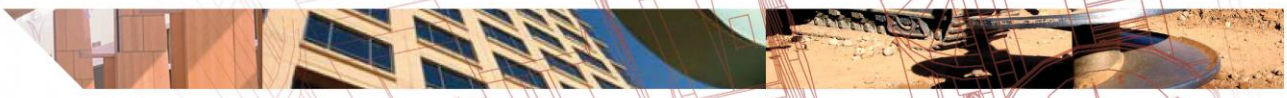


DESIGN MEMORANDUM
PROPOSED ARCH BRIDGE OVER ORAIBI WASH
BLACK MESA, ARIZONA
WT REFERENCE NO. 3120PS97

Project Description

The project will consist of constructing an arch bridge to carry BIA Route N8066(3) over the Oraibi Wash. The design recommendations presented herein were based upon the soil boring information and laboratory tests that were performed for the *Final Geotechnical Investigation and Foundation Recommendation Report* prepared by Amec Foster Wheeler dated June 15, 2016 (Project No. 17-2015-4045).

On a preliminary design basis the bridge is planned to be supported by spread footings designed for an allowable bearing pressure of approximately 4,000 pounds per square foot (psf). The footings are planned to have dimensions on the order of 11 feet by 136 feet and will have a bottom of footing elevation of approximately El. 2027 meters.

Subsurface Conditions

Borings B-1 through B-5 were drilled in the area of the proposed bridge. Copies of the test boring logs and the approximate boring locations are attached. The borings drilled along the top of the wash banks (Borings B-1 and B-2) typically encountered moderate-strength lean clay within the influence zone of the proposed foundations. The borings drilled in the bottom of the wash (Borings B-2, B-3, and B-5) typically encountered low-strength clays within the influence zone of the proposed foundations.

Design Recommendations

The soil at the proposed foundation bearing elevation exhibits low-strength characteristics and is not considered to the suitable for direct foundation support. The foundations should therefore be underlain by a layer of engineered fill in order to distribute the foundation loads over a wider area so that less load is transmitted to the underlying low-strength clay. Based upon the conditions encountered at the boring locations it is expected that it will be necessary to overexcavate the foundation area to depths of about 5 to 10 feet below the proposed bottom of footing. For design purposed it should be assumed that an

overexcavation depth of 10 feet will be required. It may be possible to reduce this overexcavation depth depending upon the conditions that are encountered during construction. The overexcavations should extend a lateral distance of at least one foot for every foot of fill that is required beneath the foundations. For example, if 10 feet of overexcavation is required, the overexcavations should extend a lateral distance of at least 10 feet beyond the outside edges of the foundations.

The foundation overexcavations should be backfilled to the design bearing elevation with imported engineered fill compacted to a minimum of 100 percent of the standard Proctor maximum dry density (ASTM D-698). The engineered fill should consist of a well-graded sand and/or sand and gravel approved by the project geotechnical engineer.

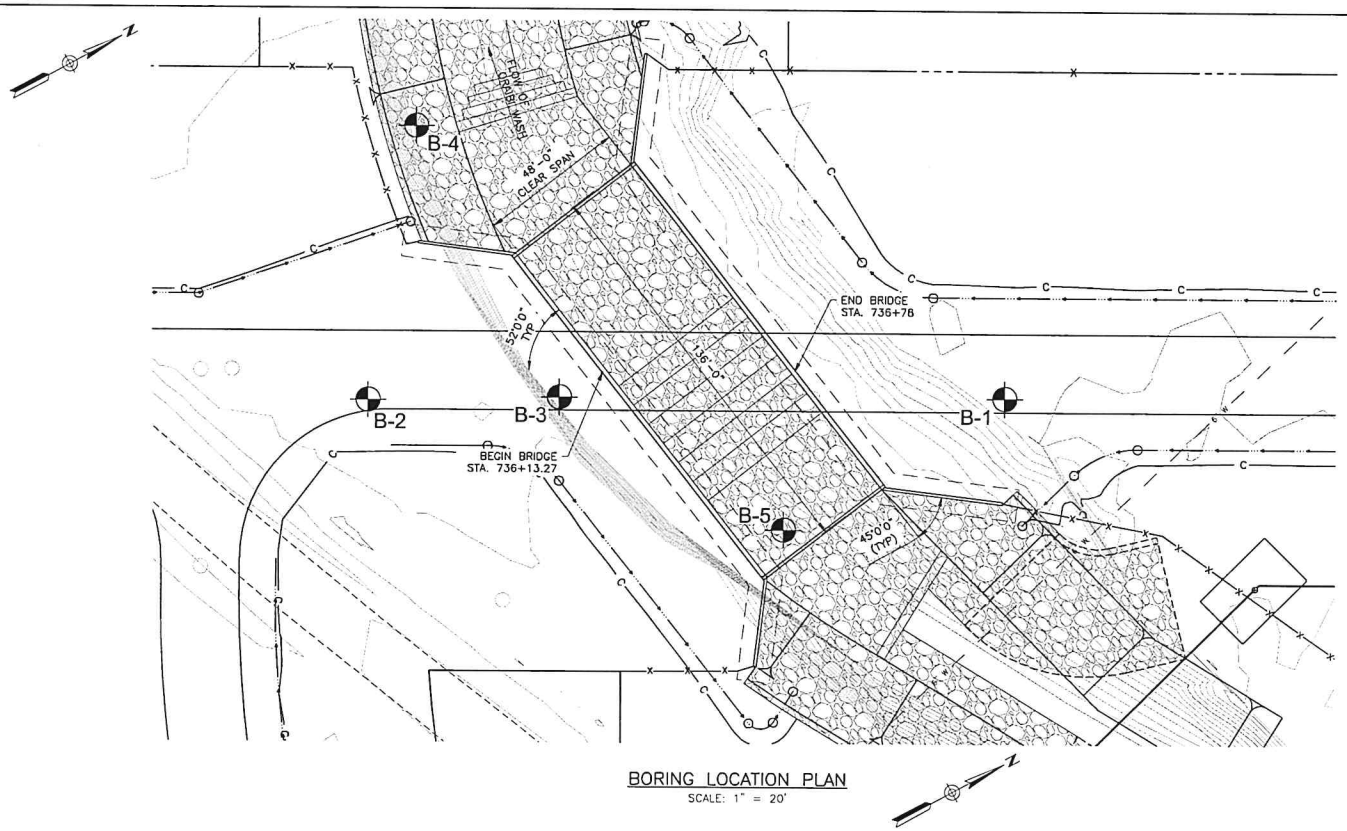
Relatively soft deposits may be present at the base of the overexcavation. This material may become disturbed by construction equipment traffic. It may be necessary to place a layer of course aggregate, possibly in conjunction with a geogrid, in order to develop a stable subgrade for fill placement and compaction.

Groundwater will likely be encountered in the overexcavation. Dewatering will be required so that the overexcavation remains dry during fill placement and compaction.

Prepared by: Roger K. Southworth, P.E.
Senior Geotechnical Engineer

Registered Professional Engineer (Civil)
CERTIFICATE NO.
68747
ROGER K.
SOUTHWORTH
DATE SIGNED
10/15/20
ARIZONA U.S.A.

Reviewed by: Randolph Marwig, P.E.
Senior Principal Geotechnical Engineer



BORING LOCATION PLAN

SCALE: 1" = 20'

STATE	PROJECT	SHEET NUMBER
AZ	N8066 / N8065 BLACK MESA	84

BORING NOTES:

1. GENERAL SOIL AND ROCK (WHERE ENCOUNTERED) STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON ENGINEERING INTERPRETATION OF AVAILABLE SUBSURFACE INFORMATION BY THE GEOTECHNICAL ENGINEER AND MAY NOT REFLECT ACTUAL VARIATION IN SUBSURFACE CONDITIONS BETWEEN BORINGS AND SAMPLES. THE LOCATION OF CONTACTS BETWEEN STRATA MAY BE GRADUAL RATHER THAN ABRUPT. CLASSIFICATION OF SOIL MATERIAL IS IN GENERAL ACCORDANCE WITH ASTM D 2488-93 AND IS PRESENTED IN THE GEOTECHNICAL REPORT.

2. THE OBSERVED WATER LEVELS AND/OR MOISTURE CONDITIONS INDICATED IN THE BORING LOGS ARE RECORDED AT THE TIME OF FIELD INVESTIGATION. THESE WATER LEVELS AND/OR MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO THE PREVAILING CLIMATE , RAINFALL, OR OTHER FACTORS AND ARE OTHERWISE DEPENDENT UPON THE DURATION OF AN METHODS USED IN THE FIELD INVESTIGATION PROGRAM.

3. SOUND ENGINEERING JUDGEMENT WAS EXERCISED IN PREPARING THE SUBSURFACE INFORMATION PRESENTED ON THESE SHEETS. THIS INFORMATION WAS PREPARED AND IS INTENDED FOR DESIGN AND ESTIMATING PURPOSES ONLY. ITS PRESENTATION ON THE PLANS OR ELSEWHERE IS FOR THE PURPOSE OF INTENDED USERS WITH ACCESS TO THE SAME INFORMATION AS WAS PROVIDED TO THE OWNER AND ITS DESIGNERS. INTERPRETATIONS OF SUBSURFACE INFORMATION ARE PRESENTED IN GOOD FAITH AND ARE NOT INTENDED AS A SUBSTITUTE FOR PERSONAL INVESTIGATION, INDEPENDENT INTERPRETATIONS, OR JUDGMENT OF THE CONTRACTOR.

4. A 140 POUND HAMMER, 30-INCH FREE FALL WAS USED TO DRIVE THE STANDARD PENETRATION TEST (SPT) SPLIT-SPOON SAMPLER AND THE RING-LINED SAMPLER IN GENERAL CONFORMANCE WITH ASTM D 1586-96 AND D 3550-01, RESPECTIVELY.

5. FOR FURTHER BORING INFORMATION, REFER TO THE GEOTECHNICAL REPORT PREPARED BY AMEC FOSTER WHEELER ENVIRONMENT & INFRASTRUCTURE INC., DATED JUNE 15, 2016, PROJECT NO. 17-2015-4045.

6. REACTION TO DILUTE HCl (AS PER ASTM D2488) DOES NOT NECESSARILY CORRELATE TO THE DEGREE OF CARBONATE CEMENTATION. FOR EXAMPLE A "STRONG" REACTION TO HCl AND A LOW SPT-N VALUE MAY INDICATE THAT THE SOIL PARTICLES ARE COATED WITH CALCIUM CARBONATE OR LIME BUT THE VOIDS ARE MOSTLY CLEAR (PARTICLES ARE NOT SIGNIFICANTLY CEMENTED TOGETHER); THEREFORE THE DENSITY IS LOOSE. IN OTHER CASES, SOIL MAY EXHIBIT "NO TO "WEAK" REACTION TO HCl BUT APPEAR TO BE STRONGLY CEMENTED DUE TO IN DURATION. THUS, THE USER SHOULD CONSIDER THE REPORTED REACTION TO HCl AND SPT-N VALUES IN CONJUNCTION WITH OTHER RELEVANT FACTORS TO EVALUATE THE DEGREE OF CEMENTATION AND ITS EFFECT ON CONSTRUCTION ACTIVITIES.

7. REFUSAL SPT-N VALUES MAY BE INDICATIVE OF THE PRESENCE OF COBBLES OR BOULDERS WHOSE SIZE CANNOT BE DETERMINED BY THE INVESTIGATIVE TECHNIQUES USED FOR THE THIS PROJECT. COBBLES AND BOULDERS WILL LIKELY BE ENCOUNTERED DURING THE CONSTRUCTION OF THE DRILLED SHAFTS. ADDITIONALLY, CEMENTED LAYERS MAY FORM COBBLE OR BOULDER SIZE PIECES WHEN BROKEN UP. THE CONTRACTOR SHOULD MOBILIZE THE APPROPRIATE EQUIPMENT FOR REMOVING THIS MATERIAL.

8. THE SITE SOILS CONTAINING RANDOM ZONES OF POORLY GRADED SANDS AND GRAVELS CAN BE PRONE TO CAVING. THEREFORE, LOCALIZED CAVING SHOULD BE ANTICIPATED DURING DRILLED SHAFT CONSTRUCTION. THESE LOCAL ZONES MAY BE UP TO 10-FEET THICK AND CAN OCCUR AT VARIOUS DEPTHS.

9. THE SITE SOILS CONTAIN RANDOM ZONES OF GRAVELS, COBBLES, AND BOULDERS MAY EXPERIENCE LARGE FLUID LOSS DURING SLURRY-ASSISTED DRILLED SHAFT CONSTRUCTION.

0' 10' 20' 40'

SCALE: 1"=20'

Dibble Engineering

PRELIMINARY SUBMITTAL

90%

NOT FOR CONSTRUCTION OR RECORDING

REVISION	BY	DATE

NAVAJO DIVISION OF TRANSPORTATION

N8066/N8065 BLACK MESA

SOIL BORING PLAN & NOTES

		DRAWING	SHEET
PROJECT MANAGER: AJS	DATE: 9/20		
LEAD DESIGNER: DMZ/JEN	DATE: 9/20		
ASBUILT BY:	DATE:	S17	84 OF 106
SCALE: AS NOTED			

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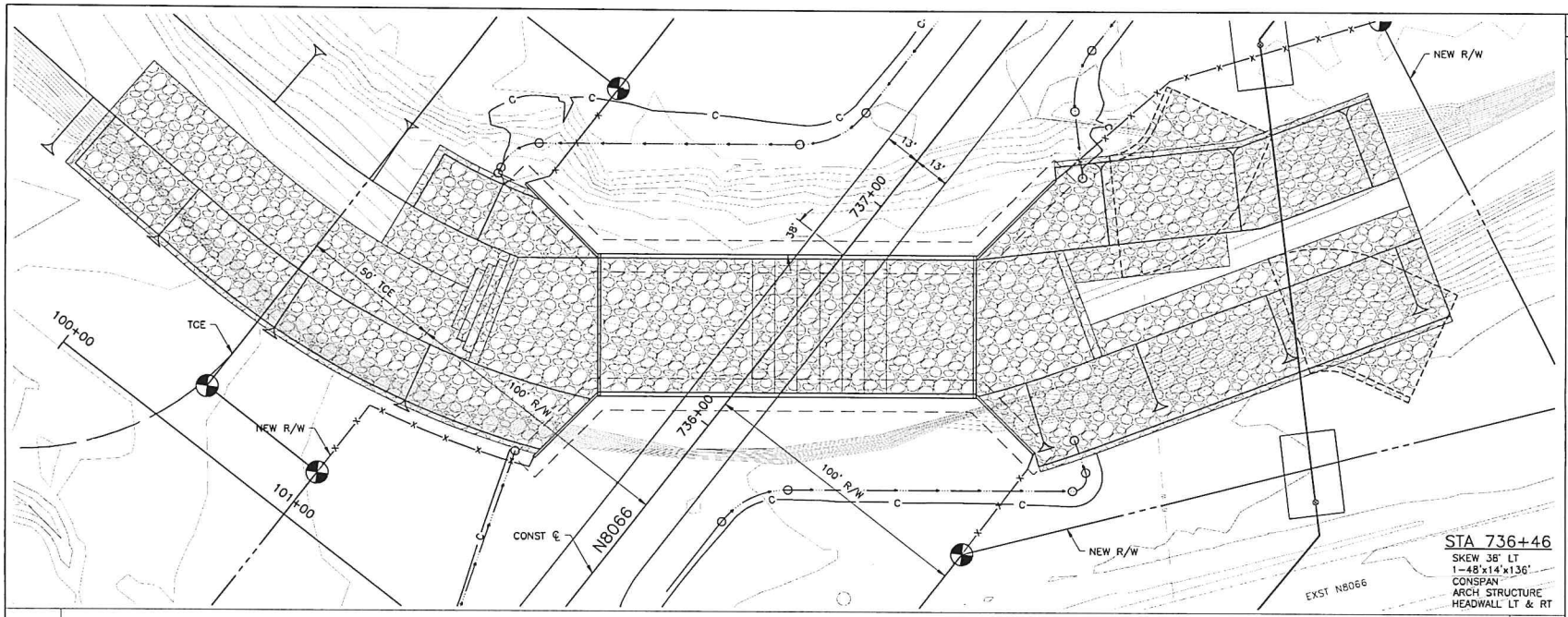
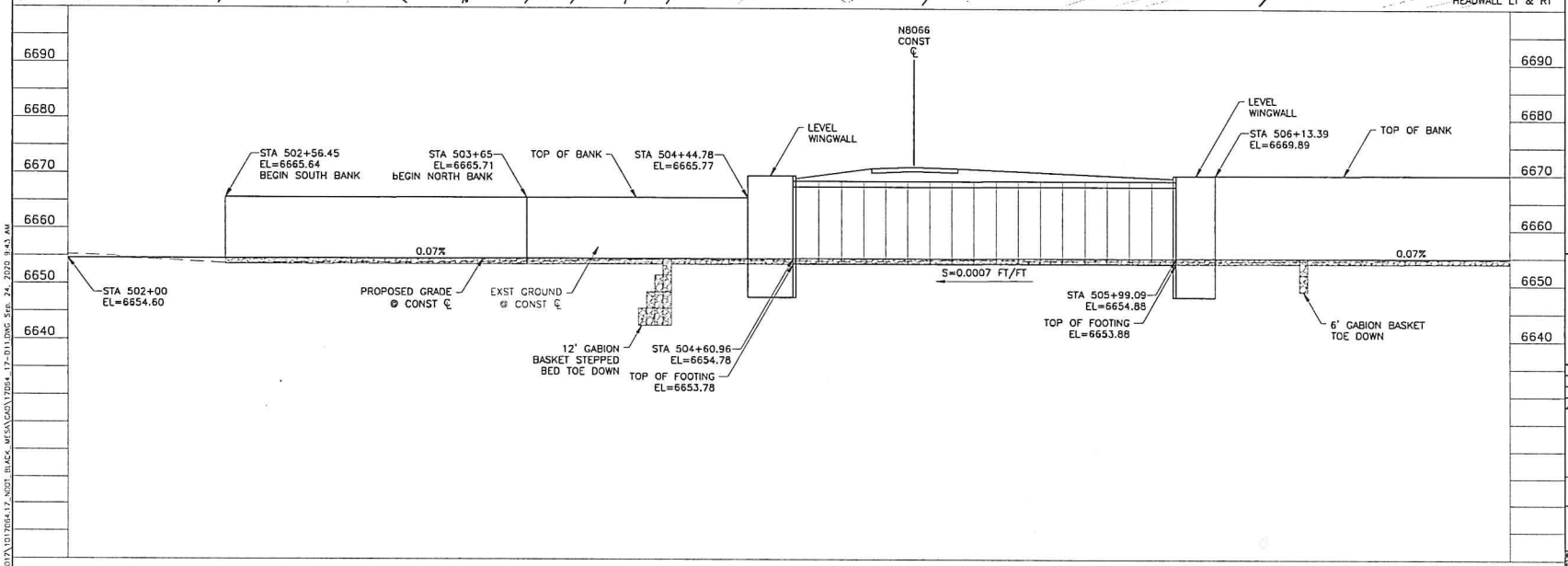
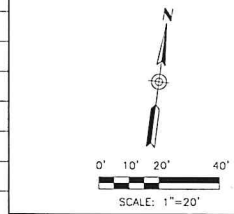




STATE	PROJECT	SHEET NUMBER
AZ	N8066 / N8065 BLACK MESA	58



Dibble Engineering

PRELIMINARY SUBMITTAL

90%

NOT FOR CONSTRUCTION OR RECORDING

REVISION	BY	DATE

NAVAJO NATION
DIVISION OF TRANSPORTATION

NAVAJO D.O.T.

N8066/N8065 BLACK MESA

CULVERT PLAN & PROFILES

PROJECT MANAGER: AJS	DATE: 9/20	DRAWING	SHEET
LEAD DESIGNER: IBM	DATE: 9/20		
ASBUILT BY:	DATE:	D15	58 of 106
SCALE: N/A			

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EAST ABUTMENT

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-2-16 to 2-3-16

LOCATION (M) N. 4022737.0 E. 583433.7
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.4m ± 6671.4'
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0.0	>4.5			S	5-6-9			CL	moist at surface frozen from 0 to 0.3m	**CLAY WITH SAND,** fine grained sand in zones, medium to high plasticity, dark brown
				A				to CH		note: some short calcium carbonate filaments below 0.6m
				S	13-8-11				moderately firm to very firm	
1.5	>4.5			S	12-14-17				slightly moist below 0.3m	
3.0				T		1433.7	13.5			
	2.50			S	10-12-11					note: clayey sand zones up to 100mm thick below 2.7m
								CL	slightly moist	**CLAY,** trace silt, fine grained sand, low to medium plasticity, brown
4.5				S	5-7-11				firm	
6.0	2.40			S	7-7-10					note: decrease in fines at 6m
~ BOTTOM OF FOOTINGS										
								CH	slightly moist	**CLAY,** trace fine grained sand, considerable calcium carbonate filaments, high plasticity, dark brown
						101 pcf				note: 8.75 kg/cm^2 Torvane Shear Test
7.5				U	39	1619.8	18.6		firm	

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	10.35	12:30	2-2-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-1

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-2-16 to 2-3-16

LOCATION (M) N. 4022737.0 E. 583433.7
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.4m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
								CH	slightly moist	**CLAY,** continued
				S	9-17-13				firm	note: some reddish-brown, iron-oxide staining
										note: decrease in sand below 8m
9.0	>4.5			S	9-13-17					31,951 psf note: 15.6 kg/cm^2 Torvane Shear Test
									moist at 10m	
▽ 10.5	2.10			S	1-3-3				very moist to wet at 10.35m	note: some clayey sand zones from 10m to 12m note: 4.5 kg/cm^2 Torvane Shear Test 9,216 psf
									medium stiff	
12.0	3.30			S	2-5-8				very moist	note: 12 kg/cm^2 Torvane Shear Test 24,578 psf
				U	15	1556.8	24.0		stiff to medium stiff below 12m	
									very moist to wet at 13m	
13.5	1.90			S	3-4-6				wet	note: 6 kg/cm^2 Torvane Shear Test 12,289 psf
15.0	1-1.2			S	1-4-4					note: 2.5 kg/cm^2 Torvane Shear Test note: increase in sand at 15m

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	10.35	12:30	2-2-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-1

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-2-16 to 2-3-16

LOCATION (M) N. 4022737.0 E. 583433.7
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.4m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
								CH	wet stiff to medium stiff	**CLAY,** continued
								SM	wet soft to very soft	**SILTY SAND,** predominantly fine grained, subangular to subrounded, nonplastic to low plasticity, light brown note: increase in fines in zones up to 150mm thick
16.5				S	1-3-3					
18.0				S	1-3-3					
19.5				S	2-2-2					note: clay with sand zones, high plasticity, up to 125mm thick below 19.2m note: rare coarse grained gravel at 19.5m
21.0				S	2-1-2			SC		note: decrease in fines at 21m note: rare coarse grained gravel at 21m
22.5				S	8-11-34					

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	10.35	12:30	2-2-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-1

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-2-16 to 2-3-16

LOCATION (M) N. 4022737.0 E. 583433.7
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.4m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
										MESAVERDE GROUP - WEPO FORMATION SANDSTONE, fine grained texture, moderately weathered with some staining, medium bedded, soft to very soft, light yellowish-gray note: dark gray to black laminated, soft mudstone below 23.9m
24.0				S	14-50/ 125mm					
25.5				S	50/ 125mm					
27.0				S	50/ 125mm					note: bluish-gray, very soft to soft sandstone in zones below 26.7m comprised of predominant quartz grains
28.5				S	50/ 100mm					note: moderately hard sandstone in zones below 28.2m
				S	50/ 50mm					Auger refused at 29.7m Sampler refused at 29.9m
30.0										

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	10.35	12:30	2-2-16
▼			

SAMPLE TYPE
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U - 76mm O.D. 61mm I.D. tube sample.
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LOG OF TEST BORING NO. B-1

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-30-16 to 1-31-16

LOCATION (M) N. 4022681.2 E. 583401.8
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.0m ± 6670'
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0.0				S A	7-6-8			CL/CH	very moist to wet at surface slightly moist below 0.15m	**CLAY,** trace fine grained sand, medium to high plasticity, brown
	3.2->4.5			S	12-15-19				moderately firm to very firm	note: some calcium carbonate filaments below 0.6m note: 3.25 kg/cm² Torvane Shear Test
1.5				T		1446.5	15.7			
3.0	>4.5			S	14-16-14					note: considerable calcium carbonate filaments below 2.7m
4.5	>4.5			S	7-9-12					note: decrease in sand
								CH	slightly moist moderately firm	**CLAY,** high plasticity, brown
Bottom of Footing 6.0				U	23	1610.0	16.1			
	>4.5			S	6-6-9					note: 12 kg/cm² Torvane Shear Test
7.5	1.9-2.4			S	4-4-5					note: fine grained clayey sand zones up to 150mm thick below 7.2m

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	8.7	12:00	1-30-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-2

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-30-16 to 1-31-16

LOCATION (M) N. 4022681.2 E. 583401.8
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.0m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
								CH	moist moderately firm	**CLAY,** continued
▽ 9.0				S	2-3-5			CL	wet below 9m medium stiff	**SANDY CLAY,** predominantly fine grained, subangular to subrounded sand, low to medium plasticity, dark brown
10.5	0.5-0.6			S	1-3-3					note: high plasticity clay with sand zones up to 100mm thick below 10.2m
12.0	0.25-0.9			S	1-2-3					note: gradational clayey sand to sandy clay below 12m
13.5				S	WOH *			SC	very soft	**CLAYEY SAND,** predominantly fine grained, subangular to subrounded sand, low plasticity, light brown * note: WOH - weight of hammer
15.0				S	1-2-2					note: decrease in fines at 15m

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	8.7	12:00	1-30-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-2

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-30-16 to 1-31-16

LOCATION (M) N. 4022681.2 E. 583401.8
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2033.0m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
			X					SC	wet very soft	**CLAYEY SAND,** continued note: clayey sand locally grading to sand with depth
16.5			X	S	1-1-1			SM	very soft	**SILTY SAND,** occasional fine grained, subangular to subrounded gravel, predominantly fine grained, subangular to subrounded sand, nonplastic, light brown
18.0			X	S	1-2-1					note: clayey sand with considerable gravel in zones below 17.7m
19.5			X	S	23-31-15					**MESAVERDE GROUP - WEPO FORMATION SANDSTONE,** siltstone & mudstone interbeds with some coal, fine grained texture, highly weathered at contact, soft, yellowish-brown to dark gray
21.0			X	S	25-50/138mm					Auger refused at 21m Sampler refused at 21.1m Began HQ Coring at 21m
22.5										

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	8.7	12:00	1-30-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
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LOG OF TEST BORING NO. B-2

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

JOB NO. 17-2015-4045 **DATE** 1-30-16 to 1-31-16

amec foster wheeler

RIG TYPE CME-75
METHOD HQ - Wireline Coring
OPERATOR Southlands Engineering, LLC.
LOGGED BY Mark Keyes
LOCATION (M) NAD 1983 UTM Zone 12N (Meters)
STA/OFFSET Sta. 22+418, on centerline
COORDS. N. 4022681.2 E. 583401.8
ELEVATION 2033.0m ±
DATUM NAVD88

Boring Operation and Drill Rate (min/meter)	Depth in Meter	Sample	Sample Type	Unconfined Compression of Point Load index Test (KPa)	% Core Recovery	% Drilling Fluid/Air Rec.	Rock Quality Designation (RQD)	DISCONTINUITIES: Spacing (Wide - Close 1 2 3 4 5)	DISCONTINUITIES: Orientation (Horiz - 45 - Vert H 45 V)	DISCONTINUITIES: Condition	Bedding and/or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
													Began HQ Coring at 21m
1/30 HQ 6.0	21.0		HQ		100	50-70	35	NONE	NONE	N/A	MB to TkB Fgn	SlW	**MESAVERDE GROUP - WEPO FORMATION SILTSTONE & MUDSTONE,** occasional irregularly-shaped, high-angle, partially-open fracture, moderately soft to very soft zones up to 0.5m thick, gray to black
						100							note: losing partial drilling mud circulation
1/31 8.0	22.5		HQ		85	50	5					MdW	note: predominantly soft to very soft, mudstone below 21.6m
						30-40							
6.6	24.0		HQ		100		90				MB with Lam in zones	SlW	
										Smth Slcks curved			note: slickensides at 24.9m & 25.8m along fracture surface
4.0	25.5		HQ		100		95						
										N/A	Thn to MB with Lam zones		note: predominantly moderately hard to hard sandstone below 26.1m
	27.0												Stopped HQ Coring at 27m

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	8.7	12:00	1-30-16
▼			
▽			

BORING OPERATION
B - BDBGM 51mm O.D. Wireline Rock Coring
BWC - B-size casing
HQ - 96mm O.D. Wireline Rock Coring
NQ - 71mm O.D. Wireline Rock Coring
S - 51mm O.D./35mm I.D. Tube Sample
D - Disturbed Bulk Sample

LOG OF TEST BORING NO. B-2

CENTER OF BRIDGE

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-27-16 to 1-28-16

LOCATION (M) N. 4022698.1 E. 583411.2
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2028.3m ± 6654.5'
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0.0				S A	24-24- 9			SC/SM	frozen ground from 0 to 0.3m	**CLAYEY SAND TO SILTY SAND,** predominantly fine grained, subangular to subrounded, low to medium plasticity, brown
▽				S	1-1- WOH *				wet below 0.75m wet	note: 75mm to 100mm of snow on wash bottom note: increase in clay with depth
~BOTTOM OF FOOTINGS								CH	very soft	note: some sand-sized coal particles at 0.75m * note: WOH - weight of hammer
1.5	1.00			S	1-3-2				very moist to wet medium stiff to stiff	**CLAY WITH SAND,** some brown iron-oxide staining, high plasticity, reddish-brown to brown note: 5 kg/cm² Torvane Shear Test
~5'										
3.0	1.50			S	3-3-5	~C=[illegible]	10[illegible]			note: clayey sand zones 50mm to 75mm thick below 2.7m note: 3.8 kg/cm² Torvane Shear Test
4.5				S	4-4-6	C= ~~[illegible]~~	10[illegible] psf			
6.0				S	2-2-3			CL	wet medium stiff	**SANDY CLAY,** predominantly fine grained sand, medium plasticity, reddish-brown to brown note: alternating fine grained clayey sand zones & highly plastic clay zones 150mm thick below 5.4m note: predominantly clay with sand from 6.3m to 7.5m
7.5	0.5-0.6			S	3-4-4					note: 0.6 kg/cm² Torvane Shear Test

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.75	13:45	1-27-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-3

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-27-16 to 1-28-16

LOCATION (M) N. 4022698.1 E. 583411.2
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2028.3m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
			X					CL	wet medium stiff	**SANDY CLAY,** continued
9.0	0.10		X	S	1-1-2			SC	wet very soft	**CLAYEY SAND,** predominantly fine grained, subangular to subrounded, medium plasticity, dark brown
10.5	0.10		X	S	1-2-3			SM	wet soft to very soft	**SILTY SAND,** predominantly fine grained, subangular to subrounded, nonplastic, light brown
12.0			X	S	1-1-1					
13.5			X	S	1-2-3			SM/SP	wet	**SILTY SAND TO SAND,** predominantly fine grained, subangular to subrounded sand, nonplastic, light brown note: heaving sand at 13.5m, added water to auger
15.0			X	S	1-2-1					

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.75	13:45	1-27-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-3

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-27-16 to 1-28-16

LOCATION (M) N. 4022698.1 E. 583411.2
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2028.3m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
								SM/SP	wet very loose to medium dense	**SILTY SAND TO SAND,** continued
16.5	0.10			S	3-4-7					note: trace gravel at 16.5m
18.0	>4.5			S	11-29-48					note: dark gray, high plasticity clay zone with coal fragments at 18m
	15.50			U	100/75mm			CH	wet hard	**CLAY,** high plasticity, dark gray to black
19.5				S	45-50/100mm					**MESAVERDE GROUP - WEPO FORMATION SANDSTONE & SILTSTONE INTERBEDS,** soft to very soft, fine grained texture, thinly bedded to laminated, dark gray
21.0				S	50/100mm					note: medium bedded zones up to 125mm thick below 21.6m
22.5				S	50/125mm					

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.75	13:45	1-27-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-3

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-27-16 to 1-28-16

LOCATION (M) N. 4022698.1 E. 583411.2
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2028.3m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
										MESAVERDE GROUP - WEPO FORMATION SANDSTONE & SILTSTONE INTERBEDS, fine grained sandstone texture (predominantly sandstone from 22.5m to 24m), medium bedded, soft, gray to light gray
										note: occasional thin coal zone up to 12.5mm thick below 23.7m
24.0			☒	S	50/ 100mm					
										note: predominantly subangular quartz grains within sandstone zones
25.5			☒	S	50/ 100mm					
										note: soft, dark gray siltstone laminae to thin laminae in zones below 26.7m
27.0			☒	S	50/ 75mm					
										Auger refused at 27.6m Begin HQ Coring at 27.6m
28.5										
30.0										

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.75	13:45	1-27-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-3

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-27-16 to 1-28-16

RIG TYPE CME-75
METHOD HQ - Wireline Coring
OPERATOR Southlands Engineering, LLC.
LOGGED BY Mark Keyes
LOCATION (M) NAD 1983 UTM Zone 12N (Meters)
STA/OFFSET Sta. 22+435, on centerline
COORDS. N. 4022698.1 E. 583411.2
ELEVATION 2028.3m ±
DATUM NAVD88

Boring Operation and Drill Rate (min/meter)	Depth in Meter	Sample	Sample Type	Unconfined Compression of Point Load index Test (KPa)	% Core Recovery	% Drilling Fluid/Air Rec.	Rock Quality Designation (RQD)	DISCONTINUITIES: Spacing (Wide - Close 1 2 3 4 5)	DISCONTINUITIES: Orientation (Horiz - Vert H 45 V)	Condition	Bedding and/or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
	27.0												Began HQ Coring at 27.6m
1/28 HQ 9.0			HQ		100	100	25	NONE	NONE	N/A	ThB to Lam some ThL	SIW	**WEPO FORMATION** **SANDSTONE & SILTSTONE INTERBEDS,** soft to moderately soft, dark gray & gray zones
													note: horizontal to subhorizontal, wavy bedding
4.0	28.5		HQ		85		45						note: low RQD values due to machine breaks along bedding planes
											MB to ThB		note: moderately hard sandstone zones up to 300mm thick below 28.8m
													note: sample from 29.6m to 29.9m
	30.0												
	31.5												Stopped HQ Coring at 30m
	33.0												

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.75	13:45	1-27-16
▼			
▽			

BORING OPERATION
B - BDBGM 51mm O.D. Wireline Rock Coring
BWC - B-size casing
HQ - 96mm O.D. Wireline Rock Coring
NQ - 71mm O.D. Wireline Rock Coring
S - 51mm O.D./35mm I.D. Tube Sample
D - Disturbed Bulk Sample

LOG OF TEST BORING NO. B-3

WEST ABUTMENT

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1/29/16

LOCATION (M) N. 4022699.2 E. 583380.3
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2028.3m ± 6654.5
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0.0				S	19-29-			SM/SP	frozen ground from 0 to 0.3m	**SILTY SAND TO SAND,** trace fine grained gravel, fine grained, subangular to subrounded sand, nonplastic, brown
				A	15				very moist to wet	
				S	2-1-2				very loose	
- BOTTOM OF FOOTINGS	▽							SM/GM	wet below 0.9m	**SILTY SAND TO SILTY GRAVEL,** predominantly medium to coarse grained, subangular sand, predominantly coarse grained, angular gravel, nonplastic, brown
1.5				S	1-3-3				loose	note: high plasticity clay zones up to 75mm thick
						113 pcf		CL		**CLAY WITH SAND & GRAVEL,** trace fine grained, subangular to angular gravel, predominantly fine grained, subangular sand, medium to high plasticity, black & brown zones
	0.75			T		1810.6	14.0			
-5'										note: 3.1 kg/cm^2 Torvane Shear Test
									wet	
3.0				S	2-12-				very stiff	note: considerable black organic material at 3m
					16					note: high plasticity clay zones up to 150mm thick
									hard below 4m	
4.5				S	50/					**MESAVERDE GROUP - WEPO FORMATION SILTSTONE TO SANDSTONE INTERBEDS,** fine grained texture, slightly weathered to moderately weathered, soft, light brown & gray zones
					125mm					
6.0				S	50-50/					note: predominantly sandstone below 6m
					75mm					
					50-50/					
7.5				S	75mm					

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.9	12:15	1-29-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-4

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1/29/16

LOCATION (M) N. 4022699.2 E. 583380.3
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2028.3m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
			⊠							**MESAVERDE GROUP - WEPO FORMATION SILTSTONE TO SANDSTONE INTERBEDS,** continued
			⊠	S	50/ 100mm					
9.0										Stopped Auger at 8.85m Sampler refused at 8.95m Began HQ Coring at 8.85m
10.5										
12.0										
13.5										
15.0										

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.9	12:15	1-29-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-4

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 1-29-6

RIG TYPE CME-75
METHOD HQ - Wireline Coring
OPERATOR Southlands Engineering, LLC.
LOGGED BY Mark Keyes
LOCATION (M) NAD 1983 UTM Zone 12N (Meters)
STA/OFFSET Sta. 22+422, 8.4m L
COORDS. N. 4022699.2 E. 583380.3
ELEVATION 2028.3m ±
DATUM NAVD88

Boring Operation and Drill Rate (min/meter)	Depth in Meter	Sample	Sample Type	Unconfined Compression of Point Load index Test (KPa)	% Core Recovery	% Drilling Fluid/Air Rec.	Rock Quality Designation (RQD)	DISCONTINUITIES: Spacing (Wide - Close: 1 2 3 4 5)	DISCONTINUITIES: Orientation (Horiz - Vert: H 45 V)	Condition	Bedding and/or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
HSA													Began HQ Coring at 8.85m
1/29 HQ 1.0	9.0		HQ		85	100	40	NONE	NONE	N/A	Fgn MB to TkB with occ Lam	SlW	**MESAVERDE GROUP - WEPO FORMATION** **SANDSTONE,** predominantly fine grained with thin coarse grained zones, moderately hard, light gray with reddish-brown streaks & black laminea note: thin, highly oxidized zones up to 75mm thick note: wavy, low-angle to subhorizontal bedding
2.5	10.5		HQ		75		10					MdW zones	
6.8	12.0		HQ		75		50				ThB to MB	SlW	note: some thin, soft clay-rich mudstone zones up to 150mm thick from 12m to 13.5m
3.2	13.5		HQ		80		70				Lam to ThB	MdW	note: predominantly dark gray & black, organic-rich, moderately soft siltstone below 13.2m
	15.0												Stopped HQ Coring at 14.85m

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	0.9	12:15	1-29-16
▼			
▽			

BORING OPERATION
B - BDBGM 51mm O.D. Wireline Rock Coring
BWC - B-size casing
HQ - 96mm O.D. Wireline Rock Coring
NQ - 71mm O.D. Wireline Rock Coring
S - 51mm O.D./35mm I.D. Tube Sample
D - Disturbed Bulk Sample

LOG OF TEST BORING NO. B-4

EAST ABUTMENT

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-18-16 to 2-19-16

LOCATION (M) N. 4022711.0 E. 583434.1
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2029.0m ± 6656.8
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0.0				S	1-1-2			SM	slightly moist	**FILL** **SILTY SAND,** predominantly fine to medium grained, subrounded sand, nonplastic, brown
				A					very soft to soft	
				S	2-2-4					note: possible sandstone zones about 75mm thick, yellow in color at 1m
1.5				S	3-3-2			CH		**NATIVE** **CLAY WITH SAND,** predominantly fine grained, subrounded sand, high plasticity, dark brown
- BOTTOM OF FOOTING									moist	
-5' 3.0				S	2-2-3	C = 7cm			soft to moderately firm	note: trace silt below 2.4m
						99 pcf				25,602 psf
-10' 4.5	3.25			U	18	1552.2	25.2			note: 12.5 kg/cm^2 Torvane Shear Test
				S	3-4-5	C = 12.5				note: increase in clay at 4.5m
6.0				S	3-3-5					
						101 pcf				note: up to 150mm thick sandy clay zones throughout, medium plasticity & dark brown below 6.9m
7.5	1.50			U	11	1619.5	24.2			note: 8 kg/cm^2 Torvane Shear Test

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	9.3	10:40	2-18-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-5

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-18-16 to 2-19-16

LOCATION (M) N. 4022711.0 E. 583434.1
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2029.0m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
								CH	moist	**CLAY WITH SAND,** continued
				S	4-5-5				soft to moderately firm	note: up to 150mm thick clayey sand zones throughout, low plasticity & brown below 7.8m
9.0				S	1-1-3					
▽									wet below 9.3m	
									medium stiff	note: up to 75mm thick silty sand zones throughout, nonplastic & brown below 9.9m
10.5				S	2-3-5					
								SM	wet	**SILTY SAND,** predominantly fine grained, subrounded sand, nonplastic, brown
12.0				S	1-2-2				very soft to soft	note: up to 75mm thick sandy clay zones with depth, low to medium plasticity, brown
13.5				S	2-3-3					
15.0				S	2-2-3					

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	9.3	10:40	2-18-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-5

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-18-16 to 2-19-16

LOCATION (M) N. 4022711.0 E. 583434.1
PROJECTION NAD 1983 UTM Zone 12N (Meters)
RIG TYPE CME-75
BORING TYPE 210mm Hollow Stem Auger
SURFACE EL. (M) 2029.0m ±
DATUM NAVD88

Depth in Meters	Pocket Penetrometer (Tons per sq ft)	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density Kg. per Cubic meter	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
								SM	wet firm	**SILTY SAND,** continued note: up to 75mm thick clay with sand zones below 15m, medium to high plasticity, dark brown
16.5				S	3-15-10					
								SP-SM	wet medium dense	**SAND WITH SILT,** predominantly medium grained, subrounded sand, weakly cemented, nonplastic, yellow note: possible sandstone
18.0				S	2-4-18					
										Auger refused at 18m Stopped Sampler at 18.3m Began HQ Coring at 18m
19.5										
21.0										
22.5										

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	9.3	10:40	2-18-16
▼			

SAMPLE TYPE
A - Auger cuttings; NR-No Recovery
S - 51mm O.D. 35mm I.D. tube sample.
U - 76mm O.D. 61mm I.D. tube sample.
T - 25mm O.D. thin-walled tube sample

LOG OF TEST BORING NO. B-5

PROJECT BIA N8066(3), N8065(1) & School Spur
Black Mesa Community School, Arizona
Navajo Nation

amec foster wheeler

JOB NO. 17-2015-4045 **DATE** 2-18-16 to 2-19-16

RIG TYPE CME-75
METHOD HQ - Wireline Coring
OPERATOR Southlands Engineering, LLC.
LOGGED BY Joe Zaleski
LOCATION (M) NAD 1983 UTM Zone 12N (Meters)
STA/OFFSET Sta. 22+455, 13m R
COORDS. N. 4022711.0 E. 583434.1
ELEVATION 2029.0m ±
DATUM NAVD88

Boring Operation and Drill Rate (min/meter)	Depth in Meter	Sample	Sample Type	Unconfined Compression of Point Load index Test (KPa)	% Core Recovery	% Drilling Fluid/Air Rec.	Rock Quality Designation (RQD)	DISCONTINUITIES: Spacing (Wide - Close: 1 2 3 4 5)	DISCONTINUITIES: Orientation (Horiz - Vert: H 45 V)	Condition	Bedding and/or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
													Began HQ Coring at 18m
2/18 HQ 8.0	18.0		HQ		100	100	35	NONE	NONE	N/A	Fgn MB to TkB with zones of Lam	HiW / MdW	**MESAVERDE GROUP - WEPO FORMATION SILTSTONE & MUDSTONE Interbeds,** soft to moderately soft, dark gray to grayish-green note: very soft from 18m to 18.3m note: horizontal to subhorizontal bedding note: moderately hard siltstone zone from 19.4m to 19.7m
7.0	19.5		HQ		90		30					SlW to MdW	note: iron-oxide staining from 19.4m to 19.7m (wavy, near vertical fracture) note: dark gray to gray mudstone below 19.7m note: occasional slickensides from 19.7m to 20m
8.0	21.0		HQ		100		40					SlW MdW to HiW	note: moderately hard siltstone from 20.9m to 21.3m note: mechanical breaks throughout recovery (breaking along bedding planes)
3.0	22.5		HQ		100		80					SlW	note: moderately hard to moderately soft below 22m
											Fgn TkB with Lam zones	SlW	**MESAVERDE GROUP - WEPO FORMATION SANDSTONE,** moderately hard to hard, gray with occasional black mudstone laminae
	24.0												Stopped HQ Coring at 24.4m Backfilled with cuttings & grouted upper 6m

GROUNDWATER

	DEPTH (m)	HOUR	DATE
▽	9.3	10:40	2-18-16
▼			
▽			

BORING OPERATION
B - BDBGM 51mm O.D. Wireline Rock Coring
BWC - B-size casing
HQ - 96mm O.D. Wireline Rock Coring
NQ - 71mm O.D. Wireline Rock Coring
S - 51mm O.D./35mm I.D. Tube Sample
D - Disturbed Bulk Sample

LOG OF TEST BORING NO. B-5