Western Technologies Inc.

GEOTECHNICAL EVALUATION REPORT

DENNEHOTSO LOOP ROAD IMPROVEMENTS
Dennehotso, Arizona
WT Reference No. 3127JS001

PREPARED FOR:
Dibble Engineering
7500 North Dreamy Draw Drive, Suite No. 200
Phoenix, Arizona 85020-4996

March 22, 2017

Roger K. Southworth, P.E.
Managing Director

Arm ando de la Rocha, P.E.
Senior Geotechnical Engineer

Western Technologies Inc.
The Quality People
Since 1955

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March 22, 2017

Dibble Engineering
7500 North Dreamy Draw Drive, Suite 200
Phoenix, Arizona 85020-4996

Attn: Mr. Drew Spear, P.E.

Re: Geotechnical Evaluation
Dennehotso Loop Road Improvements
Dennehotso, Arizona

Job No. 3127JS001

Western Technologies Inc. has completed the geotechnical evaluation for the above-referenced project. The results of our evaluation, including the boring location diagram, boring logs, laboratory test results, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. Please do not hesitate to contact us if the design conditions change or if you have any questions concerning this report. We look forward to working with you on future projects.

Sincerely,
WESTERN TECHNOLOGIES INC.

Roger K. Southworth, P.E.
Managing Director

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GEOTECHNICAL EVALUATION
DENNEHOTSO LOOP ROAD IMPROVEMENTS
DENNEHOTSO, ARIZONA

JOB NO. 3127JS001

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the reconstruction of the Dennehotso Loop Road. The purpose of these services is to provide information and recommendations for roadway reconstruction. The results of the field exploration and the field and laboratory testing programs are presented in the Appendices.

2.0 PROJECT DESCRIPTION

The project will consist of reconstructing the Dennehotso Loop Road. The reconstruction route includes N6460 and N6461, and two access roads that extend from US Highway 160 to N6460. The reconstruction will include approximately 6 miles of roadway and will follow the alignments of the current roadways. Grade changes of less than five feet will be required to develop the proposed finish site grades. The proposed reconstruction is shown on the attached *Site Location Diagram* (Plate 1).

3.0 SCOPE OF SERVICES

3.1 Field Exploration

Thirty borings were drilled for this project to a depth of 10 feet. The borings were drilled at the approximate locations indicated on the attached *Boring Location Diagram* (Plates 2 through 5). The approximate station number and ground surface elevation at each boring location is shown on the attached boring logs.

A WT engineer monitored the drilling operations and prepared a field log for each boring. These logs contain visual classifications of the materials encountered during drilling, as well as interpolation of the subsurface conditions between samples.

The final boring logs, included in Appendix A, represent our interpretation of the field logs and may include modifications based on laboratory observations of the recovered soil samples. The final logs describe the materials encountered, their thicknesses, and the depths at which samples were obtained.

The Unified Soil Classification System was used to classify the soil. The soil classification symbols appear on the boring logs and are briefly described in Appendix A.

3.2 Laboratory Testing

Laboratory tests were performed on representative samples to aid in material classification and to estimate the pertinent engineering properties of the soil. Testing was performed in general accordance with applicable ASTM methods. The following tests were performed and the results are presented in Appendix B.

- Grain Size Distribution
- Water Content
- Liquid and Plastic Limits
- Sulfates

The laboratory test results were used to develop the recommendations contained in this report.

3.3 Analyses and Report

Analyses were performed and this report was prepared for the exclusive purpose of providing geotechnical engineering information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as required to satisfy the purpose previously described.

4.0 SITE CONDITIONS

4.1 Surface

The existing roadways are typically unimproved with the road surface consisting of native silty sand and/or sandstone bedrock. The roads drain by sheet flow to ditches along the sides of the roads.

4.2 Subsurface

The borings typically encountered silty sand underlain by sandstone. The depth to sandstone varied from being exposed at the ground surface to greater than 10 feet, the maximum depth explored. Exceptions to this general stratigraphy were encountered in Borings B-14, B-15, and B-20, where a layer of lean clay was encountered at depths of about 2 to 5 feet. In addition, silty sand fill was encountered in Boring B-20 to a depth of about 2 feet. Groundwater was not encountered in the borings during drilling.

5.0 PAVEMENT RECOMMENDATIONS

5.1 General

The recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0, **Project Description**, and the assumption that the soil and subsurface conditions are those disclosed by the borings. Others may change the plans, final elevations, or details of the project during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

5.2 Design Analysis

The pavement design was performed in accordance with AASHTO design procedures using commercial computer software. A description of the pavement design methodology and recommended pavement sections are provided in the following sections.

5.3 Design Traffic Loading

The design traffic loading is based upon information contained in Average Daily Traffic (ADT) Reports dated April 2013. The reports included traffic counts at two locations; one located

0.7 miles northwest of US Highway 160 and N6460, and one located 0.2 miles east of the BIA School Access Road. The reports indicated average daily traffic (ADT) of 269 and 187 vehicles per day (VPD), respectively. The studies did not include determining the amount of truck traffic. The reports indicated a growth factor of 2 percent. Copies of the reports are attached in Appendix C.

The design lane traffic loading was based on an average daily traffic (ADT) of 269 vehicles per day. A growth factor of 2 percent and a lane distribution factor of 1.0 was assumed for design. The traffic distribution was based upon 98% pickup trucks and 2% combination trucks. The design period for the pavement was 10 years. The pavement design was therefore based upon a total traffic loading of 26,663 18-kip equivalent single-axle loads (ESALs). Detailed ESAL calculations are presented in Appendix C.

5.4 Design Parameters

The following parameters were used in the pavement design:

TABLE 1 –PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
18-kip Equivalent Single-Axle Loads, ESALs	26,663
Reliability, R	70%
Overall Deviation, S_O	0.5
Initial Serviceability	4.5
Terminal Serviceability	2.5
Effective Soil Resilient Modulus, $(M_R)_{eff}$	20,000 psi
Base Course Structural Layer Coefficient	0.12
Asphalt Structural Coefficient	0.44

The design effective soil resilient modulus was based upon published correlations between the soil classification and the resilient modulus.

5.5 Recommended Pavement Sections

On the basis of the above design criteria, pavement sections were developed for three different scenarios; aggregate surfaced, chip-seal, and asphalt pavement. The recommended sections for each of these alternatives are presented in the following table.

TABLE 2 –RECOMMENDED PAVEMENT SECTIONS

Layer Component	Layer Thickness		
	Alternative No. 1 Aggregate Surface	Alternative No. 2 Asphalt Pavement	Alternative No. 3 Chip Seal
HMAC	-	2 inches	1 inch
Base Course	9 inches	4 inches	8 inches
Compacted Soil Subgrade	8 inches	8 inches	8 inches

The output sheets from the PaveXpress software used in the analysis and the pavement design calculations are presented in Appendix D.

The "design life" of a pavement is defined as the expected life at the end of which reconstruction of the pavement will need to occur. Pavement construction should be performed in accordance with the *Navajo Nation Road Standards and Engineering Specifications for Earth/Dirt and Gravel Roads*. The gradient of paved surfaces should ensure positive drainage. Water should not be allowed to pond in areas directly adjoining paved sections.

6.0 EARTHWORK

6.1 General

The conclusions contained in this report are contingent upon compliance with recommendations presented in this section. Any excavating, trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted, and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities, or backfilling occurs.

6.2 Materials

The on-site soil can be used as embankment fill and as fill in the planned pavement areas. Imported fill should have a minimum effective soil resilient modulus of 20,000 psi.

6.3 Corrosivity

Nine soil sulfate tests were performed in accordance with EPA Method 300.0. The test results indicated sulfate contents as high as 3,200 parts per million (ppm). The chemical test results indicate that the soils at the site classify as corrosive to concrete. We recommended that all concrete in contact with the site soil be made with Type V or equivalent cement, as set forth in ACI 318-4.3.

6.4 Compliance

Recommendations for pavement elements supported on compacted fill or prepared subgrade depend upon compliance with the **Earthwork** recommendations. To assess compliance, observation and testing should be performed under the direction of the project geotechnical engineer.

7.0 LIMITATIONS

This report has been prepared assuming the project criteria described in **Section 2.0**. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, WT should be contacted in order to assess the effect that such variations may have on our conclusions and recommendations.

The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced borings. The attached logs are an indicator of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure, however variations can and often do exist. Whenever any deviation, difference or change is encountered or becomes known, WT should be contacted.

This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or

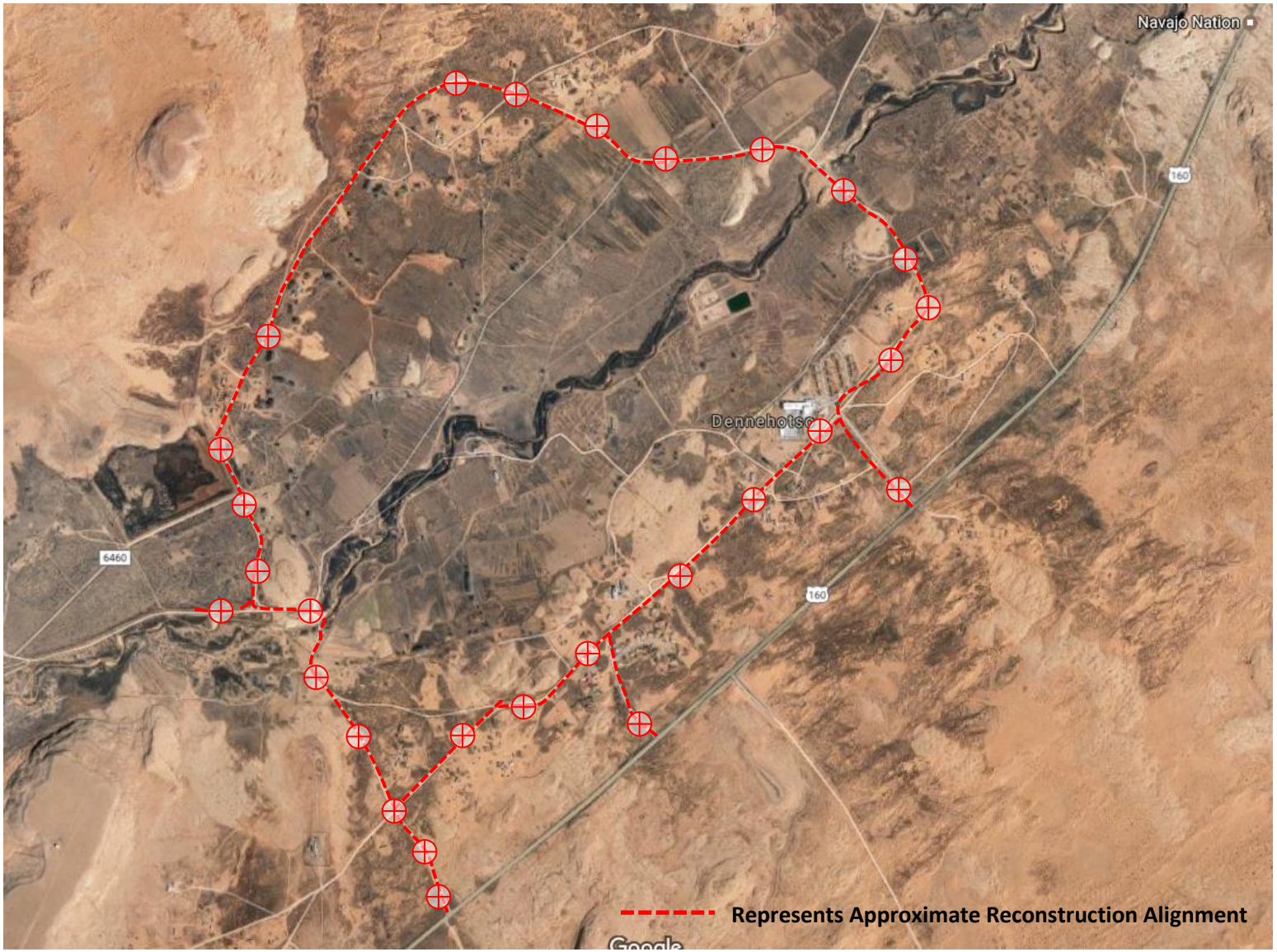
this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

This report is valid for the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall rely on this report without the express written authorization of WT.

8.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the boring locations and from laboratory tests. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.

N



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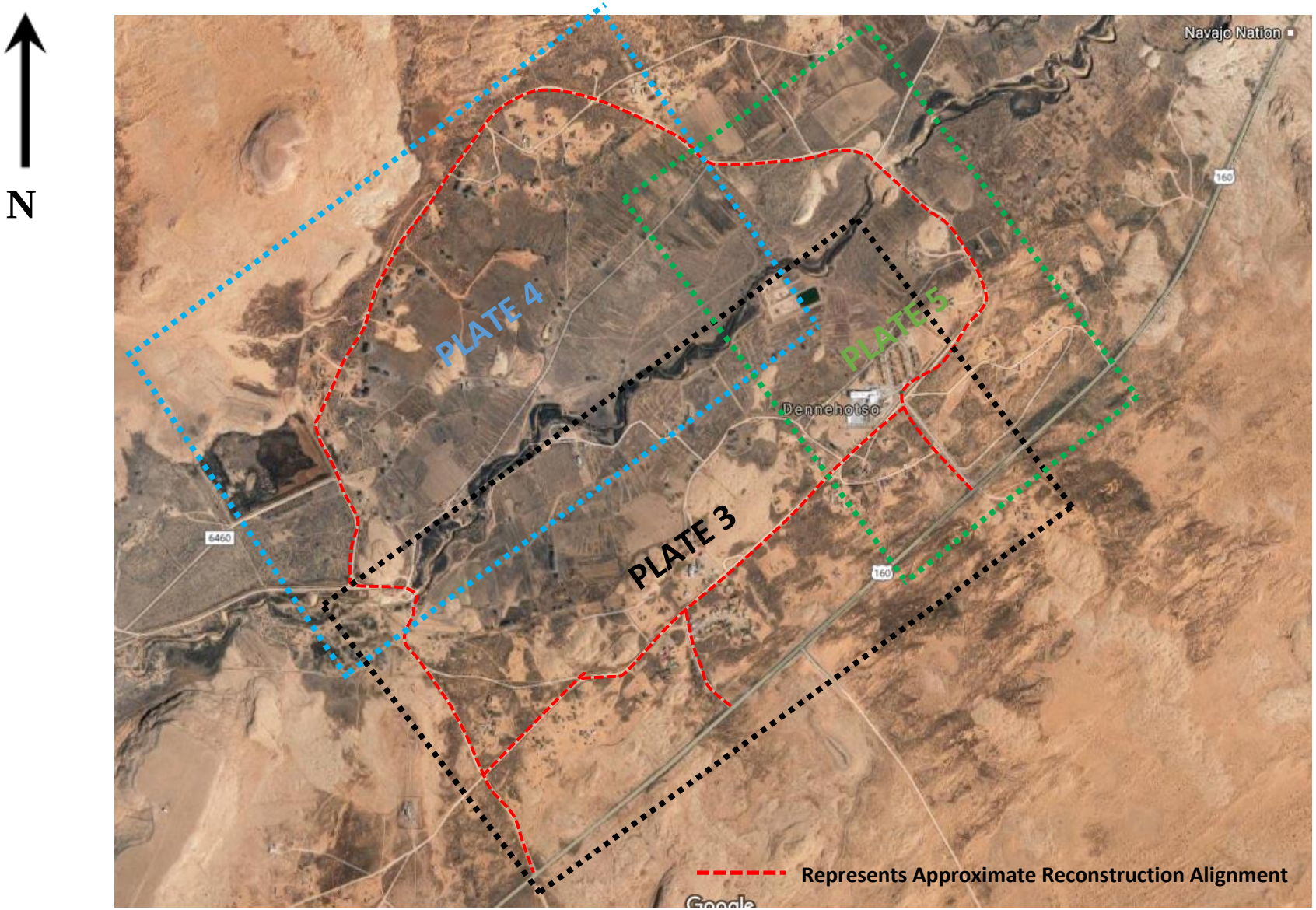
JOB NO.: 3127JS001

PLATE: 1

SITE LOCATION DIAGRAM



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BORING LOCATION DIAGRAM

PLATE: 2

⊕ APPROXIMATE BORING LOCATION

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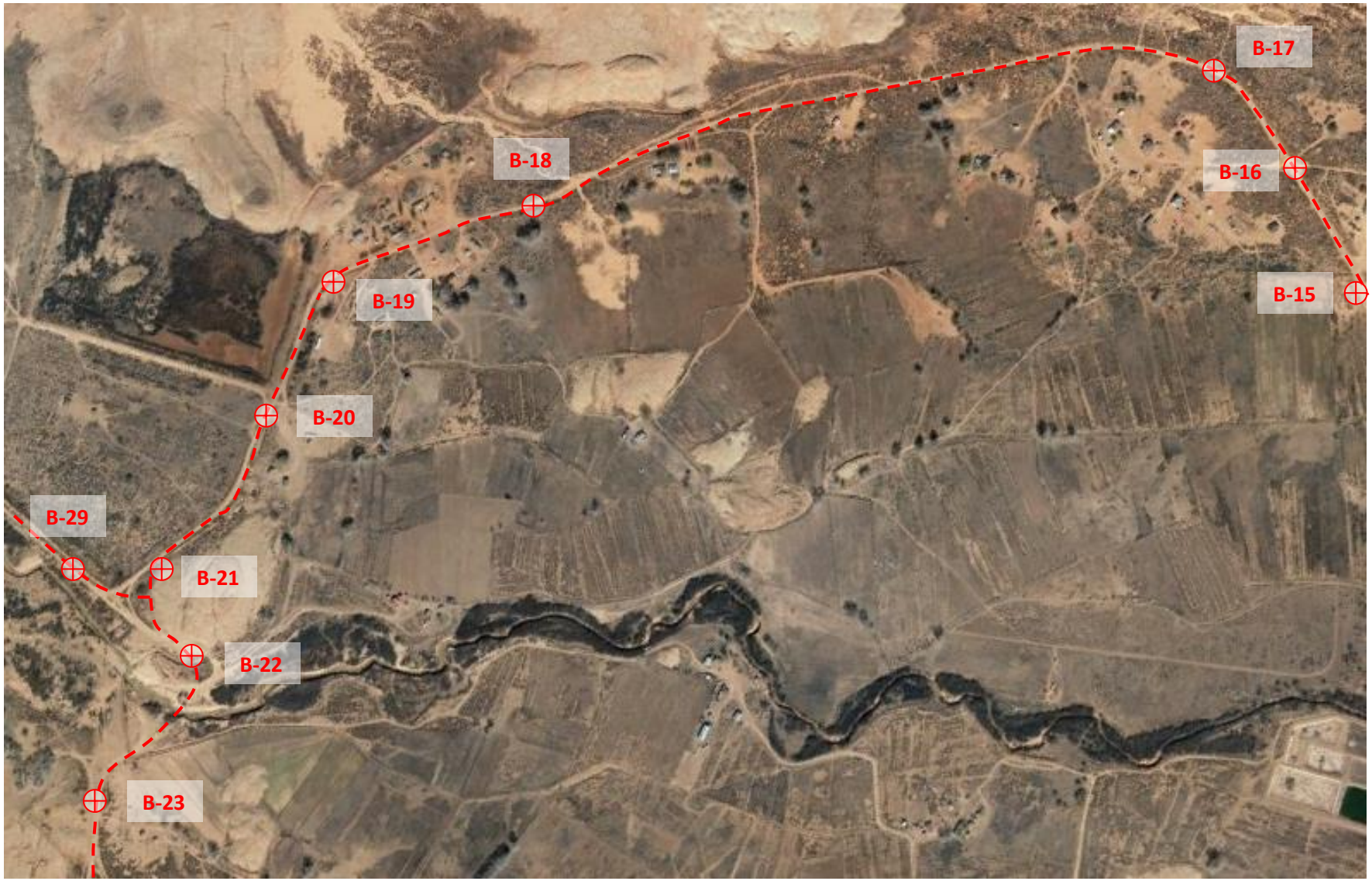
PLATE: 3

BORING LOCATION DIAGRAM



⊕ APPROXIMATE BORING LOCATION

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BORING LOCATION DIAGRAM

PLATE: 4

⊕ **Approximate Boring Location**

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BORING LOCATION DIAGRAM

PLATE: 5

APPENDIX A

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified aggregate material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson/Drilled Shaft	A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson).
Concrete Slabs-On-Grade	A concrete surface layer cast directly upon base course, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand and Gravel Base Course	A base course of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.

COARSE-GRAINED SOILS

LESS THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE
GP	POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	
GM	SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES	
GC	CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES	
SW	WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE
SP	POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	
SM	SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES	
SC	CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES	

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

FINE-GRAINED SOILS

MORE THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50
CL	LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY	
OL	ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY	
MH	ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT	SILTS AND CLAYS LIQUID LIMIT MORE THAN 50
CH	FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY	
OH	ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY	
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. – 12 in.
GRAVEL	No. 4 – 3 in.
Coarse	¾ in. – 3 in.
Fine	No. 4 – ¾ in.
SAND	No. 200 – No. 4
Coarse	No. 10 – No. 4
Medium	No. 40 – No. 10
Fine	No. 200 – No. 40
Fines (Silt or Clay)	Below No. 200

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

CLAYS & SILTS	BLOWS PER FOOT
VERY SOFT	0 – 2
SOFT	3 – 4
FIRM	5 – 8
STIFF	9 – 15
VERY STIFF	16 – 30
HARD	OVER 30

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

NOTE: Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1⅜-inch ID) split-barrel sampler (ASTM D1586).

PLASTICITY OF FINE GRAINED SOILS

PLASTICITY INDEX	TERM
0	NON-PLASTIC
1 – 7	LOW
8 – 20	MEDIUM
Over 20	HIGH

DEFINITION OF WATER CONTENT

DRY
SLIGHTLY DAMP
DAMP
MOIST
WET
SATURATED

The number shown in **"BORING NO."** refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features, or through the use of Global Positioning System (GPS) devices. The accuracy of GPS devices is somewhat variable.

"DRILLING TYPE" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

"N" in "BLOW COUNTS" refers to a 2-inch outside diameter split-barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows, or "blow count", of the hammer is recorded for each of three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2nd and 3rd increments) is defined as the Standard Penetration Test (SPT) "**N**"-Value. Refusal to penetration is considered more than 50 blows per 6 inches. (Ref. ASTM D1586).

"R" in "BLOW COUNTS" refers to a 3-inch outside diameter ring-lined split barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 12 inch is achieved or until refusal. The number of blows required to advance the sampler 12 inches is defined as the "**R**" blow count. The "**R**" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows per foot. (Ref. ASTM D3550).

"CS" in "BLOWS/FT." refers to a 2½-in. outside diameter California style split-barrel sampler, lined with brass sleeves, driven into the ground with a 140-pound hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows of the hammer is recorded for each of the three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2nd and 3rd increments) is defined as the "CS" blow count. The "CS" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows for a 6-inch increment. (Ref. ASTM D 3550)

"SAMPLE TYPE" refers to the form of sample recovery, in which **N** = Split-barrel sample, **R** = Ring-lined sample, **"CS"** = California style split-barrel sample, **G** = Grab sample, **B** = Bucket sample, **C** = Core sample (ex. diamond bit rock coring).

"DRY DENSITY (LBS/CU FT)" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol **"NR"** indicates that no sample was recovered.

"WATER (MOISTURE) CONTENT" (% of Dry Wt.) refers to the laboratory-determined water content in percent using the standard test method ASTM D2216.

"USCS" refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5041.0**

BORING NO. B-1

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 11+00

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PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-4**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5039.0**

BORING NO. B-2

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
8.9		G				SM		SILTY SAND; light orange-brown, damp
14.5		G						
		G			5			SANDSTONE; orange-brown, moderately hard
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 19+00

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PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-5**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5040.7**

BORING NO. B-3

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						SANDSTONE; orange-brown, moderately hard
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 30+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-6**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5036.4**

BORING NO. B-4

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G						SANDSTONE; orange-brown, moderately hard
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 41+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

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PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-7**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5033.1**

BORING NO. B-5

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G						SANDSTONE; orange-brown, moderately hard
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 52+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-8**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5026.2**

BORING NO. B-6

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
5.8		G				SM		SILTY SAND; light orange-brown, damp
		G			5			SANDSTONE; orange-brown, moderately hard
		G						
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 67+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-9**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5021.7**

BORING NO. B-7

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 79+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-10**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5017.1**

BORING NO. B-8

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
6.9		G						SANDSTONE; orange-brown, moderately hard
		G			5			
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 98+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-11**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5014.4**

BORING NO. B-9

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						SANDSTONE; orange-brown, moderately hard
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 106+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-12**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5003.0**

BORING NO. B-10

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
3.5		G						
		G			5	SP-SM		POORLY GRADED SAND; with silt, light brown, damp
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 115+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-13**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5005.2**

BORING NO. B-11

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			
		G						SANDSTONE; orange-brown, moderately hard
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 122+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-14**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5004.9**

BORING NO. B-12

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
5.2		G						
		G			5			SANDSTONE; orange-brown, moderately hard
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 153+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-15**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5008.5**

BORING NO. B-13

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 161+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-16**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5011.5**

BORING NO. B-14

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
		G						
		G			5	CL		LEAN CLAY; with interbedded layers of POORLY GRADED SAND, brown to red-brown, moist
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 169+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-17**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5017.1**

BORING NO. B-15

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
7.8		G				SM		SILTY SAND; light orange-brown, damp
18.4		G				CL		LEAN CLAY; with sand, brown to red-brown, moist
9.2		G			5	SM		SILTY SAND; light orange-brown, damp
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 177+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-18**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5021.7**

BORING NO. B-16

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 185+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-19**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5028.9**

BORING NO. B-17

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
5.2		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 193+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-20**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5033.1**

BORING NO. B-18

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 235+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-21**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5042.7**

BORING NO. B-19

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
		G		8.6				
		G			5			
					10			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: 243+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-22**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5038.4**

BORING NO. B-20

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		(FILL) SILTY SAND; light brown, damp
		G				CL		LEAN CLAY; dark gray, moist
						SM		SILTY SAND; light orange-brown, damp
		G			5			
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 251+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-23**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5037.7**

BORING NO. B-21

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 258+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-24**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5038.4**

BORING NO. B-22

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SP-SM		POORLY GRADED SAND; with silt, dark brown-gray, damp
3.8		G				SM		SILTY SAND; light orange-brown, damp
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 289+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-25**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5035.4**

BORING NO. B-23

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			SANDSTONE; orange-brown, moderately hard, dry
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 297+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-26**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5039.4**

BORING NO. B-24

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
		G						
		G			5			SANDSTONE; orange-brown, dry
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 318+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-27**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5041.0**

BORING NO. B-25

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
8.8		G				SM		SILTY SAND; light orange-brown, damp
		G						SANDSTONE; orange-brown, moderately hard, dry
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 326+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-28**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5048.9**

BORING NO. B-26

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
6.3		G				SM		SILTY SAND; light orange-brown, damp
		G						SANDSTONE; orange-brown, moderately hard, dry
		G			5			
					10			**Boring terminated at 10 feet**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 334+00

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-29**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5061.4**

BORING NO. B-27

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			SANDSTONE; orange-brown, moderately hard, dry
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. 340+00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-30**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5046.3**

BORING NO. B-28

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
2.6		G						
		G			5			SANDSTONE; orange-brown, moderately hard, dry
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No. +00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-31**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5036.4**

BORING NO. B-29

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7" HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light brown, damp
8.8		G						
		G			5			
		G						SANDSTONE; orange-brown, moderately hard, dry
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: +00

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-32**

BORING LOG

DATE DRILLED: **1-20-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **5040.4**

BORING NO. B-30

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Dumitru**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SM		SILTY SAND; light orange-brown, damp
		G						
		G			5			
					10			**Boring terminated at 10 feet**

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater not encountered during drilling**

Boring Location: Station No.

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED DENNEHOTSO LOOP ROAD**
REF. NO.: **3127JS001**

PLATE **A-33**

BORING LOG

APPENDIX B

Boring No.	Depth (ft)	USCS Class.	Water Content (%)	Particle Size Distribution (%) Passing by Weight						Atterberg Limits		Sulfates (ppm)	Remarks
				3"	¾"	#4	#10	#40	#200	LL	PI		
B-2	0 - 2	SM	8.9				100	99	20.3				
B-2	2 - 3	SM	14.5				100	99	27.0				
B-2	2 - 5	SM										< 11.2	
B-5	0 - 2	SM										190	
B-6	2 - 3	SM	5.8				100	87	14.1				
B-8	2 - 5	SM	6.9				100	98	37.6		NP		
B-10	0 - 2	SM										493	
B-10	2 - 5	SM	3.5				100	99	26.1				
B-12	2 - 5	SM	5.2				100	97	34.9			3,200	
B-15	0 - 2	SM	7.8				100	96	22.4				
B-15	2 - 5	CL	18.4				100	80	78.1				
B-15	5 - 10	SM	9.2				100	99	25.2		NP		
B-17	0 - 2	SM	5.2				100	99	8.2			14.2	
B-18	0 - 2	SM										21.7	
B-19	2 - 5	SM	8.6				100	95	48.6				
B-20	0 - 2	SM										< 10.6	
B-22	2 - 5	SM	3.8				100	95	21.4		NP	1,910	
B-25	0 - 1	SM	8.8				100	91	17.8				
B-26	0 - 2	SM	6.3				100	94	18.3				
B-28	2 - 4	SM	2.6				100	98	8.7				
B-29	0 - 2	SM										< 10.7	
B-29	2 - 5	SM	8.8					100	33.7		NP		

NOTE: NP = Non-plastic

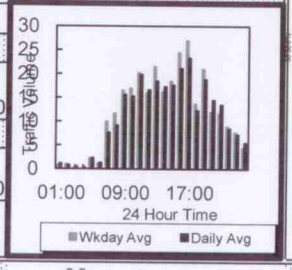
APPENDIX C

NAVAJO DIVISION OF TRANSPORTATION
TRIBAL TRANSPORTATION PLANNING PROGRAM
AVERAGE DAILY TRAFFIC (ADT) REPORT

Agency:	N33	**Class:**	4	**Mile Post:**	22.20	**ADT Mon/Yr:**	Apr-13	**ATR COORDINATES**	
Reservation:	780	**County:**	001	**Surface Type:**	1	**Start Date:**	4/25/2013	**(Degree-Minute-Seconds)**	**(N or W)**
Route:	**6460**	**State:**	04	**Roadway Width (ft.):**	23.0	**Start Time:**	00:00	36-50-21.1	N
Section:	30	**Community:**	Dennehotso			**End Date:**	4/30/2013	109-51-48.6	W
Data File:	'n6460mp-0-7.rdf'					**End Time:**	24:00		

Location: 0.7 mile northwest of Jct. US160 & N6460, (north of Laguna Wash).

DATE END TIME \ DAY	29 Mon	30 Tue	1 Wed	25 Thu	26 Fri	27 Sat	28 Sun	Wkdy Avg	Daily Avg
01:00	3	0		0	0	0	4	1	1
02:00	0	1		3	0	0	1	1	1
03:00	0	0		0	1	2	0	0	1
04:00	0	0		0	0	0	2	0	0
05:00	6	1		0	2	0	5	2	2
06:00	0	0		3	2	2	1	1	1
07:00	12	11		12	5	2	4	10	8
08:00	16	9		14	8	0	8	12	9
09:00	12	15		19	20	19	9	17	16
10:00	22	16		26	4	12	12	17	15
11:00	18	16		33	14	22	16	20	20
12:00	11	13		16	24	16	20	16	17
13:00	33	15		10	28	13	12	22	19
14:00	11	15		16	23	17	22	16	17
15:00	19	20		12	23	17	15	19	18
16:00	16	31		21	30	15	14	25	21
17:00	23	12		29	44	14	18	27	23
18:00	12	14		15	14	4	15	14	12
19:00	28	22		11	23	18	11	21	19
20:00	11	13		13	11	16	23	12	15
21:00	15	8		14	10	15	19	12	14
22:00	18	4		5	9	7	8	9	9
23:00	6	4		10	11	7	6	8	7
24:00	2	0		4	12	8	7	5	6
TOTALS	294	240		286	318	226	252	285	269
Daily Factors	*0.9161*	*1.1222*	*0.0000*	*0.9417*	*0.8470*	*1.9177*	*1.0688*	**ADT:**	**269**
Seven-day Total:	*1,616*								
% TRKS	**	**	**	**	**	**	**		
AM									
PEAK CT	22	16	0	33	24	22	20		
PEAK HR	10:00	10:00	#N/A	11:00	12:00	11:00	12:00		
PM									
PEAK CT	33	31	0	29	44	18	23		
PEAK HR	13:00	16:00	#N/A	17:00	17:00	19:00	20:00		
YEAR	2018		2023		2028		2033		
FADT (02%)	297		328		362		400		



COMMENTS:

1.) Daily Factor = 6 day avg. / daily total.
2.) % TRKS = Percent Trucks (** - No Truck Study Performed).
3.) Counter location is drawn utilizing the Map from either TOPO or ArcView program.
4.) The daily totals per lane includes the trucks.
5.) Set near proposed bridge site

COUNTER LOCATION =

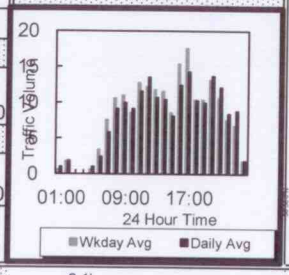
Counter Type: Gamma **Number:** 4997 **Battery Volt:** 6.3v **Hose layout:** '11' **Report By:** VHenderson

NAVAJO DIVISION OF TRANSPORTATION
TRIBAL TRANSPORTATION PLANNING PROGRAM
AVERAGE DAILY TRAFFIC (ADT) REPORT

Agency:	N33	**Class:**	5	**Mile Post:**	0.20	**ADT Mon/Yr:**	Apr-13	**ATR COORDINATES**
Reservation:	780	**County:**	001	**Surface Type:**	1	**Start Date:**	4/24/2013	**(Degree-Minute-Seconds) (N or W)**
Route:	**6461**	**State:**	04	**Roadway Width (ft.):**	20.0	**Start Time:**	00:00	36-50-51.8 N
Section:	10	**Community:**	Dennehotso			**End Date:**	4/30/2013	109-50-30.3 W
Data File:	'n6461mp0-2.rdf'					**End Time:**	24:00	

Location: 0.2 mile east of BIA School Access Road

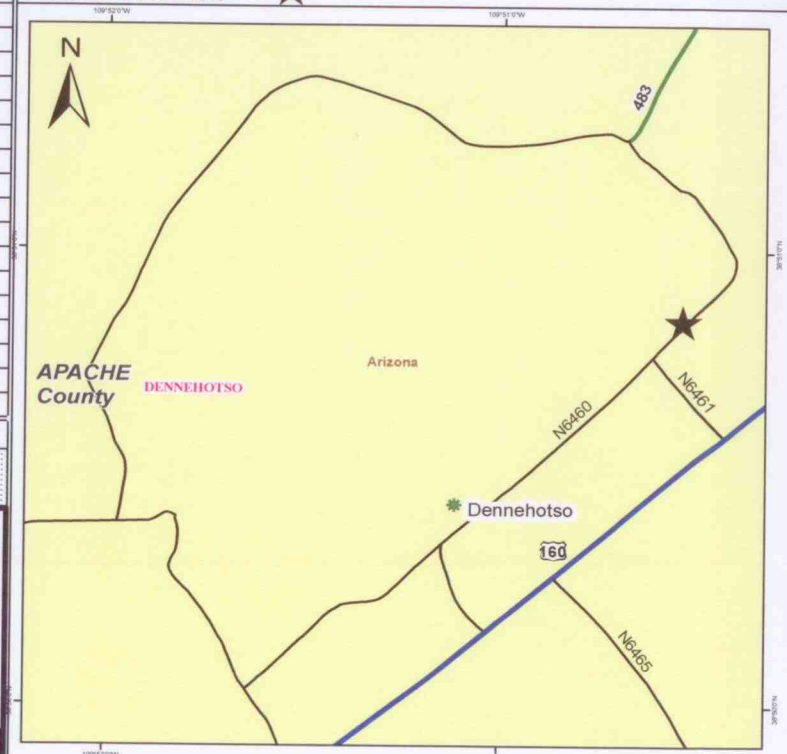
DATE END TIME \ DAY	29 Mon	30 Tue	24 Wed	25 Thu	26 Fri	27 Sat	28 Sun	Wkdy Avg	Daily Avg
01:00	1	0	1	1	0	2	2	1	1
02:00	2	1	1	3	2	1	3	2	2
03:00	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0
05:00	1	2	0	0	0	0	4	1	1
06:00	2	5	5	2	3	0	0	3	2
07:00	6	7	9	7	9	2	1	8	6
08:00	10	12	13	11	7	2	9	11	9
09:00	13	7	9	11	15	4	11	11	10
10:00	10	10	5	12	6	7	14	9	9
11:00	14	14	13	12	11	5	12	13	12
12:00	11	10	13	15	12	18	16	12	14
13:00	9	9	16	10	15	8	8	12	11
14:00	6	16	13	10	13	10	5	12	10
15:00	8	11	8	8	8	7	7	9	8
16:00	21	15	14	10	17	4	6	15	12
17:00	22	15	15	9	27	8	4	18	14
18:00	9	13	12	9	9	12	8	10	10
19:00	14	7	10	17	4	8	10	10	10
20:00	14	13	17	10	12	13	17	13	14
21:00	6	7	15	9	16	21	11	11	12
22:00	7	6	15	3	7	18	3	8	8
23:00	8	3	9	5	9	21	7	7	9
24:00	3	2	0	1	3	3	1	2	2
TOTALS	197	185	213	175	205	174	159	195	187
Daily Factors	*0.9485*	*1.0100*	*0.8773*	*1.0678*	*0.9115*	*1.0739*	*1.1752*	**ADT:**	**187**
Seven-day Total:	*1,308*								
% TRKS	**	**	**	**	**	**	**		
AM									
PEAK CT	14	14	13	15	15	18	16		
PEAK HR	11:00	11:00	08:00	12:00	09:00	12:00	12:00		
PM									
PEAK CT	22	16	17	17	27	21	17		
PEAK HR	17:00	14:00	20:00	19:00	17:00	21:00	20:00		
YEAR	2018		2023		2028		2033		
FADT (02%)	206		228		251		278		



COMMENTS:

1.) Daily Factor = 7 day avg. / daily total.
2.) % TRKS = Percent Trucks (** - No Truck Study Performed).
3.) Counter location is drawn utilizing the Map from either TOPO or ArcView program.
4.) The daily totals per lane includes the trucks.

COUNTER LOCATION =



Counter Type: Gamma **Number:** 3667 **Battery Volt:** 6.1' **Hose layout:** '11' **Report By:** VHenderson

ADT INTIAL	**269**
GROWTH RATE (%)	**2.00**
COORESPONDING GROWTH FACTOR	**10.95**

VEHICLE TYPE	**TOTAL VEHICLES**	**PERCENT**	**ESAL FACTOR**	**DESIGN ESAL**	
Automobiles	269	98	0.0008	0.21	
Trucks	269	2	1.2	6.46	
			TOTAL ADT	**6.67**	**ESAL/DAY**

FIRST YEAR TRAFFIC VOLUME: 365 days x 6.67 ESAL/Day = 2,435 ESALs

TEN YEAR DESIGN: 10.95 x 2,435 ESALs = 26,663 ESALs

AASHTO Traffic Growth Factors

Analysis Period Years (n)	Annual Growth Rate, Percent (g)							
	No Growth	2	4	5	6	7	8	10
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	2.0	2.02	2.04	2.05	2.06	2.07	2.08	2.10
3	3.0	3.06	3.12	3.15	3.18	3.21	3.25	3.31
4	4.0	4.12	4.25	4.31	4.37	4.44	4.51	4.64
5	5.0	5.20	5.42	5.53	5.64	5.75	5.87	6.11
6	6.0	6.31	6.63	6.80	6.98	7.15	7.34	7.72
7	7.0	7.43	7.90	8.14	8.39	8.65	8.92	9.49
8	8.0	8.58	9.21	9.55	9.90	10.26	10.64	11.44
9	9.0	9.75	10.58	11.03	11.49	11.98	12.49	13.58
10	10.0 →	10.95	12.01	12.58	13.18	13.82	14.49	15.94
11	11.0	12.17	13.49	14.21	14.97	15.78	16.65	18.53
12	12.0	13.41	15.03	15.92	16.87	17.89	18.98	21.38
13	13.0	14.68	16.63	17.71	18.88	20.14	21.50	24.52
14	14.0	15.97	18.29	19.16	21.01	22.55	24.21	27.97
15	15.0	17.29	20.02	21.58	23.28	25.13	27.15	31.77
16	16.0	18.64	21.82	23.66	25.67	27.89	30.32	35.95
17	17.0	20.01	23.70	25.84	28.21	30.84	33.75	40.55
18	18.0	21.41	25.65	28.13	30.91	34.00	37.45	45.60
19	19.0	22.84	27.67	30.54	33.76	37.38	41.45	51.16
20	20.0	24.30	29.78	33.06	36.79	41.00	45.76	57.28
25	25.0	32.03	41.65	47.73	54.86	63.25	73.11	98.35
30	30.0	40.57	56.08	66.44	79.06	94.46	113.28	164.49
35	35.0	49.99	73.65	90.32	111.43	138.24	172.32	271.02

*Factor = $\frac{(1+g)^n - 1}{g}$, where $g = \frac{\text{rate}}{100}$ and is not zero. If annual growth rate is zero, the growth factor is equal to the analysis period.

Note: The above growth factors multiplied by the first year traffic estimate will give the total volume of traffic expected during the analysis period.

APPENDIX D

PaveXpress

Project Information

Project Name	Dennehotso Loop Road
Project Description	
Estimated Completion Year	2018
State	Arizona
Roadway Classification	Residential/Collector

Design Parameters

Design Period (Years)	10 years
Reliability Level (R)	70 Z_R=-0.524
Combined Standard Error (S0)	0.5
Initial Serviceability Index (pi)	4.5
Terminal Serviceability Index (pt)	2.5
Change in Serviceability (ΔPSI)	2.00

Traffic Data

Completion Year Traffic	N/A
Load Equivalency Factor	N/A
Completion Year ESALs	N/A
Design Period	N/A
Future Traffic Growth Rate (%)	N/A
ESAL Growth Rate (%)	N/A
Total Design ESALs (W18)	27,000

Pavement Structure

Surface Lifts	None
Base Layers	**Type Layer Coef Drainage Thickness**
Resilient Modulus (MR)	20000 psi

Design Guidance

Required minimum design SN: 1.10

Layer Thicknesses (in)

Surface: 9.50

Total SN: 1.14

Design Notes

PAVEMENT DESIGN CALCULATIONS

Alternative No. 1 - Aggrergate Surface

	Thickness	Material Coefficient	Drainage	Value		
Base Course	9	0.12	1	1.08		
			Total SN	1.08	Required SN	1.10

Alternative No. 2 - Asphalt Pavememt

	Thickness	Material Coefficient	Drainage	Value		
Asphalt	2	0.44		0.88		
Base Course	4	0.12	1	0.48		
			Total SN	1.36	Required SN	1.10

Alternative No. 3 - Chip Seal

	Thickness	Material Coefficient	Drainage	Value		
Chip Seal	2	0.12		0.24		
Base Course	7	0.12	1	0.84		
			Total SN	1.08	Required SN	1.10