes evaluating the existing frontage roads that run parallel to I-40 along portions of the existing corridor.
Existing Improvements	The project alignment along I-40 consists of a 4-lane divided highway with varying types and degrees of development along the corridor. Most of the corridor has lane widths of about 12 feet, with inside shoulders varying between 4 to 8 feet in width and outside shoulders varying from about 6 to 12 feet in width. A frontage road system exists along portions of the existing corridor.
Length of Study Area/Improvements	150 miles
Major Structures	Several major structures are located along the project corridor and consist of the following: ■ 154 bridges including 54 concrete box culverts ■ Hundreds of drainage culverts
Current Ground Cover	Primarily asphalt and/or Portland cement concrete pavement with adjacent soil and vegetation outside paved areas of the existing corridor
Existing Traffic Volumes	NMDOT's RFP No. 22-12 dated October 2021 reports the following estimated average daily volumes in the study area. ■ AZ State Line: 20,000 vehicles per day (VPD) ■ Gallup, NM: 28,000 VPD ■ East of Gallup, NM: 13,000 to 26,000 VPD ■ Near Atrisco Vista Boulevard: 29,000 VPD ■ Frontage Roads:400 to 5,000 VPD

ITEM	DESCRIPTION
I-40 Traffic Data (NMDOT 2019 ESAL Data)	Daily Equivalent Single Axle Loads (ESAL): ■ I-40: 2,215 to 2,890 ■ Frontage Road:140 to 310 Up to about 30% truck traffic along the I-40 project corridor

2.2 Project Description

ITEM	DESCRIPTION
Structures/Improvements	At this time, project information is preliminary and proposed alternatives may consist of the following improvements: ■ Pavement reconstruction ■ Pavement rehabilitation ■ Pavement widening ■ Bridge widening or new construction ■ New drainage structures ■ ITS improvements ■ Safety improvements ■ Miscellaneous (striping, signing, etc.)
Anticipated Bridge Foundations/Support	■ Spread footings ■ Spread footings on MSE Abutments ■ Driven piles ■ Drilled shafts
Cut and Fill Slopes (assumed)	■ Cut and fill embankment slopes may be needed for new embankment construction in some bridge approaches and highway/frontage roads ■ 2:1 to 6:1 (Horizontal: Vertical)
Rock Excavation	Rock excavation is anticipated to be encountered in basalt igneous bedrock and very hard strongly cemented sedimentary bedrock along the central portion of the project alignment.
Pavement Wearing Surface (assumed)	■ Asphalt concrete ■ Portland cement concrete
Subgrade Stabilization	Chemical and/or mechanical stabilization may be required in poor quality subgrade areas
Shallow Groundwater	Shallow groundwater conditions are anticipated to be encountered within and adjacent to existing arroyos and drainages

ITEM	DESCRIPTION
Specifications	■ 2020 AASHTO LRFD – 9th Edition ■ 2020 NMDOT Design Manual ■ 2019 NMDOT Standard Specifications for Highway and Bridge Construction or most current edition

3.0 GEOLOGIC CONDITIONS

3.1 Regional Geology

3.1.1 Majority of Project Alignment

The project lies along the central portion of the Western Highlands geologic province located in western New Mexico. The Western Highlands consists of the Colorado Plateau (dominant feature includes the San Juan Basin), the Datil-Mogollon volcanic highlands and a part of the Basin and Range region in the south. The area is characterized by uplifts resulting in faulting, monoclines, and anticlines along with volcanic flows, cinder cones and necks [1].

This segment of the project alignment area is comprised predominantly of Paleozoic to Cretaceous age sedimentary bedrock underlain by Precambrian age igneous granite and metamorphic schist and gneiss bedrock.

3.1.2 Far Eastern End of Project Alignment

The project area is located in an area known locally as the "west mesa". This area constitutes a series of cut terraces which parallel the Rio Grande River on its west side, and a broad upland surface about 600 feet above the river which borders the terraces on the west. The "west mesa" was formed by upfaulted blocks which constitute the highlands of the Rio Puerco and much of the Rio Puerco Valley. The Rio Grande Valley in Albuquerque is a small part of an interconnected series of north-south aligned grabens and structural basins which have subsided between mountain and highland uplifts comprising the Rio Grande rift.

The soils on the "west mesa" were deposited as eolian dune sand, piedmont, and alluvial fan processes, and recent arroyo deposits. Basalt flows are also present. Older sediments of the Santa Fe Group can be found beneath the more recent materials.

[1] Halka Chronic. “Roadside Geology of New Mexico.” Mountain Press Publishing Company, Missoula, 1987.

3.2 Project Alignment Geology

Geologic conditions along the project alignment are consistent with the regional geology. In general, sedimentary and igneous bedrock have been mapped along most of the project alignment, with soils from various depositional processes mapped along the far eastern portion of the project alignment, along and adjacent to existing drainages, and at the ground surface along most of the project alignment.

The surficial geologic formations at or near the project alignment along with the descending geologic age are comprised of the following [2]:

- **Qa: Alluvium** (Holocene to Upper Pleistocene) - Fine to coarse grained unconsolidated sand, gravel, silt and clay
- **Ql: Landslide Deposits and Colluvium Deposits** (Holocene to Pleistocene) – Fine to very coarse grained unconsolidated sand, gravel, silt and clay
- **Qp: Piedmont Alluvial Deposits** (Holocene to Lower Pleistocene) - Fine to coarse grained unconsolidated sand, gravel, silt and clay located along higher gradient tributaries, major stream valleys, alluvial fans, and alluvial slopes
- **Qe: Eolian Deposits** (Holocene to Middle Pleistocene) – Fine grained, well sorted wind-blown sands.
- **Qoa: Older Alluvial deposits** (Middle to Lower Pleistocene) - Fine to coarse grained unconsolidated sand, gravel, silt and clay located on upland plains and piedmont areas.
- **Qtb: Basalt to Andesitic Lava Flows** (Upper Pleistocene to Lower Pliocene) – Igneous bedrock
- **Qts: Santa Fe Group** (Middle Pleistocene to Upper Oligocene) - Fine to coarse grained sand silts, and clays with varying degress of cementation
- **Tsf: Lower Santa Fe Group** (Middle Miocene to Upper Oligocene) - Fine to coarse grained sand silts, and clays with varying degress of cementation
- **Tpb: Basalt to Andesitic Lava Flows** (Pliocene) – Extrusive igneous bedrock
- **Tim: Tertiary Mafic Volcanic Basaltic and Andesitic Rock** (Pliocene) – Includes dikes, sills, and necks – Intrusive igneous bedrock
- **Ku: Upper Cretaceous Rocks of SW NM, Undivided** (Maastrictian to Cenomanian) – Sedimentary bedrock comprised of sandstone, siltstone, claystone, mudstone, shale, coal, and limestone

[2] New Mexico Bureau of Geology and Mineral Resources, Peter A. Scholle, State Geologist. "Geologic Map of New Mexico." 2003.

- **Kmv: Mesa Verde Group** (Campanian to Turonian) – Sedimentary bedrock comprised of sandstone, mudstone, shale, and some coal bearing members
- **Kcc: Crevasse Canyon Formation** (Santonian to Coniacian) – Sedimentary bedrock comprised predominantly of sandstone with some mudstone, shale, and coal bearing members
- **Kg: Gallup Sandstone** (Turonian) – Sedimentary bedrock comprised predominantly of sandstone.
- **Kmr: Rio Salado Tongue of the Mancos Shale** (Turonian) – Sedimentary bedrock comprised predominantly of limestone and shale with some sandstone and mudstone bearing members
- **Kml: Mancos Shale, Lower Part,** (Turonian and Coniacian) – Sedimentary bedrock comprised predominantly of shale and mudstone with some limestone bearing members
- **Kmd: Intertongued Mancos Shale and Dakota Sandstone of West Central NM** (Cenomanian) – Sedimentary bedrock comprised shale and sandstone with some mudstone bearing members
- **Kd: Dakota Sandstone** (Cenomanian) – Sedimentary bedrock comprised predominantly of sandstone.
- **J: Upper and Middle Jurassic Rocks, Undivided** – Sedimentary bedrock comprised of sandstone, mudstone, limestone, and siltstone
- **Jm: Morrison Formation** (Upper Jurassic) – Sedimentary (non-marine) bedrock comprised of sandstone and shale with some mudstone and limestone members
- **Jze: Zuni and Entrada Sandstone, undivided** (Callovian) – Sedimentary bedrock comprised predominantly of sandstone.
- **Jsr: San Rafel Group** (Middle Jurassic) – Sedimentary bedrock comprised of limestone, dolomite with some shale, mudstone, and chert members
- **Trc: Chinle Group** (Upper Triassic) – Sedimentary bedrock comprised of conglomerate, mudstone, and sandstone with some limestone members
- **P: Permian Rocks, Undivided** – Sedimentary bedrock comprised of limestone, dolomite, anhydrite, siltstone, sandstone, and shale
- **Psg: San Andres Formation** (Guadalupian and Leonardian) – Sedimentary bedrock comprised of limestone and dolomite with some mudstone, shale, and chert members

A geologic map and descriptions of the geologic units are included in Appendix A.

Descriptions of the geologic units on a Google.kmz file from the United States Geological Survey USGS can be found on the following web site:

https://mrdata.usgs.gov/geology/state/state.php?state=NM

Review of geologic information from the U.S. Geological Survey Quaternary Faults database for the United States, accessed October 12, 2022, from the USGS web site (https://www.usgs.gov/programs/earthquake-hazards/faults) indicates that there are several faults located at the east end of the project alignment at or near the Atrisco Vista Boulevard interchange. The Quaternary Fault Map is included in Appendix A.

3.3 Project Alignment Pavement Conditions

3.3.1 As-Built Pavement Information and Construction Plans

Based upon review of existing NMDOT Pavement and construction plans, a summary of existing pavement information along I-40 is outlined below:

Approximate Mile Post Interval Location	Asphalt [1] Concrete (in.)	Portland Cement Concrete (in.)	Untreated Base Course (in.)	Cement Treated Base Course (in.)	Lime/Cement Treated Subgrade (in.)	Geotextile/ Geogrid
0 to 7.9	3.5 [2]	-	-	-	-	-
0 to 7	9	-	8	-	8	-
4 to 9	-	8	4	4	-	-
8 to 12	12	-	9	-	12	-
12 to 17	14	-	9	-	12	-
15.5 to 18.5	-	11	8 [3]	-	12	-
18 to 22 [4]	6-9	6.5-7	-	-	-	-
17.5 to 20	11	-	11	-	-	-
21 to 22	13.5	-	6	-	-	X
24.5 to 30	9-13	-	-	4	4 [5]	-
30 to 35	12	8 [6]	15	-	-	-
34 to 40	12	-	12	-	-	-

Approximate Mile Post Interval Location	Asphalt [1] Concrete (in.)	Portland Cement Concrete (in.)	Untreated Base Course (in.)	Cement Treated Base Course (in.)	Lime/Cement Treated Subgrade (in.)	Geotextile/ Geogrid
35 to 38	14-25	-	4-29	-	-	X [7]
36.5 to 37	8	-	9.5	-	-	-
47 to 50.5	10.5	-	7	-	-	-
47 to 54	10	-	13.5	-	-	X
52.5 to 74	10.5	-	6	-	12	-
63 to 69	3.5 [2]	-	-	-	-	-
85 to 92	13	-	6	7	-	-
88.5 to 100	10	-	10	-	-	-
91 to 96	11	-	11	-	-	-
93 to 97	11	-	11	-	-	X
96 to 96.5	14	-	8	-	-	-
104 to 108.5	11	-	12	-	-	-
103.5 to 104	12	-	12	-	-	-
104 to 105.5	12	-	12	-	-	-
117 to 122	10.5	-	20	4	-	-
122.5 to 126.5	12	-	6	-	-	X
126.5 to 132	10.5	-	9.5	4	-	X [7]
132 to 139	18	-	-	-	-	-
139 to 140.5	12	-	8	-	-	-
140 to 141	8	-	19	-	-	-
147 to 150	10	-	6	-	-	-

Approximate Mile Post Interval Location	Asphalt [1] Concrete (in.)	Portland Cement Concrete (in.)	Untreated Base Course (in.)	Cement Treated Base Course (in.)	Lime/Cement Treated Subgrade (in.)	Geotextile/ Geogrid

1. Excludes open graded friction course (OGFC) typically 5/8 inch thick
2. No existing pavement section data. Pavement rehabilitation performed.
3. Includes asphalt treated base course
4. No base course or subgrade data below pavement
5. Subbase/select material
6. At some locations - 6 to 8 inches of asphalt overlay constructed in lieu of an asphalt and base course section
7. Used in alternative asphalt pavement section to reduce hot mix asphalt (HMA) and base course

3.3.2 Pavement Condition Assessment Reports

Two (2) NMDOT Pavement Condition Assessment Reports (PCARs) for CN 6101580, issued in 2022 and September 26, 2023, addresses the segment of I-40 from MP 0 to 150, were provided for our review. For the 2022 PCAR, the evaluation data was collected in 2021. For the 2023 PCAR, the evaluation data was collected in 2022.

The existing pavement conditions relative to the Pavement Condition Rating (PCR) from the 2023 PCAR report indicated values ranging from 10 to 87. These values correspond to PCR ranging from Very Poor to Very Good. The PCRs are summarized below:

RATING	PAVEMENT CONDITION
86-100	Very Good
66-85	Good
51-65	Fair
46-50	At Risk
26-45	Poor
0-25	Very Poor

The PCR and respective condition categories are summarized below (Very Poor to Poor PCR highlighted in red):

I-40 Westbound:

I-40 Mainline Approximate Mile Post Interval Location	Direction WB [1]	Approximate Pavement Condition Rating (PCR) Range	PCR Rating Category [2]
0 to 8	WB	53 to 87	Fair to Very Good
8 to 12	**WB**	**18 to 45**	**Very Poor to Poor**
12 to 26	WB	45 to 86	Fair to Good
26 to 27	WB	**32** to 86	**Poor** to Very Good
27 to 30	WB	46 to 87	Fair to Very Good
30 to 31	WB	**36** to 75	**Poor** to Good
31 to 38	WB	49 to 87	At Risk to Very Good
38 to 39	WB	**36** to 87	**Poor** to Very Good
39 to 50	WB	54 to 87	Fair to Very Good
50 to 51	WB	**43** to 73	**Poor** to Good
51 to 56	WB	46 to 87	At Risk to Very Good
56 to 57	**WB**	**20 to 33**	**Very Poor to Poor**
57 to 58	WB	**32** to 62	**Poor** to Fair
58 to 66	WB	53 to 87	Fair to Very Good
66 to 67	WB	**32** to 72	**Poor** to Good
67 to 78	WB	46 to 87	At Risk to Very Good
78 to 80	WB	**43** to 68	**Poor** to Good
80 to 81	**WB**	**25 to 32**	**Very Poor to Poor**
81 to 92	WB	50 to 87	At Risk to Very Good
92 to 93	WB	**40** to 86	**Poor** to Very Good
93 to 95	WB	53 to 76	Fair to Good
95 to 96	WB	**44** to 66	**Poor** to Good
96 to 105	WB	46 to 87	At Risk to Very Good
105 to 106	**WB**	**20 to 26**	**Very Poor to Poor**

I-40 Mainline Approximate Mile Post Interval Location	Direction WB [1]	Approximate Pavement Condition Rating (PCR) Range	PCR Rating Category [2]
106 to 109	WB	42 to 87	Poor to Very Good
109 to 116	WB	64 to 87	Fair to Very Good
116 to 118	WB	30 to 82	Poor to Good
118 to 119	**WB**	**13 to 40**	**Very Poor to Poor**
119 to 124	WB	30 to 86	Poor to Very Good
124 to 125	**WB**	**25 to 42**	**Very Poor to Poor**
125 to 132	WB	30 to 86	Poor to Very Good
132 to 136	WB	50 to 86	At-Risk to Very Good
136 to 138	WB	39 to 87	Poor to Very Good
138 to 148	WB	59 to 87	Fair to Very Good
148 to 149	**WB**	**25 to 29**	**Very Poor to Poor**
149 to 150	WB	86 to 87	Very Good

1. WB = Westbound
2. 86-100 = Very Good
   66-85 = Good
   51-65 = Fair
   46-50 = At Risk
   26-45 = Poor
   0-25 = Very Poor

I-40 Eastbound:

I-40 Mainline Approximate Mile Post Interval Location	Direction EB [1]	Approximate Pavement Condition Rating (PCR) Range	PCR Rating Category [2]
0 to 8	EB	55 to 87	Fair to Very Good
8 to 12	**EB**	**10 to 41**	**Very Poor to Poor**
12 to 26	EB	46 to 87	At Risk to Very Good

I-40 Mainline Approximate Mile Post Interval Location	Direction EB [1]	Approximate Pavement Condition Rating (PCR) Range	PCR Rating Category [2]
26 to 27	EB	35 to 87	Poor to Very Good
27 to 54	EB	46 to 87	At Risk to Very Good
54 to 55	EB	26 to 37	Poor
55 to 56	EB	46 to 87	At Risk to Very Good
56 to 57	EB	42 to 87	Poor to Very Good
57 to 61	EB	53 to 87	Fair to Very Good
61 to 63	EB	33 to 60	Poor to Fair
63 to 82	EB	46 to 87	At-Risk to Very Good
82 to 85	EB	37 to 87	Poor to Very Good
85 to 93	EB	52 to 87	Fair to Very Good
93 to 94	EB	18 to 53	Very Poor to Fair
94 to 99	EB	50 to 84	At Risk to Good
99 to 100	EB	14 to 55	Very Poor to Fair
100 to 106	EB	48 to 86	At Risk to Very Good
106 to 107	EB	24 to 55	Very Poor to Fair
107 to 116	EB	54 to 87	Fair to Very Good
116 to 119	EB	32 to 86	Very Poor to Very Good
119 to 122	EB	18 to 86	Very Poor to At Risk
122 to 124	EB	26 to 84	Very Poor to Good
124 to 126	EB	25 to 48	Poor to At Risk
126 to 131	EB	32 to 58	Poor to Fair
131 to 132	EB	22 to 34	Very Poor to Poor
132 to 137	EB	38 to 62	Poor to Fair
137 to 150	EB	46 to 87	At Risk to Very Good

I-40 Mainline Approximate Mile Post Interval Location	Direction EB [1]	Approximate Pavement Condition Rating (PCR) Range	PCR Rating Category [2]

1. EB = Eastbound
2. 86-100 = Very Good
   66-85 = Good
   51-65 = Fair
   46-50 = At Risk
   26-45 = Poor
   0-25 = Very Poor

A PCAR report was not available for adjacent frontage roads. Therefore,Terracon personnel performed visual observations of the designated frontage roads from MP 0 to 150 on August 31, 2022. The results of our visual observations of the pavement conditions (Poor areas are highlighted in red) along the existing frontage roads are outlined below.:

I-40 Frontage Roads:

Frontage Roads	
Approximate Mile Post Interval Location	**Observed Existing Pavement Condition [1,2]**
0 to 4	Fair to Good
4 to 8	Good
8 to 9	**Poor** to Good
9 to 12	**Poor** to Good
12 to 24.5	Fair to Good
24.5 to 25	Fair to Good
25 to 30	**Poor** to Fair
30 to 37	Fair to Good
47 to 56	Fair
56 to 65	Fair to Good
65 to 80	Fair to Good
80 to 90	Fair
90 to 96	Fair to Good

Frontage Roads	
Approximate Mile Post Interval Location	**Observed Existing Pavement Condition [1,2]**
96 to 105	Fair to Good
105 to 114.5	Fair to Good
141 to 150	Good

1. Pavement Condition based upon a qualitative estimated PCR from the observed distress
2. 86-100 = Very Good
   66-85 = Good
   51-65 = Fair
   46-50 = At Risk
   26-45 = Poor
   0-25 = Very Poor

3.3.3 Site Reconnaissance and Pavement Condition

To supplement the PCARs generated by NMDOT for I-40, site reconnaissance of the existing pavement conditions along the project alignment was performed by Terracon personnel during the period from August 31 to September 26, 2002.

The site reconnaissance was performed along the I-40 mainline alignment as part of this current study and the designated frontage roads that are being evaluated for emergency use and detouring included in this study.

At selected representative locations along the project alignment, the existing pavement conditions were documented and photographed. The pavement conditions were documented and categorized in general accordance with “Distress Identification Manual for the Long-Term Pavement Performance Program”, Publication No. FHWA-HRT-13-092 Revised My 2014 by the US Department of Transportation, Federal Highway Administration and “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys” ASTM D6433.

The overall pavement conditions along the I-40 mainline and frontage roads were observed to range fair to very good, with very poor to poor pavement conditions encountered at relatively limited areas along the project alignment.

In general, the very good pavement conditions were associated with newer pavement construction and/or recent pavement rehabilitation (mill/inlay) operations. The very poor to poor pavement conditions were typically associated with older pavements and areas of moderate to high severity structural distress.

Outlined below are representative photographs of the typical very poor to fair pavement conditions along I-40 and the designated frontage roads as part of this study.

I-40 mainline:

Photo 1: MP 10 - Looking West at WB Lane of I-40
Moderate severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low severity weathering and oxidation along shoulder

Photo 2: MP 23 - Looking SW along I-40
Low to moderate severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low to moderate severity transverse cracking, longitudinal cracking, weathering, raveling, and oxidation along shoulder

Photo 3: MP 38 - Looking SW along I-40
Recent OGFC/overlay. Low severity longitudinal cracking. Low to moderate severity weathering and oxidation along shoulder

Photo 4: MP 58 - Looking SW along I-40
Low severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low to moderate severity transverse cracking, weathering, raveling, and oxidation along shoulder

Photo 5: MP 84 - Looking W along I-40
Low severity lifting/stripping of OGFC/overlay. Low severity longitudinal and transverse cracking. Low to moderate severity weathering, raveling, and oxidation along shoulder

Photo 6: MP 104.5 - Looking NW along I-40
Low to moderate severity patching. Low to moderate severity lifting/stripping of OGFC/overlay, longitudinal, and transverse cracking. Low to moderate severity weathering and oxidation along shoulder

Photo 7: MP 126 - Looking SW along I-40
Low severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low to moderate severity longitudinal cracking, transverse cracking, weathering, oxidation along shoulder

Photo 8: MP 138 - Looking SW along I-40
Low severity longitudinal and transverse cracking. Low to moderate severity weathering, raveling, and oxidation along shoulder. Crack filling performed.

Photo 9: MP 149 - Looking SW along I-40
Low severity longitudinal, block, and transverse cracking. Low to moderate severity weathering, raveling, and oxidation along shoulder

I-40 Frontage Roads:

Photo 10: MP 7.5 - Looking W along Frontage Road
Low severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low severity weathering, oxidation, and raveling.

Photo 11: MP 18 - Looking SW along Frontage Road/Old Route 66
Low to moderate severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low severity weathering, oxidation, and raveling.

Photo 12: MP 28 - Looking W along Frontage Road
Low to moderate severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal, block, and transverse cracking. Low to moderate severity patching. Low severity weathering, oxidation, and raveling.

Photo 13: MP 33.5 - Looking W along Frontage Road
Low to moderate depressions/poor drainage. Low to moderate severity longitudinal, block, and transverse cracking. Low to moderate severity weathering, oxidation, and raveling.

Photo 14: MP 52.5 - Looking W along Frontage Road
Low severity lifting/stripping of OGFC/overlay. Low to moderate severity longitudinal and transverse cracking. Low to moderate severity weathering, oxidation, and raveling.

Photo 15: MP 80 - Looking W along Frontage Road
Low severity longitudinal and transverse cracking. Low severity patching. Low severity weathering, oxidation, and raveling.

Photo 16: MP 90 - Looking W along Frontage Road
High severity lifting/stripping of OGFC/overlay. Low severity bleeding. Low to moderate severity longitudinal and transverse cracking. Low severity weathering, oxidation, and raveling. Crack filling performed.

4.0 SUBSURFACE CONDITIONS

4.1 Typical Subsurface Profile

Based upon review of available geologic maps, geotechnical data, and as-built plans, a summary of the expected subsurface soil and/or bedrock conditions (excluding surficial pavement materials) along the project alignment is outlined below:

MP 0 to 4:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	5 to 10	Silt with varying amounts of sand and gravel	A-2-4 A-4	Medium Stiff to Hard
Stratum 2	50 to 80	Sand with varying amounts of silt and gravel	A-2-4 A-4	Loose to Medium Dense
Stratum 3	>100	Sandstone Sedimentary Bedrock	N/A	Firm to Very Hard

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and subsurface material types vary along project alignment. Deeper bedrock depths and shallow groundwater likely at or near drainages and arroyos.

MP 4 to 9:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	50 to 100	Silt and clay with varying amounts of sand and gravel	A-4 A-6 A-7-5 A-7-6	Very Soft to Stiff
Stratum 2	50 to 100	Sand with varying amounts of silt and gravel	A-2-4 A-4	Very Loose to Medium Dense
Stratum 3	>100	Sandstone Sedimentary Bedrock [2]	N/A	Weathered to Medium Hard

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and subsurface material types vary along project alignment. Deeper bedrock depths and shallow groundwater likely at or near drainages and arroyos.
2. Bedrock at relatively shallow depths and/or exposed in adjacent cuts in some areas. May be classified as "rock excavation" per NMDOT

MP 9 to 25:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	20 to 60	Clays and Silts with varying amounts of sand and gravel	A-6 A-7-5 A-7-6	Soft to Hard
Stratum 2	20 to 60	Sand with varying amounts of silt and gravel	A-2-4 A-4	Loose to Medium Dense
Stratum 3	>100	Claystone/Shale and Sandstone Sedimentary Bedrock [2]	N/A	Firm to Very Hard

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and subsurface material types vary along project alignment. Deeper bedrock depths and shallow groundwater likely at drainages and arroyos.
2. Bedrock at relatively shallow depths and/or exposed in adjacent cuts in some areas. May be classified as "rock excavation" per NMDOT

MP 25 to 65:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	30 to 60	Clays and Silts with varying amounts of sand and gravel	A-6 A-7-5 A-7-6	Soft to Very Stiff
Stratum 2	30 to 60	Sand with varying amounts of silt and gravel	A-2-4 A-4	Loose to Medium Dense

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 3	>100	Claystone/Shale and Sandstone Sedimentary Bedrock [2]	N/A	Weathered to Very Hard

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and subsurface material types vary along project alignment. Deeper bedrock depths and shallow groundwater likely at or near drainages and arroyos
2. Bedrock at relatively shallow depths and/or exposed in adjacent cuts in some areas. May be classified as "rock excavation" per NMDOT

MP 65 to 95:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	1 to 60	Clays and Silts with varying amounts of sand and gravel	A-6 A-7-5 A-7-6	Medium Stiff to Hard
Stratum 2	1 to 60	Sand with varying amounts of silt and gravel	A-2-4 A-4	Loose to Very Dense
Stratum 3	>100	Claystone/Shale and Sandstone Sedimentary Bedrock	N/A	Weathered to Very Hard
Stratum 4	>100	Basalt Igneous Bedrock [2]	N/A	Weathered to Very Hard

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and subsurface material types vary along project alignment. Deeper bedrock depths and shallow groundwater likely at or near drainages and arroyos
2. Bedrock typically at shallow depths or exposed at ground surface. Generally, classified as "rock excavation" per NMDOT

MP 95 to 142:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	10 to 60	Clays and Silts with varying amounts of sand and gravel	A-6 A-7-5 A-7-6	Medium Stiff to Hard
Stratum 2	10 to 60	Sand with varying amounts of silt and gravel	A-2-4 A-4	Loose to Very Dense
Stratum 3	>100	Claystone/Shale and Sandstone Sedimentary Bedrock	N/A	Weathered to Very Hard
Stratum 4	>100	Basalt Igneous Bedrock [2]	N/A	Weathered to Very Hard

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and can vary along project alignment. Deeper bedrock depths and shallow groundwater likely at or near drainages and arroyos
2. Bedrock typically classified as “rock excavation” per NMDOT

MP 142 to 150:

Description	Approximate Depth to Bottom of Stratum (feet) [1]	Expected Material Encountered	AASHTO Soil Classifications	Relative Density, Consistency, and Hardness
Stratum 1	>100	Silt and clays with varying amounts of sand and gravel	A-2-4 A-4 A-6	Medium Stiff to Very Stiff
Stratum 2	>100	Sand with varying amounts of silt and gravel	A-2-4 A-4	Loose to Medium Dense

1. Based upon review of available limited geotechnical data along and near the project alignment. Approximate range and subsurface material types vary along project alignment. Deeper bedrock depths and shallow groundwater likely at or near drainages and arroyos

4.2 Shallow Bedrock and Rock Excavation

Rock excavation as defined by NMDOT will likely be required during construction for improvements along the central and western portions of the I-40 corridor where strongly cemented

sandstones and igneous basalt bedrock are exposed at the ground surface or exposed in existing highway cut slopes.

Based upon review of geologic, as-built plans, and geotechnical reports, areas along the existing I-40 alignment that currently exhibit exposed bedrock cut slopes or areas anticipated to encounter shallow bedrock during construction are outlined below:

Approximate MP Location	Bedrock Type	Exposed in Cut Slopes	Anticipated To Be Defined as Rock Excavation Per NMDOT
5 to 6	Sandstone	Yes	Possible
9 to 11	Sandstone	Yes	Possible
12.5 to 13	Sandstone/Shale	Yes	Not Likely
14.5 to 15	Sandstone	Yes	Possible
18 to 19	Sandstone/Shale	Yes	Not Likely
29 to 30	Sandstone/Shale	Yes	Not Likely
65 to 66	Sandstone/Shale	Yes	Not Likely
76 to 77	Sandstone	Yes	Possible
81 to 90 91 to 94	Basalt	Yes	Yes
103.5 to 104.5	Sandstone	Yes	Possible
108.5 to 109.5	Sandstone	Yes	Possible
115 to 116	Sandstone	Yes	Possible
130 to 131	Sandstone	Yes	Possible

4.3 Typical Subsurface Engineering Properties

The surface and subsurface soils and/or bedrock conditions along the proposed project alignment are variable. A summary of the anticipated relative strength, bearing capacity, settlement/expansion potential, and roadbed quality is outlined below:

USCS Soil Classification	AASHTO Soil Classification	Estimated Relative Strength [1]	Estimated Bearing Capacity [1]	Estimated Settlement Potential [1]	Estimated Expansion Potential [1]	Estimated Roadbed Quality [2]
Clays (CL)	A-6	L-M	L-M	L	L	P-F

USCS Soil Classification	AASHTO Soil Classification	Estimated Relative Strength [1]	Estimated Bearing Capacity [1]	Estimated Settlement Potential [1]	Estimated Expansion Potential [1]	Estimated Roadbed Quality [2]
Clays (CH)	A-7-6	L	L	N-L	M-H	VP-P
Silts (ML)	A-4	L-M	L-M	L-M	N	P-F
Sands (SC)	A-6	L-M	L-M	L	L	P-F
Sands (SM)	A-2-4 A-4	L-M	L-M	L-M	N	F-G
Sands (SP)	A-1-b A-2-4	M	M	L	N	G

1. N= None: L = Low; M = Moderate; H=High
2. VP = Very Poor; P=Poor; F = Fair; G = Good

4.4 Structure Information

There are numerous major drainage, bridge, and retaining structures in project corridor. Based on our experience with these types of structures, project conditions, subsurface conditions, NMDOT preferences, and review of limited structures provided in as-built plans, we have included a summary matrix of expected foundation systems supporting existing structures along the project alignment:

Structure Type	Site Location Features	Anticipated Existing Foundation System	Anticipated Depth/Length of Foundation (feet)
Bridge	Drainage	Driven Steel of Timber Piles	50 to 100
	Outside Drainage	Shallow Strip/Spread Footings Driven Steel or Timber Piles Drilled Shafts	40 to 80
Retaining Wall [2]	Drainage	CIP – Deep Foundations	20 to 40
	Outside Drainage	MSE and CIP - Shallow Foundations	3 to 6
Major RCBC	Drainage	Mat/Slab or Subgrade	Below Scour Depth/ Scour Countermeasures

1. CIP = Cast-in-Place; MSE = Mechanically Stabilized Earth

4.5 Groundwater

Groundwater along most of the project alignment is anticipated to be encountered at depths greater than about 50 to 100 feet below existing site grade, excluding areas located within and adjacent to existing drainages[3]. Regional groundwater is anticipated to have significant seasonal variations and may be encountered at depths near the ground surface when drainages, arroyos, and irrigation canals are flowing. In addition, due the relatively shallow clays and bedrock along most of the project alignment, development of perched groundwater conditions is likely with seasonal variations.

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. Fluctuations in groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period.

5.0 PRELIMINARY RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

The geotechnical conditions anticipated to be along the project alignment are variable and appear to be suitable for the proposed improvements. The primary geological and geotechnical issues that could potentially negatively impact the proposed improvements along the existing alignment consist of the following:

- Loose/eolian deposits - low bearing and high settlement potential
- Medium to high plasticity clays - expansive and low strength potential
- Shallow very hard bedrock and rock excavation
- Differential bearing conditions
- Shallow groundwater located at or adjacent to existing drainages – liquefaction potential
- Very poor to poor roadbed/subgrade quality
- Subgrade stabilization – chemical or mechanical
- Settlement of high embankments
- Concrete and metal corrosion potential

[3] New Mexico Water Rights Reporting System, “Water Column Report” from New Mexico Office of State Engineer web site: http://nmwrrs.ose.state.nm.us/nmwrra/watrecolumn.html

The above outlined geotechnical conditions will require particular attention in the design and construction.

5.1 Preliminary Geotechnical Design and Construction Considerations

Preliminary geotechnical engineering recommendations for the preliminary design of earth connected phases of the project are outlined below. The preliminary recommendations contained in this report are based upon the results of our literature research, review of existing geotechnical reports, our experience along the project area, geotechnical field exploration laboratory testing, and our current understanding of the proposed project.

The surface and shallow subsurface soils along the project alignment site are variable and anticipated to possess relatively low to moderate strength soils and will likely exhibit a low to moderate tendency for compression and/or none to moderate expansion with increasing load and when elevated in moisture content. The shallow existing soils will likely exhibit low to moderate bearing capacity. The deeper soils will likely exhibit moderate to high bearing capability. Bedrock is anticipated to be encountered at relatively shallow depths along portions of the project alignment and at depths greater than 100 feet below existing site grade.

Based on the geological literature study, site reconnaissance, review of existing reports, and our experience along the project alignment, the proposed bridge structures are anticipated to be supported on shallow foundations or deep foundations consisting of drilled shafts or driven piles. The wing walls, cast-in-place retaining walls, MSE walls, and other ancillary structures are anticipated to bear on shallow foundations bearing on undisturbed native soils or structural backfill.

The anticipated pavement thickness along I-40 and adjacent frontage roads will be based upon the subgrade materials and traffic types and volumes along the project alignment. It is our opinion that the subgrade soils exhibit very poor (clays) to good (sands) pavement support characteristics.

On-site poorly graded and silty sands are anticipated to be suitable for use as structural backfill beneath bridge footings, wingwalls, cast-in-place retaining walls, MSE walls and drainage structures. On-site clay and silt soils are not considered suitable for use as structural backfill. Shallow excavations into the on-site soils are expected to be accomplished with conventional earthwork equipment. Caving soils should be anticipated due to loose and granular soils. Dense to very dense soils with large gravels or cobbles may be encountered along the project alignment and require heavy-duty or specialized equipment. Very hard cemented sedimentary and igneous basalt bedrock is anticipated to be encountered along the central and western portions of the project alignment and will likely be classified as “rock excavation” per NMDOT. The above

conditions are likely to vary and should be confirmed with additional site-specific subsurface exploration at the proposed structure locations.

5.2 Earthwork and Slopes

For balancing grading plans, preliminary estimated shrink or swell of soils when used as compacted fill following recommendations in this report are as follows:

Estimated Shrink/Swell	
Soil Type	**Based on ASTM D1557**
Clays	+10% to -20%
Silts	-15% to -30%
Sands	-15% to -30%
Gravels	-5% to -10%

For permanent slopes in compacted fill and cut areas with maximum heights of about 20 to 25 feet, recommended preliminary maximum configurations for soil and bedrock materials are as follows:

Maximum Slope Configuration	
Soil Type	**Horizontal: Vertical (H: V)**
Clays and Silts	2.5H:1V to 3H:1V
Poorly Graded to Silty Sands and Gravels	2H:1V [1] to 2.5H:1V [2]
Sedimentary Bedrock	0.75:1V to 1.5H:1V [3]
Igneous Basalt Bedrock	0.5:1V to 1H:1V [3]

1. Structural backfill and used in conjunction with slope paving or rip rap
2. Cemented soils may allow for steeper slopes, where encountered
3. Flatter slope associated with more weathered/fractured bedrock

Steeper slopes can be considered with site specific subsurface information (geophysical and/or geotechnical) and slope stability analysis. If steeper slopes are required for project alignment development, we recommend the use of retaining walls/systems comprised of mechanically stabilized earth (MSE) retaining walls, soil nails, or cast-in-place (CIP) retaining walls. Preliminary recommendations and design criteria for MSE and CIP retaining walls are outlined in subsequent sections of this report.

5.3 Preliminary Foundation Recommendations

5.3.1 Bridge Construction and Replacement

Based upon review of the geologic maps, geotechnical information, and as-built plans, the anticipated foundation systems that should be considered further in preliminary design are as follows:

Approximate Mile Post Location	Structure Type	Site Location Features	Anticipated Proposed Foundation System
0 to 4	Bridge	Drainage [1]	Driven Steel Piles Drilled Shafts
		Outside Drainage [2]	Shallow Strip/Spread Footings Driven Steel Piles Drilled Shafts
4 to 9	Bridge	Drainage [1]	Driven Steel Piles
		Outside Drainage [2]	Driven Steel Piles
9 to 25 [3]	Bridge	Drainage [1]	Driven Steel Piles Drilled Shafts
		Outside Drainage [2]	Shallow Strip/Spread Footings Driven Steel Piles Drilled Shafts
25 to 65 [3]	Bridge	Drainage [1]	Driven Steel Piles Drilled Shafts
		Outside Drainage [2]	Shallow Strip/Spread Footings Driven Steel Piles Drilled Shafts
65 to 95 [3,4]	Bridge	Drainage [1]	Driven Steel Piles Drilled Shafts
		Outside Drainage	Shallow Strip/Spread Footings Driven Steel Piles [5] Drilled Shafts [6]
95 to 142 [3,4]	Bridge	Drainage [1]	Driven Steel Piles Drilled Shafts
		Outside Drainage [2]	Shallow Strip/Spread Footings Driven Steel Piles [5] Drilled Shafts [6]

Approximate Mile Post Location	Structure Type	Site Location Features	Anticipated Proposed Foundation System
142 to 150	Bridge	Drainage [1]	Driven Steel Piles Drilled Shafts
		Outside Drainage [2]	Shallow Strip/Spread Footings Driven Steel Piles Drilled Shafts

1. Relatively shallow groundwater anticipated. Drilling slurry/casing of drilled shafts should be anticipated
2. Casing and drilling slurry should be anticipated in loose/caving soil zones
3. Relatively shallow sedimentary bedrock anticipated along the project interval/alignment
4. Shallow igneous basalt bedrock (rock excavation)
5. Pre-drilling required in areas of shallow basalt bedrock
6. Minimum rock socket length of 2.5 to 3X shaft diameter

Based on the geological literature study, site reconnaissance, review of existing reports, and our experience along the project alignment, the proposed bridge structures are anticipated to be supported on shallow foundations or deep foundations consisting of drilled shafts or driven piles. Shallow excavations may encounter both loose and caving soils. Dense to very dense soils and/or bedrock are anticipated to be encountered at varying depths along the project alignment ranging from about 1 to over 100 feet below existing site grade.

For areas outside existing drainages, supporting the bridge structures on footings bearing on undisturbed soils and/or mechanically stabilized earth (MSE) abutments could be considered depending upon the magnitude of long-term settlement/consolidation of existing subsurface soils. The service limit bearing pressure for shallow foundations will vary depending upon the relative strength of the subsurface soils and bridge loading conditions. The results of our preliminary analyses indicate that the estimated axial capacities will vary depending upon the number and length of spans and whether the footings would bear on native soils, structural backfill, or reinformed embankments (MSE). For footings bearing on MSE embankments, strength and service bearing resistance of 7,500 psf and 4,000 psf, respectively, could be used for preliminary design purposes.

In areas of existing drainages, supporting the bridge structures on deep foundations consisting of drilled shafts or driven piles should be considered due to potential erosion and scour. The results of our preliminary analyses indicate that the estimated required axial and lateral capacity per pile or drilled shaft can likely be achieved with pile/shaft lengths ranging from about 50 to 100 feet. Shorter pile/shaft lengths would be applicable for areas of shallow bedrock.

Pile drivability analysis should be performed using GRLWEAP software. This will determine any pre-drilling that could be required for pile installation along with specifying the appropriate pile

driving equipment. Dense to very dense gravel soils and large cobbles will affect drivability and constructability of deep foundations. Pile driving criteria should be determined based on Pile Dynamic Analysis (PDA) testing of the first pile driven at each abutment and pier. During installation of piles, driving stresses should not be allowed to exceed 90 percent of the pile yield strength. For A-252 Grade 3 (minimum certified yield strength 45 ksi) piling this is 40.5 ksi.

Drilled shaft excavations for foundation construction may encounter caving soils, groundwater, and or bedrock. Therefore, a slurry or temporary casing may be required during installation and some difficulty of completing the drilled shaft should be anticipated, especially in areas of existing drainages. The use of drilling slurries should consider any environmental impacts or restrictions. Cross-hole sonic logging (CSL) testing will need to be performed on each completed shaft to assess and confirm shaft construction integrity. In the case of dense to very dense gravels or very hard bedrock, specialized or heavy-duty equipment may be required to pre-drill and construct the drilled shaft excavations. Where igneous basalt bedrock or “rock excavation” areas are encountered, specialized equipment and tooling will be required. A qualified contractor should be used for deep foundation installation.

5.3.2 Wingwalls, Retaining Walls and Ancillary Structures

For wingwalls, retaining walls, and ancillary structures, a shallow foundation system consisting of shallow continuous or spread footings could be considered feasible, provided that some movement can be tolerated. However, based upon the magnitude of potential compression, consolidation, and/or expansion anticipated in the near surface soils, shallow footings bearing on undisturbed native soils or a zone of structural backfill may be required for support of the proposed structures. The thickness of engineered fill below footings is anticipated to be on the order of about 2 to 4 feet.

Areas of loose soils may be encountered at shallow foundation bearing depth after excavation is completed for footings. When such conditions exist beneath planned footing areas, the subgrade soils should be surficially compacted prior to placement of the foundation system. If sufficient compaction cannot be achieved in-place, the loose soils should be removed and replaced as engineered fill.

5.4 Preliminary Pavement Design Considerations

Pavement rehabilitation and/or reconstruction could be considered along the project alignment. The anticipated new or rehabilitation pavement section thickness will be based upon the existing pavement conditions, pavements materials, subgrade soil, and traffic types and volumes along the project alignment.

5.4.1 I-40 Pavement Condition Rating and Pavement Treatment Strategy

Based upon the PCARs, the Pavement Condition Ratings (PCR) along I-40 indicated values ranging from 10 to 87. These values correspond to Very Poor to Very Good pavement condition. Overall, the PCR typically ranges from Fair to Very Good. However, there are several areas of Very Poor to Poor pavement condition (PCR 0 to 45).

Per NMDOT, the suggested pavement treatment for a PCR of Very Poor (PCR 0 to 25) is pavement reconstruction. For a PCR rating of Poor (26 to 45), the NMDOT suggested pavement treatment consists of major rehabilitation. However, due to the time frame that will likely occur for start of new construction projects along the I-40 corridor, and the further deterioration of the pavements addressed in NMDOT's 2022 and 2023 Pavement Condition Assessment Reports, consideration should also be given to reconstruction in areas currently identified as Poor (PCR = 26 to 45) pavement condition. Rehabilitation measures would generally be considered applicable for areas exhibiting PCR ranging from At Risk to Fair (PCR 46 to 65) at the time of future evaluation.

A summary of the current NMDOT pavement option/treatment strategy is outlined below:

RATING	PAVEMENT CONDITION	PAVEMENT OPTION/ TREATMENT STRATEGY
86-100	Very Good	Monitor – None to minor preservation, fog seals, and other surface coats
66-85	Good	Major Preservation, overlays – to minor rehabilitation
51-65	Fair	Minor to major rehabilitation
46-50	At Risk	Minor to major rehabilitation – Mill and inlay 2.5 to 5 inches
26-45	Poor	Major rehabilitation 5 inches deep to PPC or FDR
0-25	Very Poor	Reconstruction

PPC = Process, Place, and Compact
FDR = Full Depth Reclamation

Based upon the variability of the existing asphalt, Portland cement concrete, and base course thickness and pavement conditions along the project alignment, a partial mill and inlay/overlay could be considered for pavement rehabilitation. The design life and future performance would be based upon the new overall pavement section thickness, condition of existing pavement materials, subgrade, and traffic. Available plans indicate the pavement along the existing alignment has been rehabilitated/resurfaced several times and the existing thickness may vary along the alignment and between westbound and eastbound lanes.

In areas of Very Poor Pavement Condition Rating (PCR) and significant structural distress, pavement reconstruction is recommended. For areas of Poor PCR, reconstruction is likely probable in the immediate future. For areas of At Risk PCR, rehabilitation and/or reconstruction is likely probable in the very near future. In areas of Fair to Very Good PCR, rehabilitation measures could be considered. Estimated construction priorities and estimated remaining pavement design life for rehabilitation and/or reconstruction options. Very Poor to Poor PCR and reconstruction (highlighted in red) and probable reconstruction (highlighted in orange) are summarized below.

Pavement reconstruction recommendations are based on NMDOT's *Pavement Condition Assessment Report* (PCAR) dated September 26, 2023. For purposes of this analysis:

Reconstruction Recommended
No = PCR of At Risk (PCR of 46) or higher
Probable = PCR of 26 to 45
Yes [1] = PCR of 0 to 25
1. Includes PCRs at the boundary of Very Poor and Poor

In summary, Pavement reconstruction (highlighted in red) or probable reconstruction (highlighted in orange) is recommended for approximately 39 miles of the existing I-40 mainline in the westbound direction and 36 miles in the eastbound direction.

I-40 Westbound:

As summarized in the table below, pavement reconstruction (highlighted in red) or probable reconstruction (highlighted in orange) is recommended for approximately 39 miles of the existing I-40 mainline in the westbound direction.

I-40 Mainline Approx. Mile Post Interval Location	Direction [1]	Approx. Pavement Condition Rating (PCR) Range [2]	PCR Category Range [3]	Rehabilitation		Reconstruction Recommended
				Est. Priority [4]	Est. Life Remain. (Yrs.) [4]	
0 to 8	WB	53 to 87	Fair to Very Good	L	<10-20	No
8 to 12	**WB**	**18 to 45**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**

I-40 Mainline Approx. Mile Post Interval Location	Direction [1]	Approx. Pavement Condition Rating (PCR) Range [2]	PCR Category Range [3]	Rehabilitation		Reconstruction Recommended
				Est. Priority [4]	Est. Life Remain. (Yrs.) [4]	
12 to 26	WB	45 to 86	Fair to Good	L	<10-20	No
26 to 27	WB	**32** to 86	**Poor** to Very Good	M	<5-15	Probable
27 to 30	WB	46 to 87	At Risk to Very Good	L	<10-20	No
30 to 31	WB	**36** to 75	**Poor** to Good	M	<5-15	Probable
31 to 38	WB	49 to 87	At Risk to Very Good	L	<10-20	No
38 to 39	WB	**36** to 87	**Poor** to Very Good	M	<5-15	Probable
39 to 50	WB	54 to 87	Fair to Very Good	L	<10-20	No
50 to 51	WB	**43** to 73	**Poor** to Good	M	<5-15	Probable
51 to 56	WB	46 to 87	At Risk to Very Good	L	<10-20	No
56 to 57	**WB**	**20 to 33**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
57 to 58	WB	**32** to 62	**Poor** to Fair	M	<5-15	Probable
58 to 66	WB	53 to 87	Fair to Very Good	L	<10-20	No
66 to 67	WB	**32** to 72	**Poor** to Good	M	<5-15	Probable
67 to 78	WB	46 to 87	At Risk to Very Good	L	<10-20	No
78 to 80	WB	**43** to 68	**Poor** to Good	M	<5-15	Probable
80 to 81	**WB**	**25 to 32**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
81 to 92	WB	50 to 87	At Risk to Very Good	L	<10-20	No
92 to 93	WB	**40** to 65	**Poor** to Very Good	M	<5-15	Probable

I-40 Mainline Approx. Mile Post Interval Location	Direction [1]	Approx. Pavement Condition Rating (PCR) Range [2]	PCR Category Range [3]	Rehabilitation		Reconstruction Recommended
				Est. Priority [4]	Est. Life Remain. (Yrs.) [4]	
93 to 95	WB	53 to 76	Fair to Good	L	<10-20	No
95 to 96	WB	**44** to 66	**Poor** to Good	M	<5-15	Probable
96 to 105	WB	46 to 87	At Risk to Very Good	L	<10-20	No
105 to 106	**WB**	**20 to 26**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
106 to 109	WB	**42** to 87	**Poor** to Very Good	M	<5-15	Probable
109 to 116	WB	64 to 87	Fair to Very Good	L	<10-20	No
116 to 118	WB	**30** to 82	**Poor** to Good	M	<5-15	Probable
118 to 119	**WB**	**13 to 40**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
119 to 124	WB	**30** to 86	**Poor** to Very Good	M	<5-15	Probable
124 to 125	**WB**	**25 to 42**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
125 to 132	WB	**30** to 86	**Poor** to Very Good	M	<5-15	Probable
132 to 136	WB	50 to 86	At-Risk to Very Good	L	<10-20	No
136 to 138	WB	**39** to 87	**Poor** to Very Good	M	<5-15	Probable
138 to 148	WB	59 to 87	Fair to Very Good	L	<10-20	No
148 to 149	**WB**	**25 to 29**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
149 to 150	WB	86 to 87	Very Good	L	<10-20	No

I-40 Mainline Approx. Mile Post Interval Location	Direction [1]	Approx. Pavement Condition Rating (PCR) Range [2]	PCR Category Range [3]	Rehabilitation		Reconstruction Recommended
				Est. Priority [4]	Est. Life Remain. (Yrs.) [4]	

1. WB = Westbound
2. Includes boundary transition areas indicative of higher PCRs
3. 86-100 = Very Good
   66-85 = Good
   51-65 = Fair
   46-50 = At Risk
   26-45 = Poor
   0-25 = Very Poor
4. Based upon current PCR and provided anticipated traffic.
   L=Low; M=Medium; H=High

Notes:

For areas identified as requiring Probable Reconstruction, these areas fall into the Poor PCR category and will likely deteriorate to Very Poor PCR category within a short (few years) period of time. Therefore, for budget, planning, and constructability purposes, the "Probable Reconstruction" areas should be considered and included in the total length of pavement reconstruction. As indicated from review of the data outlined in the two (2) Pavement Condition Assessment Reports performed within about a 1 year period, pavement conditions can change rapidly and recommendations need to be assessed regularly. The pavement recommendations do not reflect pavement rehabilitation that occurred after NMDOT's 2023 pavement assessment from MP 9.2 to 16, MP 89 to 95.5, and spot locations from MP 95.5 to MP 132 or other maintenance activities.

Based on a review of NMDOT's *Pavement Condition Assessment Report* from 2022 (based on 2021 data) and NMDOT's updated *Pavement Condition Assessment Report* from 2023 (based on 2022 data), the PCR values for the areas listed below substantially improved. It is assumed that pavement maintenance and rehabilitation may have occurred in these areas between 2021 and 2022:

- MP 97 to 98 Westbound
- MP 102 to MP 104 Westbound
- MP 139 to 141 Westbound
- MP 139 to 141 Westbound

I-40 Eastbound:

As summarized in the table below, pavement reconstruction (highlighted in red) or probable reconstruction (highlighted in orange) is recommended for approximately 36 miles of the existing I-40 mainline in the eastbound direction.

I-40 Mainline Approx. Mile Post Interval Location	Direction [1]	Approx. Pavement Condition Rating (PCR) Range [2]	PCR Category Range [3]	Rehabilitation		Reconstruction Recommended
				Est. Priority [4]	Est. Life Remain. (Yrs.) [4]	
0 to 8	EB	55 to 87	Fair to Very Good	L	<10-20	No
8 to 12	**EB**	**10 to 41**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
12 to 26	EB	46 to 87	At Risk to Very Good	L	<10-20	No
26 to 27	EB	**35** to 87	**Poor** to Very Good	M	<5-15	Probable
27 to 54	EB	46 to 87	At Risk to Very Good	L	<10-20	No
54 to 55	**EB**	**26** to **37**	**Poor**	**H**	**<3-10**	**Yes**
55 to 56	EB	46 to 87	At Risk to Very Good	L	<10-20	No
56 to 57	EB	**42** to 87	**Poor** to Very Good	M	<5-15	Probable
57 to 61	EB	53 to 87	Fair to Very Good	L	<10-20	No
61 to 63	EB	**33** to 60	**Poor** to Fair	M	<5-15	Probable
63 to 82	EB	46 to 87	At-Risk to Very Good	L	<10-20	No
82 to 85	EB	**37** to 87	**Poor** to Very Good	M	<5-15	Probable
85 to 93	EB	52 to 87	Fair to Very Good	L	<10-20	No
93 to 94	**EB**	**18** to 53	**Very Poor** to Fair	**H**	**<3-10**	**Yes**
94 to 99	EB	50 to 84	At Risk to Good	L	<10-20	No
99 to 100	**EB**	**14** to 55	**Very Poor** to Fair	**H**	**<3-10**	**Yes**
100 to 106	EB	48 to 86	At Risk to Very Good	L	<10-20	No
106 to 107	**EB**	**24** to 55	**Very Poor** to Fair	**H**	**<3-10**	**Yes**

I-40 Mainline Approx. Mile Post Interval Location	Direction [1]	Approx. Pavement Condition Rating (PCR) Range [2]	PCR Category Range [3]	Rehabilitation		Reconstruction Recommended
				Est. Priority [4]	Est. Life Remain. (Yrs.) [4]	
107 to 116	EB	54 to 87	Fair to Very Good	L	<10-20	No
116 to 119	EB	**32** to 86	**Poor** to Very Good	M	<5-15	Probable
119 to 122	**EB**	**18 to 86**	**Very Poor** to At Risk	**H**	**<3-10**	**Yes**
122 to 124	EB	**26** to 84	**Poor** to Good	M	<5-15	Probable
124 to 126	**EB**	**25** to 48	**Very Poor** to At Risk	**H**	**<3-10**	**Yes**
126 to 131	EB	**32** to 58	**Poor** to Fair	M	<5-15	Probable
131 to 132	**EB**	**22 to 34**	**Very Poor to Poor**	**H**	**<3-10**	**Yes**
132 to 137	EB	**38** to 62	**Poor** to Fair	M	<5-15	Probable
137 to 150	EB	46 to 87	At Risk to Very Good	L	<10-20	No

1. EB = Eastbound
2. Includes boundary transition areas indicative of higher PCRs
3. 86-100 = Very Good
   66-85 = Good
   51-65 = Fair
   46-50 = At Risk
   26-45 = Poor
   0-25 = Very Poor
4. Based upon current PCR and provided anticipated traffic.
   L=Low; M=Medium; H=High

Notes:

For areas identified as requiring Probable Reconstruction, these areas fall into the Poor PCR category and will likely deteriorate to Very Poor PCR category within a short (few years) period of time. Therefore, for budget, planning, and constructability purposes, the "Probable Reconstruction" areas should be considered and included in the total length of pavement reconstruction. As indicated from review of the data outlined in the two (2) Pavement Condition Assessment Reports performed within about a 1 year period, pavement conditions can change rapidly and recommendations need to be assessed regularly. The pavement recommendations do not reflect pavement rehabilitation that occurred after NMDOT's 2023 pavement assessment from MP 9.2 to 16, MP 89 to 95.5, and spot locations from MP 95.5 to MP 132 or other maintenance activities.

Based on a review of NMDOT's *Pavement Condition Assessment Report* from 2022 (based on 2021 data) and NMDOT's updated *Pavement Condition Assessment Report* from 2023 (based on 2022 data), the PCR values for the

areas listed below substantially improved. It is assumed that pavement maintenance and rehabilitation may have occurred in these areas between 2021 and 2022:

- MP 89 to 90 Eastbound
- MP 102 to MP 104 Eastbound
- MP 139 to 141 Eastbound
- MP 139 to 141 Eastbound

The above recommended reconstruction or probable reconstruction options are based upon current NMDOT suggested pavement treatments. In addition, the recommended areas for probable reconstruction assumes that funding, design plans, and/or actual construction for areas along the alignment may take a few to several years to complete. Therefore, depending upon the time frame after the 2022 and 2023 PCARs, the current Poor to At Risk PCRs could further deteriorate and extend into the Very Poor PCR that would require reconstruction. However, the rate of pavement deterioration and resulting decrease in PCR with time will be affected/impacted by the amount and magnitude of current and future maintenance and/or repairs being performed along the project alignment and remaining pavement design life.

5.4.2 Frontage Roads Estimated PCR and Pavement Treatment Strategy

A PCR report is not available for frontage road areas. Therefore, Terracon personnel performed visual observations and limited pavement condition survey of the designated frontage roads from MP 0 to 150 on August 31, 2022. Based upon our visual observations, in areas of estimated Poor Pavement Condition Rating (PCR) and significant structural distress, pavement reconstruction is recommended. Since the traffic levels are relatively low along the frontage roads and these roads used only for emergency detour routes associated with the I-40 traffic, rehabilitation measures could be considered in areas of estimated Fair to Good PCR. The areas of estimated Poor PCR, estimated remaining pavement design life, and recommended reconstruction areas are summarized in the table below. Probable reconstruction (highlighted in orange) is recommended for approximately 9 miles of the existing I-40 frontage roads. More detailed analysis is recommended to confirm these field observations.

I-40 Frontage Roads/Ramps Approximate MP Interval Location	Observed Existing Pavement Condition [1]	Rehabilitation		Reconstruction Recommended
		Estimated Priority [2]	Est. Life Remaining (yrs.) [2]	
0 to 4	Fair to Good	Low	<10-20	No
4 to 8	Good	Low	<10-20	No
8 to 9	Poor to Good	Med	<5-15	Probable
9 to 12	Poor to Good	Med	<5-15	Probable
12 to 24.5	Fair to Good	Low	<10-20	No

I-40 Frontage Roads/Ramps Approximate MP Interval Location	Observed Existing Pavement Condition [1]	Rehabilitation		Reconstruction Recommended
		Estimated Priority [2]	Est. Life Remaining (yrs.) [2]	
24.5 to 25	Fair to Good	Low	<10-20	No
25 to 30	Poor to Fair	Med	<5-15	Probable
30 to 37	Fair to Good	Low	<10-20	No
47 to 56	Fair	Low	<10-20	No
56 to 65	Fair to Good	Low	<10-20	No
65 to 80	Fair to Good	Low	<10-20	No
80 to 90	Fair	Low	<10-20	No
90 to 96	Fair to Good	Low	<10-20	No
96 to 105	Fair to Good	Low	<10-20	No
105 to 114.5	Fair to Good	Low	<10-20	No
141 to 150	Good	Low	<10-20	No

1. Pavement Condition based upon a qualitative estimated PCR from the observed distress
   86-100 = Very Good
   66-85 = Good
   51-65 = Fair
   46-50 = At Risk
   26-45 = Poor
   0-25 = Very Poor
2. Based upon observed existing pavement conditions, future pavement deterioration, and provided anticipated traffic

The above recommended probable reconstruction options are based upon current pavement condition at the time of our field observations and NMDOT suggested pavement treatments. In addition, the recommended areas of probable reconstruction or no reconstruction assume that funding, design plans, and/or actual construction for areas along the alignment may take a few to several years to complete. Therefore, depending upon the time frame for design and construction, the areas of poor to fair pavement condition could further deteriorate and extend into a poor to very poor condition that would require reconstruction. However, the rate of pavement deterioration and resulting decrease in pavement condition with time will be affected/impacted by the amount and magnitude of current and future maintenance and/or repairs being performed along the project alignment and remaining pavement design life.

5.5 Preliminary Pavement Design

5.5.1 I-40 Mainline

Based upon the traffic data provided by NMDOT, the Equivalent Single Axle Loads (ESAL) along portions of I-40 are summarized below:

Highway/Road Segment	Daily ESAL
I-40 Mainline	2,215 to 2,890

Using the traffic data outlined above, a range of preliminary pavement section thicknesses were developed for very poor to good roadbed quality subgrade soils. Per NMDOT protocol, in areas of very poor to poor quality subgrade soils, chemical stabilization, mechanical stabilization, geogrid, and/or replacement with higher quality subgrade soils should be considered to reduce pavement section thickness, enhance long-term pavement performance, and reduce pavement maintenance. The preliminary thicknesses are summarized below:

I-40 Mainline Preliminary Hot Mix Asphalt (HMA) Design [1,2]	
Layer	**Thickness (inches)**
HMA	8 to 14.5
Base Course	6
Stabilized Subgrade or Base Course[3]	8 to 12

1. For preliminary budgeting purposes only. Site specific and detailed field exploration, laboratory testing, and engineering analysis will need to be performed using actual traffic data
2. 20-year design
3. Should be considered in areas of poor to very poor quality subgrade soils (i.e - clays and silts)

I-40 Mainline Preliminary Portland Cement Concrete (PCC) Design [1,2]	
Layer	**Thickness (inches)**
PCC	9.5 to 10.5
Base Course	4
Stabilized Subgrade [3]	8 to 12

1. For preliminary budgeting purposes only. Site specific and detailed field exploration, laboratory testing, and engineering analysis will need to be performed using actual traffic data
2. 20-year design
3. Should be considered in areas of poor to very poor quality subgrade soils (i.e. - clays and silts)

5.5.2 I-40 Frontage Roads

Based upon the traffic data provided by NMDOT, the Equivalent Single Axle Loads (ESAL) along portions of I-40 frontage roads are summarized below:

Highway/Road Segment	Daily ESAL
I-40 Ramps/Frontage Roads	140 to 310

Using the traffic data outlined above, a range of preliminary pavement section thicknesses were developed for very poor to good roadbed quality subgrade soils. Per NMDOT protocol, in areas of very poor to poor quality subgrade soils, chemical stabilization, mechanical stabilization, geogrid, and/or replacement with higher quality subgrade soils should be considered to reduce pavement section thickness, enhance long-term pavement performance, and reduce pavement maintenance. The preliminary thicknesses are summarized below:

I-40 Ramps/Frontage Roads Preliminary Hot Mix Asphalt (HMA) Design [1,2]	
Layer	**Thickness (inches)**
HMA	5 to 9
Base Course	6
Stabilized Subgrade or Base Course[3]	6 to 8

1. For preliminary budgeting purposes only. Site specific and detailed field exploration, laboratory testing, and engineering analysis will need to be performed using actual traffic data
2. 20-year design
3. Should be considered in areas of poor to very poor quality subgrade soils (i.e - clays and silts)

I-40 Ramps/Frontage Roads Preliminary Portland Cement Concrete (PCC) Design [1,2]	
Layer	**Thickness (inches)**
PCC	6 to 7
Base Course	4
Stabilized Subgrade [3]	6 to 8

1. For preliminary budgeting purposes only. Site specific and detailed field exploration, laboratory testing, and engineering analysis will need to be performed using actual traffic data
2. 20-year design
3. Should be considered in areas of poor to very poor quality subgrade soils (i.e. - clays and silts)

5.5.3 Pavement Section Considerations

Thicker pavement sections will be associated with poorer quality (A-4, A-6, and A-7) subgrades associated with the clays, silts, and clayey sands to anticipated to be encountered throughout the

project alignment, excluding the far east end. Thinner pavement sections will be associated with higher quality (A-1 and A-2) subgrades associated with the poorly graded, well graded and silty sands and gravels. Per NMDOT protocol, stabilization may be required in areas of poor quality/low R-value (less than 20) subgrade and/or in areas of elevated moisture contents present within the subgrade soils along the project alignment.

In addition, in areas of existing pavement distress, remediation and/or replacement of unstable subgrade soils should be anticipated in areas of pavement reconstruction and/or rehabilitation. The depth of remediation and/or replacement would be based upon the magnitude of instability of the subgrade. Placement of geotextile fabrics or geogrids could also be considered to improve subgrade strength and stability, reduce long term maintenance, and decrease pavement section thickness. Chemical treatment (lime or cement) could be considered as a potential option for expansive soils. Additional chemical tests of the subgrade materials will need to be verified/performed to verify the feasibility and use of lime for subgrade stabilization measures to ensure that sulfate heave is not an issue during construction. High sulfate contents would preclude the use of lime treated subgrade.

5.6 Corrosion Potential

Based upon our experience along the project alignment and review of geotechnical reports, the on-site soils and bedrock are considered to have low to high soluble chloride and sulfate concentrations, low to moderate resistivity values, and alkaline pH values. A summary of the soil and bedrock types and estimated corrosion potential are outlined below:

USCS Soil Type	AASHTO Soil Type	Estimated Concrete Corrosion Potential	Estimated Metal Corrosion Potential
Clays (CL)	A-6	L-H	M-H
Clays (CH)	A-7-6	M-H	M-H
Silts (ML)	A-4	L-M	M-H
Sands (SC)	A-6	L-H	M-H
Sands (SM)	A-2-4 A-4	L-M	L-M
Sands (SP)	A-1-b A-2-4	L-M	L-M

1. L = Low; M = Moderate; H=High

Therefore, ASTM Type I and I-II Portland cement can be considered in areas of low corrosion potential. ASTM Type II Portland cement can be considered in areas of moderate corrosion

potential. ASTM Modified Type II or V Portland cement can be considered in areas of low high corrosion potential. Foundation concrete will need to be designed for low to moderate sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

The estimated metal corrosion potential along the project alignment is considered low to high to metal piping or conduits. Therefore, construction materials will need to be specified for a particular corrosion potential and may include non-corrosive materials, coatings, and wraps.

Project specific testing should be conducted to assess concrete and metal corrosion potential.

5.7 Seismic Considerations

Site Class D should be considered for preliminary design purposes throughout the corridor. Site Class C could be considered in areas of dense to very dense or hard soils and shallow bedrock that extend down to considerable depth below the project alignment. Anticipated Site Class along Project alignment is summarized below:

Project Alignment Area	Anticipated Subsurface Soil and/or Bedrock Conditions [1]	Anticipated Site Class
Approximate Western 2/3	Very Dense or Hard Soils Shallow Bedrock	C
Approximate Eastern 1/3	Very Loose to Dense or Soft to Very Stiff Soils Deep Bedrock	D [2]

1. May be locally impacted if structures located adjacent or within drainages and arroyos where shallow groundwater is present.
2. In areas of shallow groundwater, Site Class E or F may be applicable along with assessing liquefaction potential.

The Site Class should be verified with site specific exploration consisting of seismic testing or borings.

5.8 Scour and Erosion Considerations

Scour and/or erosion were observed at existing bridges and culverts along the project alignment and is anticipated to be a concern with design and construction of new drainage and/or bridge structures. In areas of existing drainages, erosion and scour countermeasures will likely be required and may include rip rap, slope paving, gabion walls, sediment fencing, and soil cement. In areas outside existing drainages and along cut and/or fill embankments, erosion countermeasures will likely be required and may include rock mulch, vegetation, and slope paving.

6.0 SUMMARY OF GEOLOGICAL, GEOTECHNICAL, AND PAVEMENT CONDITIONS

A summary of the geological, geotechnical, and pavement conditions along the project alignment that will impact the proposed alternatives are shown on the spreadsheet in Appendix B.

7.0 GENERAL COMMENTS

Terracon should be retained to provide supplemental geotechnical services and review the preliminary design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the preliminary design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The preliminary recommendations presented in this report are based upon the data obtained from information discussed in this report. This report does not reflect variations that may occur across the corridor study areas, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until further corridor specific studies have been completed or during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project 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.

This preliminary report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

8.0 REFERENCES

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New Mexico Water Rights Reporting System, “Water Column Report” from New Mexico Office of State Engineer web site: http://nmwrrs.ose.state.nm.us/nmwrra/watrecolumn.html

New Mexico Department of Transportation Pavement Management and Design Bureau, 2022; “Pavement Condition Assessment Report, I-40, MP 0-150 Corridor Study, CN 6101580”

New Mexico Department of Transportation Pavement Management and Design Bureau, September 26, 2023; “Pavement Condition Assessment Report, I-40, MP 0-150 Corridor Study, CN 6101580”

New Mexico Department of Transportation – numerous construction plans, as-built plans, and drainage reports along the project alignment.
U.S. Geological Survey, Quaternary fault and fold database for the United States, accessed October 12, 2022, from USGS web site: https://www.usgs.gov/programs/earthquake-hazards/faults

U.S. Geological Survey – numerous geologic maps and reports along the project alignment

APPENDIX A

GEOLOGIC MAP AND

QUATERNARY FAULT MAP

GEOLOGIC MAP

CN 6101580 I-40 from AZ State Line to Atrisco Vista Blvd, McKinley, Cibola, and McKinley County, NM ■ Albuquerque, NM

May 2, 2024 ■ Terracon Project No. 66215219 Revision No.1

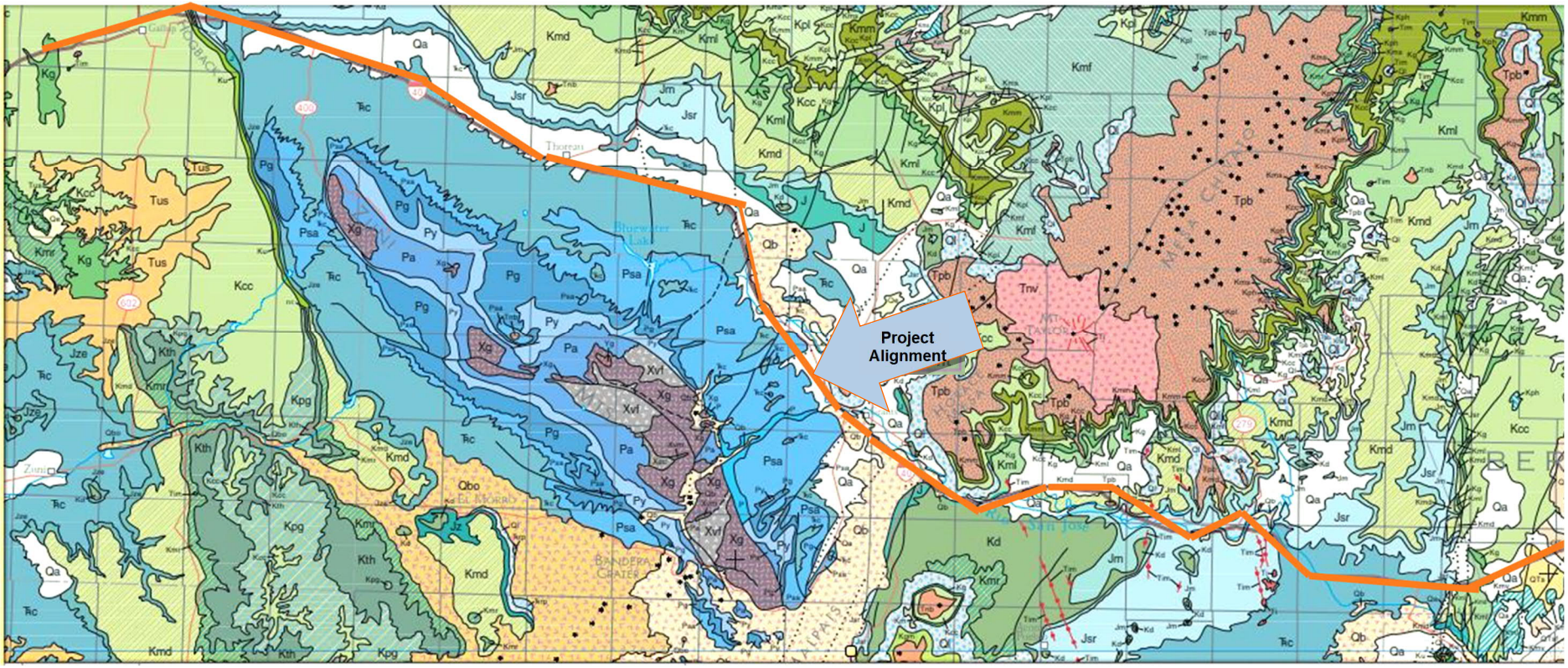

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

New Mexico Bureau of Geology and Mineral Resources - NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY - 801 Leroy Place Socorro, New Mexico 87801 (505) 835-5410 geoinfo.nmt.edu

DESCRIPTION OF MAP UNITS

QUATERNARY

Qa : Alluvium (Holocene to upper Pleistocene)

Ql : Landslide deposits and colluvium (Holocene to Pleistocene)—Landslide deposits on western flanks of Socorro Mountains not shown for clarity

Qp : Piedmont alluvial deposits (Holocene to lower Pleistocene)—Includes deposits of higher gradient tributaries bordering major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans. May locally include uppermost Pliocene deposits

Qe : Eolian deposits (Holocene to middle Pleistocene)

Qoa : Older alluvial deposits of upland plains and piedmont areas, and calcic soils and eolian cover sediments of High Plains region (middle to lower Pleistocene)—Includes scattered lacustrine, playa, and alluvial deposits of the Tahoka, Double Tanks, Tule, Blackwater Draw, and Gatuña Formations, the latter of which may be Pliocene at base; outcrops, however, are basically of Quaternary deposits

Qb : Basaltic to andesitic lava flows (Holocene to middle Pleistocene)—Flows south of Grants and west of Carrizozo are Holocene. Includes minor vent deposits

QTs : Upper Santa Fe Group (middle Pleistocene to uppermost Miocene)— Includes Camp Rice, Fort Hancock, Palomas, Sierra Ladrones, Arroyo Ojito, Ancha, Puye, and Alamosa Formations

TERTIARY

Tsf : Lower Santa Fe Group (upper Miocene to uppermost Oligocene)—Includes Hayner Ranch, Rincon Valley, Popotosa, Cochiti, Tesuque, Chamita, Abiquiu, Zia, and other formations

Tpb : Basaltic to andesitic lava flows (Pliocene)—Includes minor vent deposits and small shield volcanoes. Flows are commonly interbedded in the Santa Fe and Gila Groups

Tim : Tertiary mafic intrusive rocks (Pliocene to upper Eocene)-- Includes many long basaltic andesite dikes of Oligocene age near Pie Town, Acoma, Riley, Chupadera, Truth or Consequences, Roswell, Raton, and Dulce; and several elongate or shoestring-like sills of basalt or basaltic andesite. Also includes basaltic necks of Pliocene age that dot the landscape northeast of Mount Taylor. Where dikes extend into Quaternary alluvium the contact is an unconformity

CRETACEOUS

Ku : Upper Cretaceous rocks of southwestern New Mexico, undivided (Maastrichtian to Cenomanian for most part, although Beartooth and Sarten Formations are in part Albian) — Includes Virden Formation in northern Hidalgo County, Ringbone Formation in Hidalgo, Luna, and Grant Counties, Beartooth and Sarten Formations in Luna and Grant Counties, Mancos Shale in Silver City area

Kmv : Mesaverde Group (Campanian to Turonian) — Includes Cliff House Sandstone, Menefee Formation and Point Lookout Sandstone.

Kcc : Crevasse Canyon Formation (Santonian to Coniacian)—Coal-bearing units are Dilco and Gibson Coal Members; other members are Bartlett Barren, Dalton Sandstone, and Borrego Pass Sandstone (or Lentil)

Kg : Gallup Sandstone (Turonian) — Generally regressive marine sandstone

Kmr : Rio Salado Tongue of the Mancos Shale (Turonian)—Overlies Twowells Tongue of Dakota Sandstone; mapped only where Tres Hermanos Formation or the Atarque Sandstone is present; mapped as Kdr in parts of Socorro County

Kml : Mancos Shale, lower part (Turonian and Cenomanian)

Kmd : Intertongued Mancos Shale and Dakota Sandstone of west-central New Mexico (Cenomanian)—Includes the Whitewater Arroyo Tongue of Mancos Shale and the Twowells Tongue of the Dakota

Kd : Dakota Sandstone (Cenomanian)—Includes Oak Canyon, Cubero, and Paguate Tongues; includes Clay Mesa Tongue of Mancos Shale

JURASSIC

J : Upper and Middle Jurassic rocks, undivided. In southwest includes the basalt-bearing Broken Jug Formation

Jm : Morrison Formation—Upper Jurassic nonmarine rocks

Jze : Zuni and Entrada Sandstones, undivided

Jsr : San Rafael Group (Middle Jurassic) — Consists of Entrada Sandstone, Todilto and Summerville Formations, Bluff Sandstone, and locally Zuni Sandstone (or only Acoma Tongue of Zuni)

TRIASSIC

TRc : Chinle Group (Upper Triassic)—Map unit includes Moenkopi Formation (Middle Triassic) at base in many areas; in eastern part of state the following five formations are mapped:

PALEOZOIC

P : Permian rocks, undivided

Psa : San Andres Formation (Guadalupian in south, in part Leonardian to north)—Limestone and dolomite with minor shale

QUATERNARY FAULT MAP

CN 6101580 I-40 from AZ State Line to Atrisco Vista Blvd, McKinley, Cibola, and McKinley County, NM ■ Albuquerque, NM

May 2, 2024 ■ Terracon Project No. 66215219 Revision No.1

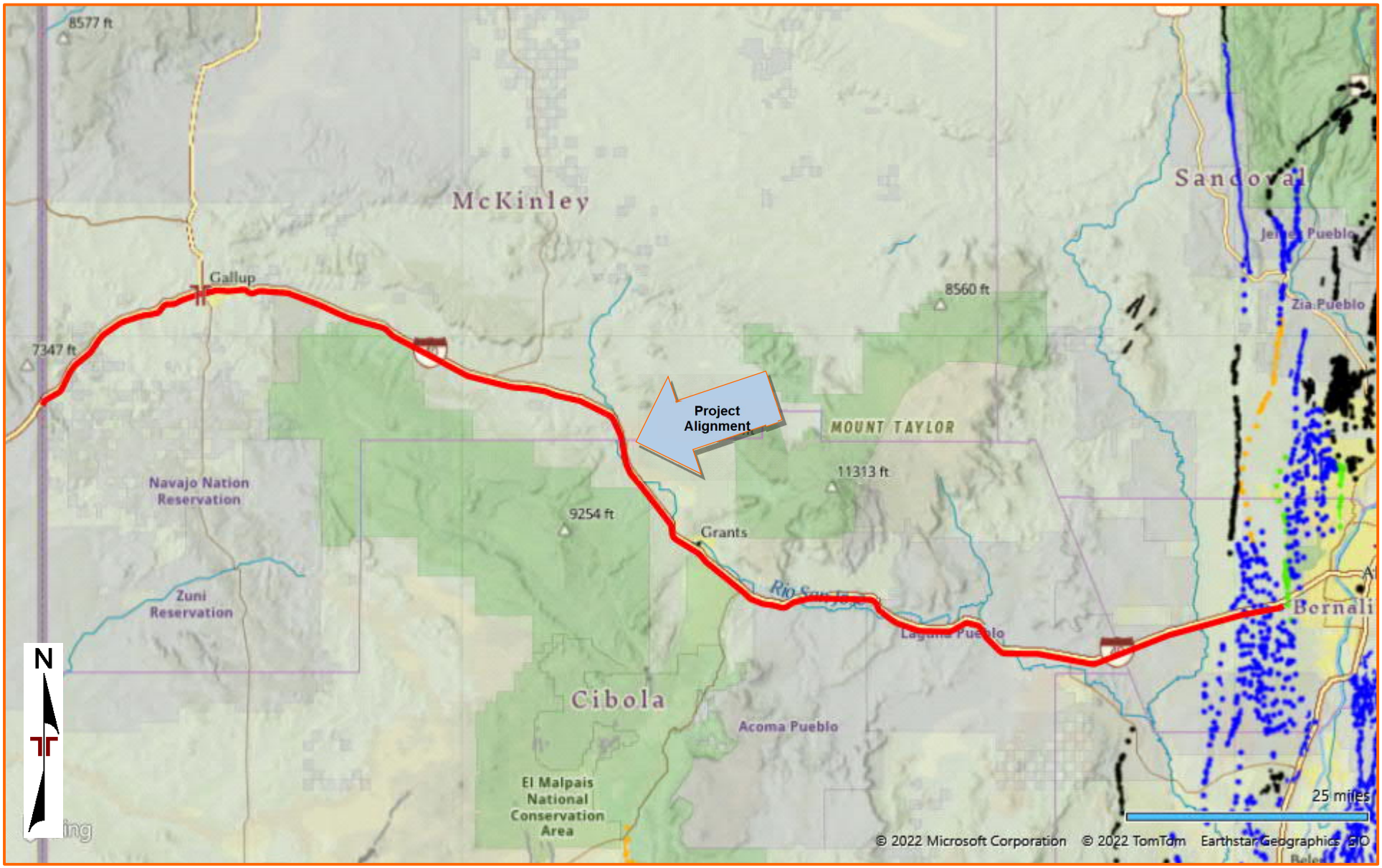

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Esri, CGIAR, USGS, Sources: Esri, USGS, New Mexico State University, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS

QUATERNARY FAULT MAP LEGEND

CN 6101580 I-40 from AZ State Line to Atrisco Vista Blvd, McKinley, Cibola, and McKinley County, NM ■ Albuquerque, NM

May 2, 2024 ■ Terracon Project No. 66215219 Revision No.1

Terracon GeoReport

Fault Areas

- Class B
- historic
- late Quaternary
- latest Quaternary
- middle and late Quaternary

National Database

- Historic (< 150 years), moderately constrained location
- Historic (< 150 years), inferred location
- Latest Quaternary (<15,000 years), well constrained location
- Latest Quaternary (<15,000 years), moderately constrained location
- Latest Quaternary (<15,000 years), inferred location
- Late Quaternary (< 130,000 years), well constrained location
- Late Quaternary (< 130,000 years), moderately contrained location
- Late Quaternary (< 130,000 years), inferred location
- Middle and late Quaternary (< 750,000 years), well constrained location
- Middle and late Quaternary (< 750,000 years), moderately constrained location
- Middle and late Quaternary (< 750,000 years), inferred location
- Undifferentiated Quaternary (< 1.6 million years), well constrained location
- Undifferentiated Quaternary (< 1.6 million years), moderately constrained location
- Undifferentiated Quaternary (< 1.6 million years), inferred location

APPENDIX B

SUMMARY OF GEOLOGICAL, GEOTECHNICAL AND PAVEMENT CONDITONS

SUMMARY OF GEOLOGICAL, GEOTECHNICAL, AND PAVEMENT CONDITIONS

PHASE 1-A/B Study
AZ State Line to Atrisco Vista Boulevard - MP 0 to 150
CN 6101580
McKinley, Cibola, and Bernalillo Counties, NM
Terracon Project No. 66215219
5/2/2024

From Approx. MP	To Approx. MP	Geologic Formation/ Group	Geologic Quadrangle Map	Soil/ Bedrock Types (Est.)	Shallow Bedrock <50 feet (Est.)	USCS Soil Types (Est.)	Shallow Groundwater (Est.)	Exposed Rock Outcrops ROW	Exposed Rock Outcrops Widening	NMDOT Rock Excavation (Est.)	Rockfall Hazard (Est.)	Quat. Faults	AASHTO Soil Type (Est.)	Subgrade Quality (Est.)	Unsuit. Material / Stabilize (Est.)	Hydro-Collapse Soils (Est.)	Loose/ Soft Soils (Est.)	Expan. Soils/ Bedrock (Est.)	Concrete Corrosion Potential (Est.)	Metal Corrosion Potential (Est.)	I-40 Mainline: Pavement Rutting In.	Pavement Rutting Rating	Pavement Cracking %	Pavement Cracking Rating	Pavement Condition Rating: Scale No.	Pavement Condition Rating: Rating	Pavement Condition Rating: MP Priority	Approx. MP	Rehab. Option: Est. Priority	Rehab. Option: Est. Pavement Life (yrs)	Recon./Probable Recon. Recommend (PCR = V Poor/Poor)	Frontage Roads: Approx. MP	Observed Est. Pavement Condition Rating	Rehab. Option: Est. Priority	Rehab. Option: Est. Pavement Life Remain (yrs)	Recon./Probable Recon. Recommend (PCR = V Poor/Poor)
0 AZ State Line	4 W. of Manuelito	Alluvium (minor) Zuni Sandstone Entrada Sandstone	NM State Geology	sand, silt, clay minor gravel sandstone sandstone	Yes	SM ML N/A N/A	Drainages Drainages Perched Perched	No No	No No	N/A N/A	No No	No No No No	A-2-4/A-4 A-4 N/A N/A	F to G P to F G G	No Possible No No	Yes Yes No No	Yes Possible No No	No No No No	L to M L to H L to M L to M	L to M M to H M to H L to M	0.10-0.25	Good -Fair	0-2	Good	57-87	Fair - V Good	N/A	0-4	Low	<10-20	No	0-4	Fair-Good	Low	<10-20	No
4 W. of Manuelito	9 Puerco River/ BIA 7140	Alluvium (minor) Rio Salado Tongue Mancos Shale	Manuelito	sand, silt, clay minor gravel sandstone shales/claystone	Possible	SM ML MH CL CH N/A N/A	Drainages Drainages Drainages Drainages Drainages Perched Perched	Yes Yes	No No	Possible Not Likely	Possible Possible	No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 N/A N/A	F to G P to F P P to F P G P to F	No Possible Possible Possible Possible No Possible	Yes Yes No No No No No	Yes Possible Possible Possible Possible No No	No No No Possible Yes No Yes	L to M L to H L to H L to H L to H L to M L to H	L to M M to H M to H M to H M to H L to M M to H	0.07-0.32	Fair-Good	6-43	Poor-Good	15-87	V Poor-V Good	8-9 WB 8-9 EB	4-8 8-9 WB 8-9 EB	Low High High	<10-20 <3-10 <3-10	No Yes Yes	4-8 8-9	Good Poor-Good	Low Med	<10-20 <5-15	No Probable
9 Puerco River/ BIA 7140	24.5 E. Gallup/ Hogback	Alluvium Crevasse Canyon	Gallup E. Gallup	sand, silt, clay minor gravel sandstone shales siltsone	Yes	SM ML MH CL CH N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Perched Perched Perched	Yes Yes Yes	No No No	Possible Not Likely Not Likely	Possible Possible Possible	No No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 N/A N/A N/A	F to G P to F P P to F P G P to F P to F	No Possible Possible Possible Possible No Possible Possible	Yes Yes No No No No No No	Yes Possible Possible Possible Possible No No No	No No No Possible Yes No Yes Yes	L to M L to H L to H L to H L to H L to M L to H L to H	L to M M to H M to H M to H M to H L to M M to H M to H	0.06-0.32	Fair-Good	0-50	Poor-Good	10-87	V Poor-V Good	9-12 WB 9-12 EB	9-12 WB 9-12 EB 12-24.5 WB 12-24.5 EB	High High Low Low	<3-10 <3-10 <10-20 <10-20	Yes Yes No No	9-12 12-24.5	Poor-Good Fair-Good	Med Low	<5-15 <10-20	Probable No
24.5 E. Gallup/ Hogback	25 E. Gallup/ Hogback	Alluvium (minor) Gallup Sandstone Mancos Shale Dakota Sandstone San Rafael Group	Gallup E. Gallup	sand, silt, clay minor gravel sandstone shale sandstone sandstone/siltstone	Yes	SM ML MH CL CH minor N/A N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Perched Perched Perched Perched	Yes Yes Yes Yes	No No No No	Possible Not Likely Possible Not Likely	Yes Yes Yes Yes	No No No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 N/A N/A N/A N/A	F to G P to F P P to F P G P to F G P to G	No Possible Possible Possible Possible No Possible No Possible	Yes Yes No No No No No No No	Yes Possible Possible Possible Possible No No Yes No	No No No Possible Yes No Yes No No	L to M L to H L to H L to H L to H L to M L to H L to M L to H	L to M M to H M to H M to H M to H L to M M to H L to M L to H	0.05-0.15	Good	0-1	Good	84-87	Good-V Good	N/A	24.5-25	Low	<10-20	No	24.5 -25	Fair-Good	Low	<10-20	No
25 E. Gallup/ Hogback	65 Prewitt	Alluvium Chinle Group	Gallup E. Gallup Church Rock Pinedale Ft. Wingate Foster Canyon Cont. Divide Thoreau Thoreau NE	sand, silt, clay minor gravel sandstone shale/claystone conglomerate	Yes/ Possible	SM ML MH CL CH N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Perched Perched Perched	Yes Yes Yes	No No No	Possible Not Likely Not Likely	Possible Possible Possible	No No No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 N/A N/A N/A	F to G P to F P P to F P G P to F G	No Possible Possible Possible Possible No Possible No	Yes Yes No No Yes No Yes No	Yes Possible Possible Possible Possible No Possible No	No No No Possible Yes No Yes No	L to M L to H L to H L to H L to H L to M L to H L to M	L to M M to H M to H M to H M to H L to M M to H L to M	0.05-0.68	Poor-Good	0-36	Poor-Good	20-87	V Poor-V Good	26-27 WB 26-27 EB 30-31 WB 38-39 WB 50-51 WB 54-55 EB 56-57 WB 56-57 EB 57-58 WB 61-63 EB	25-26 26-27 WB 26-27 EB 27-30 WB 27-54 EB 30-31 WB 31-38 WB 38-39 WB 39-50 WB 50-51 WB 51-56 WB 54--55 EB 55--56 EB 56-57 WB 56-57 EB 57-58 WB 57-61 EB 58-65 WB 61-63 EB 63-65 EB	Low Med Med Low Med Low Med Low Med Low Med Low Med Low Med Low Med Low Med Low	<10-20 <5-15 <5-15 <10-20 <10-20 <5-15 <10-20 <5-15 <10-20 <5-15 <10-20 <10-20 <10-20 <3-10 <10-20 <5-15 <10-20 <10-20 <5-15 <10-20 <10-20	No Probable Probable No Probable No Probable No Probable No Probable Yes No Yes Probable Probable No Probable No Probable No	25-30 30-37 47-56 56-65	Poor-Fair Fair-Good Fair Fair-Good	Med Low Low Low	<5-15 <10-20 <10-20 <10-20	Probable No No No
65 Prewitt	96 McCartys	Alluvium Dakota Sandstone/ Mancos Shale Basaltic to Andesitic Flows Chinle Group San Andres Formation Dakota Sandstone	Bluewater Milan Grants El Malpais Grants SE Lobo Canyon McCarty's	sand, silt, clay minor gravel sandstone shale Volcanic flows shale/claystone conglomerate Dolomite Limestone sandstone	Yes/ Possible	SM ML MH CL CH minor Variable N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Drainages Perched Perched Perched Perched Perched Perched Perched Perched Perched Perched	Yes Yes Yes Yes Yes Yes Yes Yes	Yes Yes No No No No No No	Yes Possible Possible Not Likely Not Likely Yes Possible Yes Possible	Yes Possible Possible Possible Possible Possible Possible Possible Possible	No No No No No Yes No No No No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 Variable N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	F to G P to F P P to F P P to G P to G P to G G P to F G G G G G G	No Possible Possible Possible Possible No No No No Possible No No No No No No	Yes Yes No No Possible No No No No Yes No No No No No No	Yes Possible Possible Possible Possible Yes No No No Possible No No No No No No	No No No No No No No No No No No No No No No No	L to M L to H L to H L to H L to H L to H L to H L to H L to H L to H L to M L to M L to M L to M L to M L to M	L to M M to H M to H M to H M to H M to H M to H M to H M to H M to H L to M L to M L to M L to M L to M L to M	0.05-0.39	Fair-Good	0-25	Poor-Good	18-87	V Poor-V Good	66-67 WB 78-80 WB 80-81 WB 82-85 EB 92-93 WB 93-94 EB 95-96 WB	65-66 WB 65-82 EB 66-67 WB 67-78 WB 78-80 WB 80-81 WB 81-92 WB 82-85 EB 85-93 EB 92-93 WB 93-95 WB 93-94 EB 94-96 EB 95-96 WB	Low Low High Low Med High Low Med Low Med Low High Low Med	<10-20 <10-20 <3-10 <10-20 <5-15 <3-10 <10-20 <5-15 <10-20 <5-15 <10-20 <3-10 <10-20 <10-20 <3-10 <10-20	No No Yes No Probable Yes No Probable No Probable No Yes No No Yes No	65-96	Fair-Good	Low	<10-20	No
96 McCartys	105 Seama	Alluvium Dakota Sandstone/ Mancos Shale Basaltic to Andesitic Flows Chinle Formation	McCarty's Cubero	sand, silt, clay minor gravel sandstone shale Volcanic flows sandstone shale/claystone conglomerate	Yes/ Possible	SM ML MH CL CH N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Perched Perched Perched	Yes Yes Yes	Yes No No	Possible Not Likely Possible	Possible Possible Possible	No No No No No No No No No No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	F to G P to F P P to F P P to G G P to F G P to G G G G G G G	No Possible Possible Possible Possible No No Possible No No No No No No No No	Yes Yes No No No No Yes Yes No No No No No No No No	Yes Possible Possible Possible Possible No Yes Yes No No No No No No No No	No No No No No No No No No No No No No No No No	L to M L to H L to H L to H L to H L to H L to H L to H L to H L to H L to M L to M L to M L to M L to M L to M	L to M M to H M to H M to H M to H M to H M to H M to H M to H M to H L to M L to M L to M L to M L to M L to M	0.07-0.53	Poor-Good	0-19	Fair-Good	14-87	V Poor to V Good	96-105 WB 96-99 EB 99-100 EB 100-105 EB	96-105 WB 96-99 EB 99-100 EB 100-105 EB	Low Low High Low	<10-20 <10-20 <3-10 <10-20	No No Yes No	96-105	Fair-Good	Low	<10-20	No
105 Seama	129 E. of NM 6	Alluvium (minor) Basaltic to Andesitic Flows Morrison Formation San Rafael Group Chinle Formation	Laguna Mesita Mesita South NM State Geology	sand, silt, clay minor gravel Volcanic flows siltstone shale/claystone sandstone sandstone/siltstone Sandstone shale/claystone coongolmerate	Yes	SM ML MH CL CH N/A N/A N/A N/A N/A N/A N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Perched Perched Perched Perched Perched Perched Perched Perched Perched	Yes Yes Yes Yes Yes Yes Yes	No No No No No No No	Yes Not Likely Not Likely Possible Not Likely Possible Possible	Possible Possible Possible Possible Possible Possible Possible	No No No No No No No No No No No No No No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	F to G P to F P P to F P P to G P to F P to G G G F to P G G G G G	No Possible Possible Possible Possible No No Possible No No Possible No No No No No	Yes Yes No No No No Yes Yes No No No No No No No No	Yes Possible Possible Possible Possible No Yes Yes No No No No No No No No	No No No No No No No No No No No No No No No No	L to M L to H L to H L to H L to H L to M L to H L to M L to H L to H L to M L to M L to M L to M L to M L to M	L to M M to H M to H M to H M to H L to M M to H L to M M to H M to H L to M L to M L to M L to M L to M L to M	0.06-0.41	Poor-Good	0-46	Poor-Good	13-87	V Poor-V Good	105-106 WB 106-109 WB 106-107 EB 116-118 WB 116-119 EB 118-119 WB 119-124 WB 119-122 EB 122-124 EB 124-125 WB 124-126 EB 125-129 WB 126-129 EB	105-106 WB 105-106 EB 106-109 WB 106-107 EB 107-116 EB 109-116 WB 116-118 WB 116-119 EB 118-119 WB 119-124 WB 119-122 EB 122-124 EB 124-125 WB 124-126 EB 125-129 WB 126-129 EB	High Low Med High Low Med Low Med High Med High Med High Med High Med High Med	<3-10 <10-20 <5-15 <3-10 <10-20 <10-20 <5-15 <5-15 <3-10 <5-15 <3-10 <5-15 <3-10 <5-15 <3-10 <5-15 <3-10 <5-15	Yes No Probable Yes No No Probable Probable Yes Probable Yes Probable Yes Yes Probable Probable Yes Probable	105-114.5	Fair-Good	Low	<10-20	No
129 E. of NM 6	141 Rio Puerco	Alluvium Eolian Deposits Santa Fe Formation Dakota Sandstone/ Mancos Shale San Rafael Group	Mesa Gigante Canoncito School NM State Geology	sand, silt, clay minor gravel sandstone shale sandstone/siltstone	Yes/ Possible	SM ML MH CL CH SP-SM SM CL ML N/A SP-SM SM CL ML N/A N/A N/A	Drainages Drainages Drainages Drainages Drainages Drainages Drainages Drainages Drainages Perched Drainages Drainages Drainages Drainages Perched Perched Perched	No No No	No No No	N/A N/A N/A	Possible Possible Possible	No No No No No Yes Yes Yes Yes No Yes Yes Yes Yes No No No	A-2-4/A-4 A-4 A-7-5 A-6/A-7-6 A-7-6 A-2-4 A-2-4/A-4 A-6 A-4 N/A A-2-4 A-2-4/A-4 A-6 A-4 N/A N/A N/A	F to G P to F P P to F P F to G F to G P to F P to F P to G F to G F to G P to F P to F G P to G G	No Possible Possible Possible Possible No No Possible Possible No No No Possible Possible No No No	Yes Yes No No No Yes Yes No Possible No Yes Yes No Possible No No No	Yes Possible Possible Possible Possible No Yes Possible Possible No No Yes Possible Possible No No No	No No No No No No No No No No No No No No No No No	L to M L to H L to H L to H L to H L to M L to M L to H L to H L to H L to M L to M L to H L to H L to M L to H L to H	L to M M to H M to H M to H M to H L to M L to M M to H M to H M to H L to M L to M M to H M to H L to M M to H M to H	0.07-.041	Poor-Good	0-34	Poor-Good	22-87	V Poor-V Good	129-132 WB 129-131 EB 131-132 EB 132-137 EB 136-138 WB	129-132 WB 129-131 EB 131-132 EB 132-136 WB 132-137 EB 136-138 WB 137-141 EB 138-141 WB	Med Med High Low Med Med Low Low	<5-15 <5-15 <3-10 <10-20 <5-15 <5-15 <10-20 <10-20	Probable Probable Yes No Probable Probable No No	129-132	Poor-Fair	Med	<5-15	Probable
141 Rio Puerco	150 Atrisco Vista Blvd.	Eolian Deposits Basaltic to Andesitic Flows (isolated) Santa Fe Formation	La Mesita Negra NM State Geology Albuquerque West	wind blow soils Volcanic flows Cemented soils	No	SP-SM SM CL ML N/A N/A SP-SM SM CL ML	Drainages Drainages Drainages Drainages Perched Perched Drainages Drainages Drainages Drainages	No	No	N/A	No No	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	A-2-4 A-2-4/A-4 A-6 A-4 N/A N/A A-2-4 A-2-4/A-4 A-6 A-4	F to G F to G P to F P to F P to G P to G F to G F to G P to F P to F	No No Possible Possible No No No No Possible Possible	Yes Yes No Possible No No Yes Yes No Possible	Yes Yes Possible Possible No No No No Possible Possible	No No No No No No No No No No	L to M L to M L to H L to H L to H L to H L to M L to M L to H L to H	L to M M to H M to H M to H M to H M to H L to M L to M M to H M to H	0.07-0.52	Poor-Good	0-22	Poor-Good	25-87	V Poor-V Good	148-149 WB	141-148 WB 141-150 EB 148-149 WB 149-150 WB	Low Low High Low	<10-20 <10-20 <3-10 <10-20	No No Yes No	141-150	Good	Low	<10-20	No

Note: Please refer to the complete Geotechnical Scoping Report (Terracon Project No. 662152109 Revison No. 1) for assumptions and limitations used to generate the data and recommendations outlined in the table above.