

**GEOTECHNICAL REPORT  
BIA ROUTE N55 (1-1) 2&4  
NAVAJO NATION, NEW MEXICO  
KLEINFELDER PROJECT NO. 20162433.001A**

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**SUBJECT: Draft Geotechnical Report  
BIA Route N55  
BIA Project N55 (1-1)2&4  
Navajo Nation, New Mexico**

Dear Ms. Dempsey:

Kleinfelder is pleased to present our geotechnical report for the planned reconstruction and paving of Route N55 on the Navajo Nation, located approximately 10 kilometers north of Alamo, New Mexico. This report presents the results of our field exploration program, initial laboratory testing results and engineering analyses. An addendum including the unconfined compression test results was also submitted on February 9, 2016, and should accompany this report. It also includes our conclusions and recommendations regarding subgrade suitability, preparation and earthwork, pavement section design considerations, and drainage. Additionally, our report presents a short discussion regarding construction considerations related to the geotechnical and geologic conditions.

We appreciate the opportunity to be of service to you. Should any questions arise concerning this report or if you require any additional information regarding this project, please contact us.

Respectfully submitted,

**KLEINFELDER**




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## **1 INTRODUCTION**

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### **1.1 GENERAL**

This report presents the results of the geotechnical exploration by Kleinfelder for the proposed design and reconstruction of BIA Route N55, BIA Project N55(1-1)2&4 on the Navajo Nation, which is located approximately 10 kilometers north of Alamo, New Mexico. The general location of the project site is shown on Figure 1 (Vicinity Map), in the Figures section of this report.

The purpose of this investigation was to characterize the subsurface soils and evaluate their engineering properties for use in the design of the proposed pavement structure of Route N55. The investigation included a site reconnaissance, subsurface exploration, selected soil sampling, field and laboratory testing, engineering design and analyses, and preparation of this report. The recommendations contained in this report are subject to the limitations presented herein.

The recommendations and conclusions of this report are based on the subsurface conditions found at the locations of our exploratory borings at the time our exploration was performed. They are also subject to the provisions stated in the following specific sections of this report: “Additional Services” and “Limitations.” Our findings, conclusions, and recommendations for this evaluation may not be extrapolated to other adjacent sites or used for other projects without our written approval.

### **1.2 PROJECT DESCRIPTION**

The current alignment of the portion of Route N55 included in this project consists of an existing two-lane, asphalt-paved road approximately 13.43 kilometers (8.35 miles) long. The roadway was originally constructed in 2002, with the original design cross section consisting of 76 mm of hot asphalt concrete pavement (HACP), 152 mm of aggregate base course (ABC), and 300 mm of lime stabilized subgrade. The beginning of project (BOP) is located at station 27+709.955, which is approximately 10 kilometers north of the census-designated place (CDP) of Alamo, New Mexico. The end of project (EOP) is located at station 41+130.830 at the Socorro County line. The EOP is located at the northern boundary of the Valencia/Socorro County Line where it intersects with N55. N55 extends northeastward where it eventually intersects with Old US Hwy 66. The N55 roadway within the limits of the project crosses various minor drainages and small culverts.

Kleinfelder understands the existing pavement has experienced distress over much of its length, including a reported sulfate induced heave over some of its length. The purpose of the project is to rehabilitate Route N55 within the limits of this project. This rehabilitation will most likely consist of complete removal of the asphalt and aggregate base, re-treatment of the subgrade and replacement of the pavement section. We have also been asked to consider other alternative treatments such as a double chip seal or a cape seal. The majority of the improved N55 road will maintain the same basic horizontal and vertical alignment as the existing road.

### **1.3 PURPOSE AND SCOPE**

The purpose of our investigation was to explore and evaluate subsurface conditions at selected locations along the alignment of BIA Route N55 and develop recommendations relating to the geotechnical aspects of project design and construction. The conclusions and recommendations in this report are based on our understanding of the project, our analysis of the data from our field exploration, and the results of our laboratory tests. Our services were conducted in general accordance with the scope of services presented in our Proposal No. TEM15P25333, dated September 2, 2015. Specifically, our scope included the following:

- Site Reconnaissance, permitting, and boring layout.
- Drilling of 34 exploratory borings and sampling of subsurface materials.
- Laboratory testing of selected samples obtained during the field exploration to evaluate relevant physical and engineering properties of the soil.
- Laboratory testing for the evaluation of existing asphalt for use in cold recycled asphalt pavement.
- Evaluation and engineering analysis of the field and laboratory data to develop our geotechnical conclusions and recommendations.
- Preparation of this report.

## 2 FIELD EXPLORATION

The subsurface conditions along Route N55 were explored by drilling 34 borings at the subject site. The boring locations are shown in Figure 2, Sheets 1 through 3. Logs of the borings are presented in Appendix A. The borings were advanced by hollow-stem auger drilling using a truck-mounted drill rig. A summary of the GPS NAD 83 coordinates associated with each boring is presented in Table 2.1.

**TABLE 2.1**  
**SUMMARY OF BORING COORDINATES**

Boring ID	Latitude (deg)	Longitude (deg)	Lane (Northbound/Southbound)
1	34.501738	-107.502839	NB
2	34.504190	-107.500095	NB
3	34.505861	-107.496286	SB
4	34.507499	-107.492397	NB
5	34.509107	-107.488610	SB
6	34.510724	-107.484765	NB
7	34.512337	-107.480926	SB
8	34.513958	-107.477096	NB
9	34.515603	-107.473203	SB
10	34.517204	-107.469372	NB
11	34.519034	-107.465691	SB
12	34.521876	-107.463200	NB
13	34.525057	-107.461296	SB
14	34.528243	-107.459398	NB
15	34.531238	-107.457179	SB
16	34.533772	-107.454192	NB
17	34.536045	-107.450814	SB

**TABLE 2.1 (CON'T.)**  
**SUMMARY OF BORING COORDINATES**

<b>Boring ID</b>	<b>Latitude (deg)</b>	<b>Longitude (deg)</b>	<b>Lane (Northbound/ Southbound)</b>
18	34.538402	-107.447654	NB
19	34.541214	-107.444999	SB
20	34.544079	-107.442428	NB
21	34.546949	-107.439858	SB
22	34.549697	-107.437140	NB
23	34.552156	-107.433923	SB
24	34.554540	-107.430774	NB
25	34.556968	-107.427584	SB
26	34.559405	-107.424410	NB
27	34.561831	-107.421204	SB
28	34.564314	-107.417926	NB
29	34.566725	-107.414776	SB
30	34.569131	-107.411595	NB
31	34.571570	-107.408399	SB
32	34.574006	-107.405199	NB
33	34.576403	-107.402052	NB
34	34.578825	-107.398849	SB

Traffic control was provided by Highway Supply, and was required during subsurface exploration along the existing Route N55. Traffic control consisted of warning signs, traffic cones placed around the drill rig and Kleinfelder field vehicle to mark an exclusionary zone, and two flagmen to direct traffic during temporary lane closures. All traffic control was performed in general accordance with the Temporary Traffic Control Plan approved for the project.

The geotechnical profile encountered in the borings was examined and soils retrieved from the boreholes were visually classified. In general accordance with the Unified Soil Classification System (ASTM: D2487). A key for the classification of the soil is presented at the beginning of Appendix A.

A total of 40.2 lineal meters (132 lineal feet) of hollow stem auger drilling was completed utilizing a truck-mounted CME-75 drill rig. A 4-inch (101.6 mm) inside diameter (ID) diameter hollow-stem auger was used and soil samples were obtained using a modified California (ring) sampler (2.5 in, 64 mm ID) and a standard split-spoon sampler (1.375 in, 35 mm ID). The sampler was driven with a 140-pound, 63.5-kilogram CME automatic hammer free-falling through a distance of 30 inches, (0.76 m). The sampler driving resistance was recorded as the number of blows per one foot (305 mm) of penetration (referred to as blow counts or N-values), the results of which are presented on the boring logs in Appendix A.

Due to the nature of the subsoils, Shelby tube samples were not practical at this site and modified California samples were therefore substituted in lieu of Shelby tubes. This sampler consists of a series of brass rings placed inside a steel tube that is lowered to the bottom of the borehole and driven through the soil by means of hammer blows at the top of the drilling rod. Because the rings are encased inside a steel tube, they do not crumple when driven through the soils. This substitution was necessary to obtain in-situ densities in order to fulfill the objectives of the Statement of Work (SOW) per contract requirements. The density values that we obtained from soils sampled by the ring sampler compared well with published textbook values and additional sampling would not change any of Kleinfelder's recommendations provided in our geotechnical report.

The lines defining boundaries between soil strata are approximate and are based on the observations of the field engineer or geologist and interpolation between samples. Samples obtained during the field exploration were transported to our laboratory for further examination and testing.

### 3 LABORATORY TESTING

Selected laboratory tests were performed on representative samples recovered from the field exploration to support our field classification and to provide information regarding engineering characteristics and properties of the subsurface soils, and the existing asphalt. The results of these tests are presented in Appendix B and C of this report. As shown in Table 3.1, the following tests were performed according to the corresponding ASTM methods and comparable AASHTO methods:

**TABLE 3.1**  
**SUMMARY OF GEOTECHNICAL LABORATORY TESTS**

Laboratory Test	Sample Type	ASTM Method	Comparable AASHTO Method	Number of Tests	Purpose of Test
Sieve Analysis	Bulk	C136	T27	34	Soil Classification
Atterberg Limits	Bulk	D4318	T89 and T90	34	Soil Classification
Moisture/Density	Ring	D2216/D2937	T265	16	In-Situ Density and Moisture Conditions
Resistance Value	Bulk	D2844	T190	8	Pavement Subgrade Modulus
Modified Proctor	Bulk	D1557	T180	4	Soil Compaction Characteristics
Remolded Swell	Bulk	D4546-96	--	4	Soil Expansion Potential
Unconfined Compressive Strength (UCS)	Bulk	D2166	T208	4	Soil Strength Characteristics
pH and Resistivity	Bulk	*ARIZ 236	T288 and T289	7	Preliminary Soil Corrosion Characteristics
Sulfates and Chlorides	Bulk	*ARIZ 733/736	T290 and T291	16	Preliminary Soil Corrosion Characteristics

**TABLE 3.1 (CON'T.)**  
**SUMMARY OF GEOTECHNICAL LABORATORY TESTS**

Laboratory Test	Sample Type	ASTM Method	Comparable AASHTO Method	Number of Tests	Purpose of Test
Extraction & Gradation	Composited Cores	--	T164 & T30	10	Asphalt Characteristics
Asphalt Binder Penetration	Composited Cores	--	T49	10	Asphalt Characteristics
Asphalt Binder Viscosity	Composited Cores	--	T202	10	Asphalt Characteristics
Core Unit Weight and Thickness	Core	--	T166	10	Asphalt Characteristics
Max Theoretical Density	Composited Cores	--	T209	10	Asphalt Characteristics

\*Testing performed in general accordance with Arizona Department of Transportation methods.

## 4 GENERAL SITE CONDITIONS

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### 4.1 SURFACE AND GEOLOGIC CONDITIONS

The Route N55 alignment is shown on Figure 1. This alignment is characterized by a series of low lying hills dissected by a series of small drainages that ultimately drain into the Canada Bonito drainage. The Canada Bonito drainage flows to the southeast and empties into the Rio Salado Drainage which further flows eastward and ultimately joins the Rio Grande River. The low lying hills in the site area are erosional remnants of the underlying bedrock geology and include soft mudstone and sandstone of the Chinle Group with the harder sandstone beds forming the more pronounced ridge/hill tops along the alignment. The higher ridges adjacent (southeast) to the alignment are composed of a younger sequence of the Dakota Sandstone that stratigraphically overlies the Chinle Group. Two larger mesas with elevations approximately 1000 feet higher than the basin that the N55 crosses are present to the immediate east and north and are referred to as the Pueblo Viejo Mesa and Cerro Del Oro Mesa, respectively. The Geologic units exposed in the mesas include from oldest to youngest the Dakota Sandstone at the base, landslide deposits and a capping basalt flow forming the mesa top.

The project lies in the south eastern edge of the Colorado Physiographic Province (CPP). This area is dominated by a thick sequence of slightly tilted Paleozoic sedimentary rocks with bedding that dips gently to the west. As a result, the sequence includes exposures of older rocks to the east and progressively younger (upper section) rocks to west. Younger Tertiary to Quaternary deposits also locally overlie the Paleozoic sequence in the area with Tertiary volcanic rocks of basaltic minerology forming small mesas in the area and Quaternary alluvium in the low lying areas and associated with drainages. Landslide deposits also occur typically around the edges of the mesas below the volcanic flows. The Albuquerque Basin of the Rio Grande Rift system marks the edge of the CPP to the east. The geologic units exposed in the Albuquerque basin to the east differ from those in the CPP and largely consist of Tertiary to Quaternary volcanic rocks and basin fill sediments.

The primary geologic unit underlying the project alignment is the Triassic Chinle Group. The Chinle Group includes interbedded layers of mudstone and sandstone. The mudstone layers are more abundant than the sandstone beds and they are red to reddish brown, soft and moderately to highly weathered and composed of medium to highly plastic clay. The sandstone beds are typically lighter brown, less weathered and moderately hard to hard. The Chinle is locally overlain with alluvium and residual soils derived from in-situ weathering of the Chinle mudstone. These

deposits are typically composed of a sand, silt, and clay mixtures that are mostly reddish brown as a result of weathering and erosion of the underlying mudstones of the same color.

## 4.2 SUBSURFACE CONDITIONS

The 34 borings completed along the alignment were completed through the existing asphalt to establish the thickness of the asphalt and condition of the aggregate base, existence of lime stabilized soils, and general subgrade conditions. In general the measured asphalt thickness (AC) was 76mm to 102 mm thick and the aggregate base (ABC) varied from none (Boring B-1) to 51mm to 203mm thick as summarized in Table 4.1. Boring B-23 was drilled within a section of Route N55 consisting of only aggregate base pavement, underlain by similar subgrade soils found in other borings.

**TABLE 4.1**  
**EXISTING PAVEMENT SECTION THICKNESS**

Boring No.	AC (mm)	ABC (mm)	Total Depth (mm)
B-1	76.2	0	76.2
B-2	76.2	76.2	152.4
B-3	76.2	76.2	152.4
B-4	101.6	50.8	152.4
B-5	76.2	101.6	177.8
B-6	127	101.6	228.6
B-7	76.2	101.6	177.8
B-8	76.2	50.8	127.0
B-9	76.2	127.0	203.2
B-10	76.2	76.2	152.4
B-11	88.9	127.0	215.9
B-12	76.2	127.0	203.2
B-13	76.2	152.4	228.6
B-14	76.2	101.6	177.8
B-15	88.9	101.6	190.5
B-16	76.2	76.2	152.4
B-17	76.2	76.2	152.4

**TABLE 4.1 (CON'T.)**  
**EXISTING PAVEMENT SECTION THICKNESS**

Boring No.	AC (mm)	ABC (mm)	Total Depth (mm)
B-18	101.6	152.4	254.0
B-19	76.2	152.4	228.6
B-20	76.2	76.2	152.4
B-21	76.2	152.4	228.6
B-22	76.2	127.0	203.2
B-23	0	127.0	127.0
B-24	101.6	101.6	203.2
B-25	88.9	76.2	165.1
B-26	101.6	101.6	203.2
B-27	76.2	152.4	228.6
B-28	88.9	177.8	266.7
B-29	76.2	177.8	254.0
B-30	88.9	152.4	241.3
B-31	76.2	177.8	254.0
B-32	76.2	152.4	228.6
B-33	76.2	152.4	228.6
B-34	76.2	203.2	279.4

The lime stabilized soils varied from 51mm to 127mm in thickness and were only noted directly below the ABC on the north end of the project including in boring numbers B-22, B23 AND B-25 through B-34. The material was visually composed of lumps of green powdered crystal mixed with clay. Some lime was present in the subgrade soils but it appeared to be a natural secondary precipitate rather than a lime treated soil. Thus, the design section of 300mm of stabilized soil was likely not achieved as observed in our drilled borings and subsequent testing.

The subgrade was generally a sandy clay and clayey sand with plastic index values ranging from 16 to 40. Most of the values ranged from 22 to 30 with four locations over 30 including B-12, B-20, B-30 and B-9 (PI of 40). Four locations had PI values of less than 20 including B-3, B-14, B-32 and B-33 indicating a relatively consistent subgrade profile across the site. The clayey subgrade soils appear to be derived from a combination of erosion of local clay rich beds of the Chinle Group and/or in-situ decomposition of the Chinle mudstones. The SPT blow counts in the borings were generally low indicative of the persistent soft condition of the subgrade soils. Harder layers

of less weathered sandstone were encountered in a few borings sporadically along the alignment including borings B-14, B-16, B-18, B-23, B-24, and B-32. Sandstone outcrops occurred in some of the cuts and adjacent ridges throughout the site.

The sulfate results show elevated values of 3,935 and 5,245 ppm in borings B-21 and B-23, respectively. The sulfate testing results are in agreement with the results of the forensic geotechnical exploration report prepared by Western Technologies, dated February 2003. According to the forensic report, high amounts of sulfates were present, from UTM station 35+350 to 37+250 corresponding to the locations of borings B-20 to B-25. The aerial view of the site also shows exposed white beds in the area of station 34+400 to 34+600, which appears to be gypsum beds within the Chinle.

#### **4.3 EXPANSION POTENTIAL**

The near surface soils encountered at the site were generally comprised of fine-grained soils with medium plasticity throughout the project alignment limits. Our laboratory testing included performing 34 grain-size and 34 Atterberg limits tests to determine correlated R-values. The tested samples indicated plastic index values of 16 to 40 and percent passing the No. 200 sieve of 38 to 95 percent with most values ranging from 50 to 65 percent. Four swell tests were performed on selected samples with swell percentages varying from 7.6 (no swell) to 17.2 percent. The near surface soils likely possess a low to high potential for expansion upon wetting.

#### **4.4 LIQUEFACTION**

In conjunction with the ground shaking potential of seismic events, some areas may also possess a potential for liquefaction during a high-magnitude event. Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. Horizontally continuous liquefied layers may also have a potential to spread laterally where sufficient slope or free-face conditions exist. The primary factors affecting liquefaction potential of a soil deposit are: (1) magnitude and duration of seismic ground motions; (2) soil type and consistency; and (3) depth-to-groundwater.

No recently published literature was found regarding liquefaction potential along the alignment. Based on the results of our site reconnaissance, the results of the boring program, and the

laboratory testing program, it is our opinion that the potential for liquefaction to occur is very low to negligible, due to the presence of shallow bedrock and apparent absence of shallow groundwater along the alignment.

#### **4.5 OTHER GEOLOGICAL HAZARDS**

Based on our site reconnaissance, the field boring program, and our review of available literature and geological maps, the alignment does not appear to be exposed to other geologic hazards such as areas of slope instability, shallow groundwater limitations, or severe flooding. There could be some localized flooding in or near the several small arroyos that cross the alignment. CMP's and box culverts accommodate drainage at many of those locations. Slope stability of future roadway cuts, if any, should be evaluated on a case by case basis, once the profiles are known.

## 5 CONCLUSIONS AND RECOMMENDATIONS

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### 5.1 GENERAL

The existing roadway pavement has undergone excessive distress likely caused by heaving of the supporting soils. A contributing factor to heaving subgrade is the presence of highly plastic or potentially sulfate laden clay soils that undergo expansion and contraction in response to wetting and drying cycles. The pavement distress consisted primarily of wide spread low to high severity longitudinal cracking, and low to moderate severity rutting and associated fatigue cracking in the wheel paths. The elevation of the pavement surface along BIA Route N55 is notably varied along the alignment, illustrating the effect of the heaving/settling underlying soils. The types of distress noted in the pavement are indicative of subgrade issues, as opposed to defects in the asphalt pavement. However as shown in Table 4.1, the thickness of the ABC was less than the original design section in many of the boring locations. The locations meeting the design thickness included B-13, B-18, B-19 and B-27 through B-34.

Ponded water adjacent to this relatively low lying, flat section of roadway likely inundated the supporting soils with elevated moisture during wet periods of the year. Much of this water likely became trapped beneath the pavement section contributing to weakening or expansion of the near-surface clay soils. The degree of instability depends on the physical properties of the clay and the fluctuation of moisture conditions.

Based on the information presented herein, it is Kleinfelder's opinion that the roadway may be reconstructed to perform in a manner where moisture fluctuations have a lesser impact on the performance of the pavement section, provided that the recommendations presented in this report are incorporated into appropriate design and construction methods. These opinions and recommendations are based on our site reconnaissance, the test boring program, laboratory testing, and our understanding of the project.

Geotechnical engineering recommendations for the support of the pavement within the N55 project alignment are presented in the following sections. We understand the BIA is interested in options including stabilization of the subgrade materials using Roadbond EN-1 (EN-1), reclamation of the existing pavement materials as a replacement of the aggregate base, and wearing surface treatment options. These items are discussed in the following sections.

## 5.2 PAVEMENT DESIGN

Pavement reconstruction will be the most proactive means to obtain a future pavement section that performs better than the existing distressed pavement. Based on the distress observed, we do not recommend pavement rehabilitation including mill and overlay options. It is apparent that the subgrade is moisture sensitive and modification of the upper portion of these materials appears warranted. The following sections provide pavement design recommendations for reconstruction of the existing pavement section and modification of the existing subgrade using EN-1 soil stabilizer.

Based on our analysis conducted on the subgrade soils with Roadbond EN-1 soil stabilizer, the existing subgrade soils, including the portions of lime treated soils found on the north end of the project, can be effectively stabilized with EN-1 soil stabilizer. In our opinion, due to the apparent lower quantities of existing lime treated soils, and through our discussions with Roadbond, the lime treated soils do not need to be replaced prior to conditioning.

To determine the effectiveness of the EN-1 soil stabilizer, unconfined compression tests were performed on multiple specimens consisting of existing subgrade soils mixed with the EN-1 solution. The results of the compression tests were used as an index to evaluate the potential improvements on the structural properties of the subgrade. Prior to performing the EN-1 testing, the optimum moisture content for each subgrade sample was determined (prior to EN-1 mixing) by performing a Proctor test. Subgrade samples were mixed at optimum moisture content using both water only and a mix of water and 3 percent EN-1 solution. The specimens were molded in 102 mm x 152 mm cylindrical molds using a compactive effort of 2200 kN-m/m<sup>3</sup>. After curing for 17 days after the molding date, samples were capped and broken, and the compressive strength is recorded.

The average compressive strength for the untreated specimens was 1297.9 kPa. For specimens that were treated with the EN-1 solution, the average compressive strength was 1882.3 kPa, corresponding to an average increase in strength of approximately 49.8 percent. For sample 31258B the strength increase due to the EN-1 solution was only 9.7 percent, however, this untreated sample also had a relatively high untreated compressive strength. In general, the strengthening effect of the EN-1 solution was the most significant in subgrade soils having relatively lower untreated compressive strengths, although data suggests that some increases can still be achieved in all soils. Test specimens associated with sample 31258F had the lowest untreated and treated compressive strengths, with values of 675.7 kPa and 979.1 kPa,

respectively. It is likely that zones or lenses of this weaker soil are present in various areas throughout the site. In order to establish a pavement design that is sufficient for all soils present, soil properties from sample 31258F were used in the final pavement design. In Section 5.2 the structural layer coefficient for the clayey subgrade soils present at the site was assumed to be 0.06. Based on correlations for structural coefficients provided by the Arizona DOT Preliminary Engineering and Design Manual, (Figure 202.02-4), and the treated unconfined compressive strength of sample 31285F (979.1 kPa), the actual structural layer coefficient of the treated subgrade soils can be assumed to be at least 0.16. It is recommended that the original pavement design be used, as it is conservative and will be sufficient for weaker soils that are present along various sections along the alignment. It is unknown what effect the treatment may have on the PI of the clayey soils and thus the soils should still be considered moisture sensitive. However, it is noted that the manufacturer of the EN-1 solution claims that the treated soil is more resistant to water penetration. The manufacturer's dosage of EN-1 is 1 gallon of solution to each 180 SF at 6-inch depths. A summary of the EN-1 testing is provided in Appendix E.

### 5.2.1 Traffic

Traffic data for this project, including 2015 average daily traffic (ADT), growth rate, truck percentages etc., was provided in the RFP. The following table provides calculated two-way ADT's for design years 2016 and 2036 (assuming standard 20 year pavement design) based on a 2015 ADT of 112, the provided growth rate of 2 percent with 2 percent trucks and 2 percent buses:

**TABLE 5.1 – 2015  
TRAFFIC DATA & TRAFFIC ESTIMATES FOR 2016 AND 2036**

Roadway Section	2016* ADT	2036* ADT	Bus Percentage (**TEF 0.25)	Truck Percentage (**TEF 1.00)	Car Percentage (**TEF 0.0008)
Route N55	112	163	2.0%	2.0%	96.0%

\*Projected Growth of 2 percent

\*\*Traffic Equivalency Factor

The design lane 18-kip equivalent single axle loads (ESALs) for the design period were calculated by averaging the initial and design year one-way ADT, and multiplying by the 20-year design period and the Lane Distribution Factor (1.0 for a two lane road). The following table provides the design lane 18-kip ESALs for a design period of 20 years.

**TABLE 5.2**  
**DESIGN LANE ADT AND  $W_{18}$**

Design Life (Years)	Design Lane ADT (one-way)	Design Lane 18-kip ESALs ( $W_{18}$ )
20	69	12,940

### 5.2.2 Subgrade Soil Characteristics

Kleinfelder drilled 34 roadway borings and performed laboratory testing on selected samples recovered from the field exploration. The boring logs and the results of the laboratory tests are presented in Appendices A and B, respectively. The following table presents a summary of our laboratory test results of the subgrade soils obtained from the proposed roadway improvements.

**TABLE 5.3**  
**SUMMARY OF LAB TEST DATA AND CORRELATED R-VALUES**

Boring (depth bps)	% Passing #200 Sieve	Plastic Index (PI)	Correlated R-Value	Laboratory R-value
B-1 (1-4')	57	25	17	18 <sup>1</sup>
B-2 (0.5-4')	59	29	14	
B-3 (1-4')	44	17	27	
B-4 (0.5-4')	57	28	15	40 <sup>2</sup>
B-5 (1-4')	50	29	16	
B-6 (1-4')	49	25	19	
B-7 (1-4')	52	22	20	n/a
B-8 (0.5-4')	51	24	19	n/a
B-9 (1-4')	61	40	8	16 <sup>3</sup>
B-10 (1-4')	60	27	15	
B-11 (1-4')	56	29	14	
B-12 (1-4')	63	33	11	
B-13 (1-4')	64	27	14	n/a

**TABLE 5.3 (CON'T)**  
**SUMMARY OF LAB TEST DATA AND CORRELATED R-VALUES**

Boring (depth bps)	% Passing #200 Sieve	Plastic Index (PI)	Correlated R-Value	Laboratory R-value
B-14 (1-4')	49	18	25	n/a
B-15 (1-4')	52	25	18	17 <sup>4</sup>
B-16 (1-4')	43	23	22	
B-17 (1-4')	56	22	19	
B-18 (1-3')	45	22	22	
B-19 (1-4')	53	28	16	12 <sup>5</sup>
B-20 (0.5-4')	59	33	12	
B-21 (1-4')	67	30	12	
B-22 (1-4')	49	23	20	n/a
B-23 (1-3')	52	20	22	n/a
B-24 (1.5-3')	54	24	18	20 <sup>6</sup>
B-25 (2-4')	64	28	13	
B-26 (1.5-4)	57	22	19	
B-27 (2-4')	47	23	21	20 <sup>7</sup>
B-28 (2-4')	58	27	15	
B-29 (2-4')	45	24	20	
B-30 (2-4')	58	32	12	
B-31 (2-4')	46	20	24	n/a
B-32 (2-3')	95	16	14	5 <sup>8</sup>
B-33 (2-4')	44	18	26	
B-34 (2-4')	88	26	10	5 <sup>8</sup>

1 B-1, B-2, B-3 composite sample R-value

2 B-4, B-5, B-6 composite sample R-value

3 B-10, B-11, B-12 composite sample R-value

4 B-15, B-16, B-17, B-18 composite sample R-value

5 B-19, B-20, B-21 composite sample R-value

6 B-24, B-25, B-26 composite sample R-value

7 B-27, B-28, B-29, B-30 composite sample R-value

8 B-32, B-34 composite sample R-value

Based on our laboratory test results and in general accordance with the AASHTO 1993 Pavement Design Procedures and standard engineering practice, we calculated a mean R-Value ( $R_{\text{mean}}$ ) of 17.4 and corresponding soil resilient modulus ( $M_R$ ) of 37.8 MPa. The R-values and resilient modulus for subgrade were calculated using the method described in Section 202 of the Arizona Department of Transportation Preliminary Engineering Design Manual (1989).

### 5.2.3 Pavement Reconstruction Option – AC Over AB Over Stabilized Subgrade

The design for a new asphalt concrete (AC) pavement section for N55 was performed in general accordance with AASHTO 1993 Pavement Design Procedures using the traffic data input presented in Section 5.2.1 and the subgrade data provided in Section 5.2.2. The following design criteria were used to determine the pavement sections for the proposed reconstructed roadway:

**TABLE 5.4**  
**PAVEMENT DESIGN CRITERIA**

Design Factor	Design Criteria (Arterial)
Analysis Period	20 years
Level of Reliability $Z_R$ Value	75% -0.674
Serviceability: Initial ( $P_0$ ) Terminal ( $P_t$ )	4.0 2.4
Overall Standard Deviation ( $S_o$ )	0.45
Seasonal Variation Factor (SVF)	3.1*
Structural Coefficients: Asphalt Concrete (AC) Aggregate Base Course (ABC) Stabilized Subgrade	0.44 0.14 0.06**

\* Alamo, NM SVF based on Prescott, AZ with similar climate

\*\* Assumed subgrade coefficient to be verified by testing.

A structural number of 1.70, required for Route N55, was calculated based on the AASHTO 1993 asphalt pavement design equations, traffic data and subgrade soil information described in this report. The following table presents the minimum recommended pavement section for proposed new pavement, should this option be chosen.

**TABLE 5.5**  
**RECOMMENDED PAVEMENT SECTIONS – FULL REPLACEMENT**

Design Years	AC Thickness (mm)	ABC Thickness (mm)	Total Thickness (mm)	Required Structural Number	Actual Structural Number
20	75	150	225	1.70	2.70*

\*Assumes 225 mm of stabilized subgrade.

Site grading within the new pavement areas should be accomplished as recommended in the “Site Preparation and Grading” section of this report. A compacted subgrade of on-site soils mixed with soil stabilizer in the upper 225 mm is assumed. In an effort to reduce water infiltration and retard premature oxidation of the surfacing, the pavement surface should be sealed after the first summer of use, and routinely thereafter.

#### 5.2.4 Other Pavement Options

The existing pavement structure as it was measured in the field, consisted of 76 to 127 mm of asphalt pavement underlain by 51 to 203 mm of aggregate base. According to the BIA RFP, the original design cross section consisted of 76 mm of HACP, 152 mm of aggregate base course, and 300 mm of lime-stabilized subgrade. For the relatively low amount of traffic loading, the existing design cross section is structurally sufficient. However, as previously mentioned, the excessive distress is likely due to the heaving and contracting of the subgrade soils. This phenomena is made apparent by the severe rutting and uneven pavement surfaces in various sections of the roadway. In addition, the full design section of 152 mm aggregate base course was not accomplished throughout the alignment. Lime-stabilized subgrade was also not detected in many drilled locations.

Recycling of the AC materials for use as hot or cold mix recycled asphalt pavement (RAP) should be considered. For hot mix asphalt mixtures, 10 to 25 percent RAP is typically used with virgin materials. RAP can also be used to blend with the existing subgrade or subbase materials for further stabilization, as described below in section 5.2.5.

#### 5.2.5 Using Existing AC and AB for Cold Recycled AB (Full Depth Reclamation)

An additional alternative to the reconstruction methods described above, include full depth reclamation (FDR) of the existing materials. The existing asphalt and base materials can be used as a cold in place aggregate base replacement. The existing pavement section should be pulverized in place to provide a pulverized base section prior to topping with asphalt pavement. Additional materials should be overexcavated several inches (thickness selected based on field conditions) and recompact in place.

Based on the field measurements, the average depth of salvageable aggregate base course and hot mix asphalt for use as cold recycled asphalt base course is 203 mm. It is assumed that the recommended pavement structure will result in new pavement at or near existing grade. Recycled asphalt pavement (RAP), which is a mixture of existing AC and AB, can be blended with new AB in order to lessen the import requirements new pavement. For RAP blends which do not exceed 40 percent, no reduction in the structural coefficient of the base material (0.14) is considered to be necessary, as discussed in (FHWA, 2012). For this low volume road, up to 100 percent of RAP may be used. For any blend amount which exceeds 40 percent RAP, we recommend the structural coefficient be reduced to 0.08. Even with this lowered coefficient, the actual structural number (determined as 3.21) would exceed the required value of 1.70.

### 5.2.6 Surface Treatment Methods

We understand the BIA may consider replacement of the pavement section with a stabilized base and a minimal surface treatment for cost considerations. Application of a double (or multiple) chip seal coat or a cape seal could be considered for a reduced service life until additional funding becomes available. The seal treatment options would be applied over reconstructed subbase as described above. It is important to note without an adequate compacted pavement layer, additional traffic, particularly truck traffic, or extended periods of excessive precipitation may quickly reduce the integrity of the reconstructed subbase.

A chip seal would not improve the rideability of the existing roadway. A cape seal consists of a seal coat application over a chip seal to provide additional protection from moisture infiltration. The cape seal will lessen the potential for flying chips and reduce pavement noise and potentially improve rideability. Surface treatments will provide a temporary riding surface and moisture barrier to the subbase structure, with negligible added strength to the pavements. Should a surface treatment option be implemented in lieu of an adequately constructed pavement layer, we recommend allotment of funds to provide an adequate pavement section within three years.

## 5.3 SITE DRAINAGE & MOISTURE PROTECTION

Long-term performance of the reconstructed roadway will require that the subgrade soils be protected against excessive water infiltration and/or saturation. This is of particular concern at the locations where the drainages cross the alignment and in areas where the pavement subgrade is sufficiently low so as to be subject to frequent wetting. In this regard, it is recommended that the roadway either be re-designed so as to be sufficiently elevated above the surrounding terrain that

the subgrade soils will not be subject to frequent inundation or that the existing subgrade soils be modified by either removal and replacement with higher quality (non-expansive) soils or that the existing soils be treated in-place. Either mitigation option will require that the existing pavement section be removed and replaced. Design, construction, and maintenance of adequate ditching along both sides of the roadway are important, together with sufficient culverts to divert water away from the sides of the roadway. Any drainage improvements that could be made to divert water away from the roadway, would help to minimize moisture change related impacts.

## **6 CLOSURE**

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### **6.1 LIMITATIONS**

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of the geotechnical profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on visual reconnaissance, literature research, a field test boring program, laboratory testing, and engineering analyses.

Kleinfelder makes no other representation, guarantee or warranty, expression or implication, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

The scope of our services for this report did not include any environmental assessment or evaluation regarding the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, air, or below or around the site.

This report may be used only by the Client and other registered design professionals in association with the project, and only for the purposes stated and within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

### **6.2 ADDITIONAL SERVICES**

It is our recommendation that Kleinfelder be retained to review the project plans and specifications in order to confirm that the intent of our recommendations have been followed, and to make any necessary adjustments to those recommendations.

## 7 REFERENCES

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Arizona Department of Transportation, 1989, Preliminary Engineering & Design Manual, 31-017, 3rd Edition.

Federal Highway Administration, 2012, Report – User Guidelines for Waste and Byproduct Materials in Pavement Construction, Publication Number: FHWA-RD-97-148, Reclaimed Asphalt Pavement User Guideline.

# Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## **Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects**

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

## **Read this Report in Full**

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

## **You Need to Inform Your Geotechnical Engineer about Change**

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## **This Report May Not Be Reliable**

*Do not rely on this report* if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be, and, in general, if you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying it.* A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

## **Most of the "Findings" Related in This Report Are Professional Opinions**

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may

perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old*.

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration*. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists*.



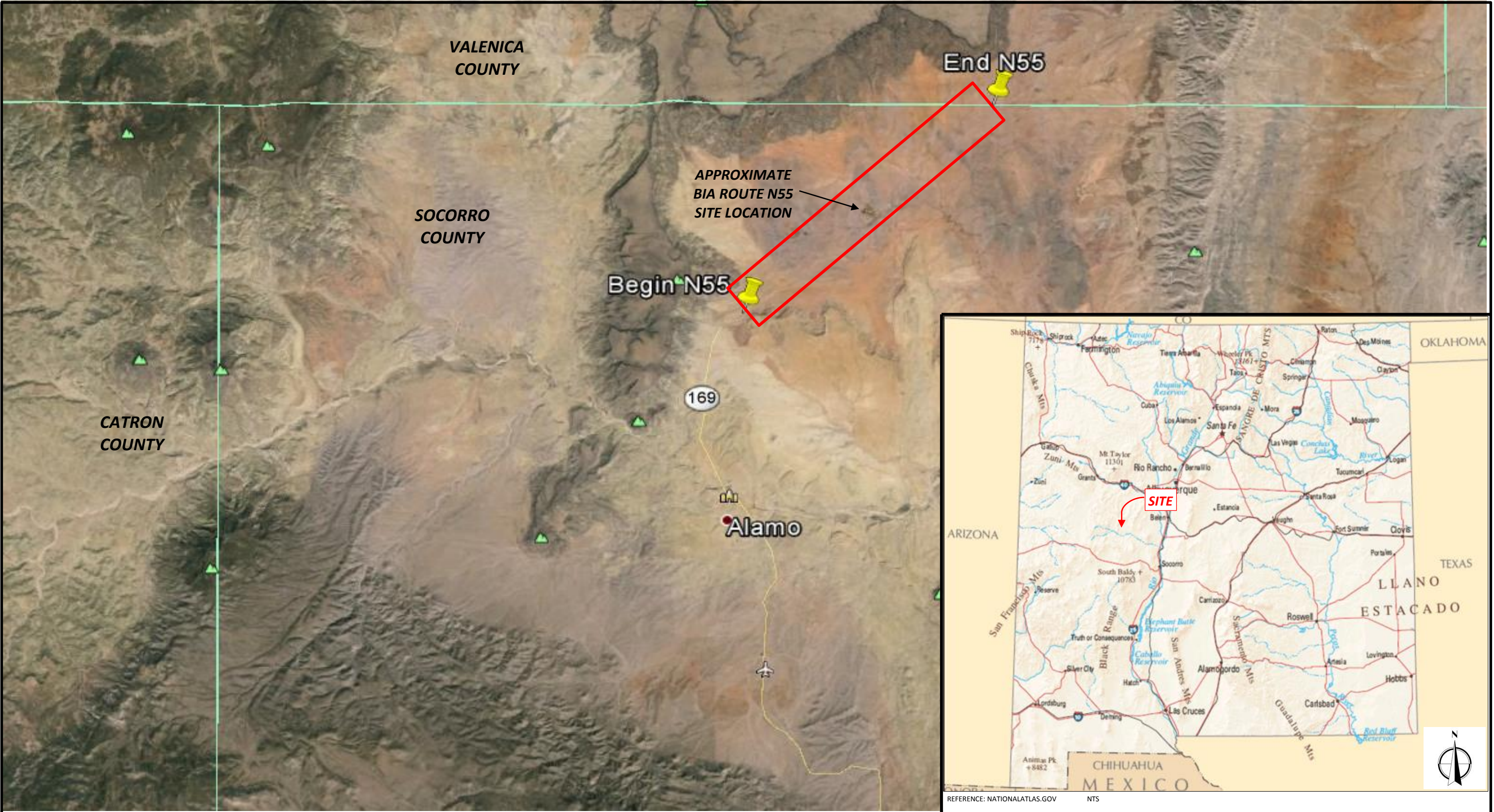
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## FIGURES AND PLATES

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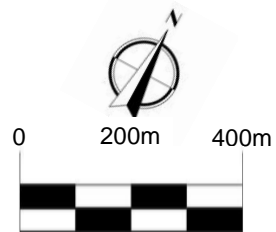


PROJECT NO. 20162433  
DRAWN: 12/30/2015  
DRAWN BY: DR  
CHECKED BY: KD

**VICINITY MAP**  
BIA NAVAJO ROUTE N55  
SOCORRO COUNTY, NM

FIGURE

**1**



**EXPLANATION**

 APPROXIMATE BORING LOCATION



PROJECT NO. 20162433  
DRAWN: 12/30/2015  
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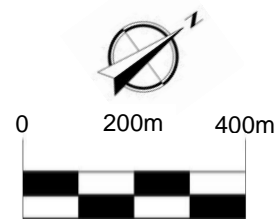
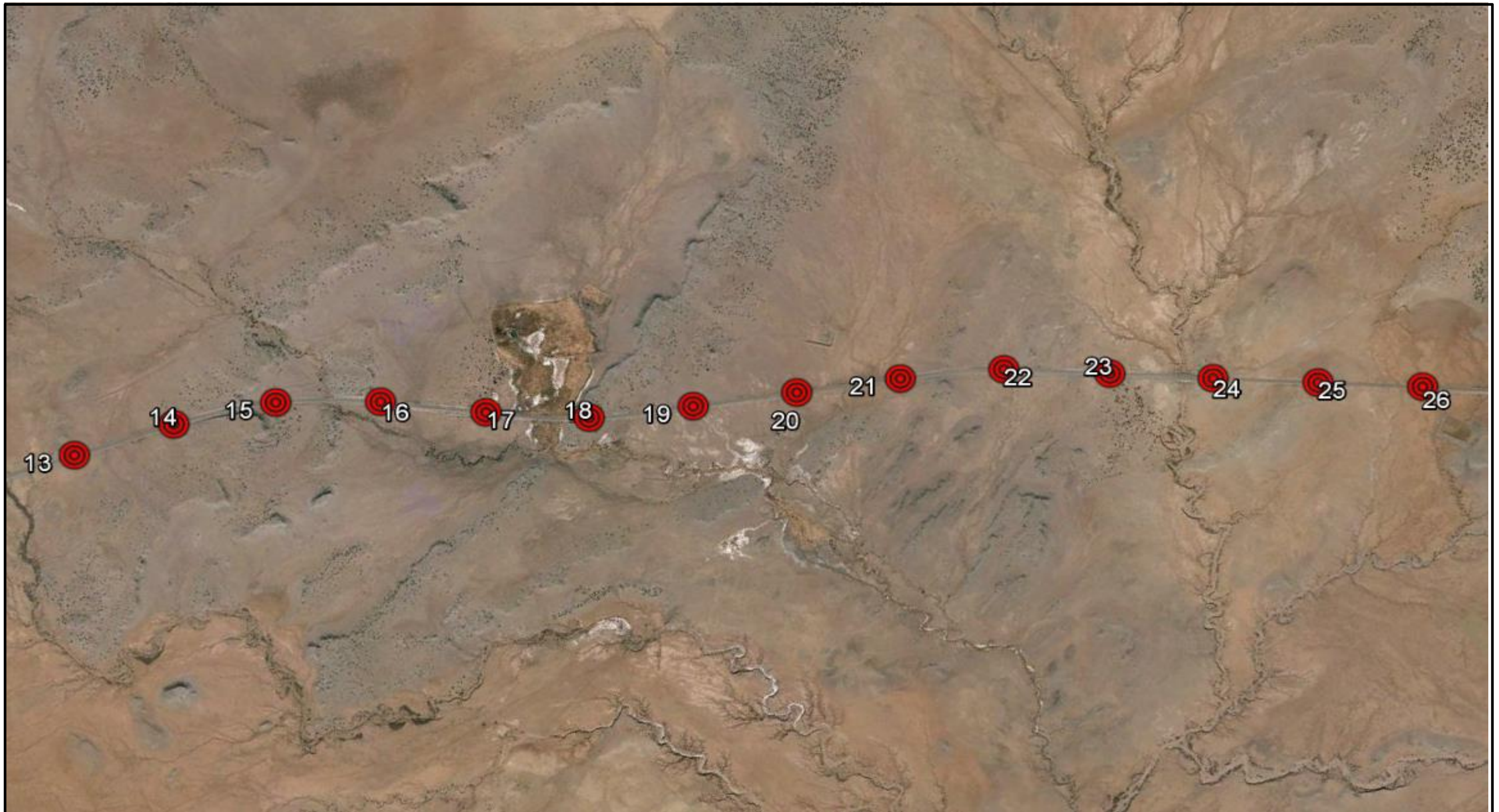
**BORING LOCATION MAP**  
BIA NAVAJO ROUTE N55  
SOCORRO COUNTY, NM

FIGURE

2

SHEET

1



**EXPLANATION**

 APPROXIMATE BORING LOCATION



PROJECT NO. 20162433  
DRAWN: 12/30/2015  
DRAWN BY: DR  
CHECKED BY: KD

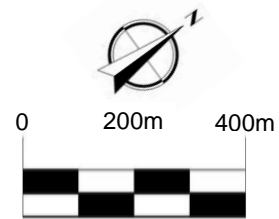
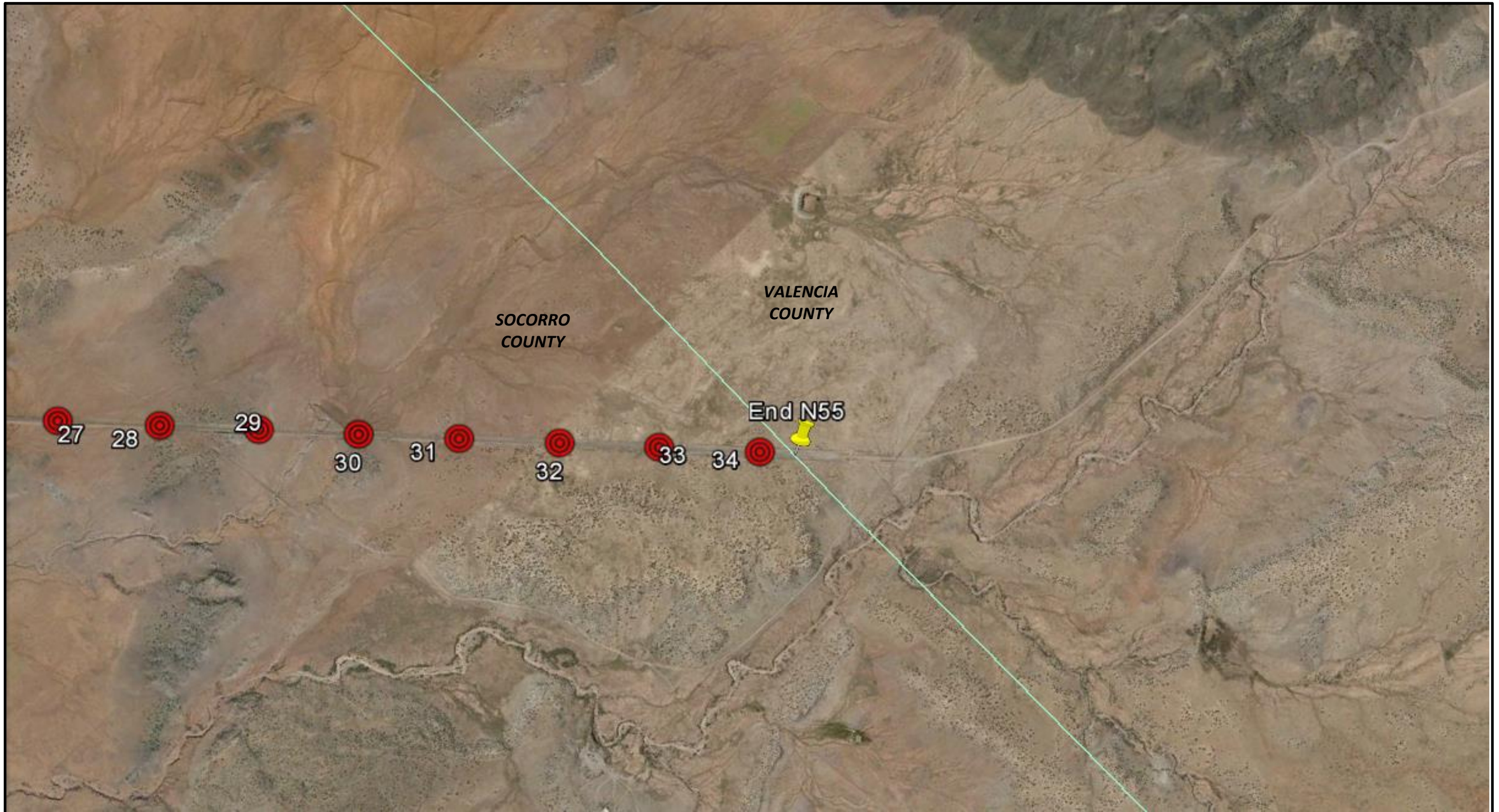
**BORING LOCATION MAP**  
BIA NAVAJO ROUTE N55  
SOCORRO COUNTY, NM

FIGURE

2

SHEET

2



**EXPLANATION**

 APPROXIMATE BORING LOCATION



PROJECT NO. 20162433  
DRAWN: 12/30/2015  
DRAWN BY: DR  
CHECKED BY: KD

**BORING LOCATION MAP**  
BIA NAVAJO ROUTE N55  
SOCORRO COUNTY, NM

FIGURE

**2**

SHEET

**3**

## **APPENDIX A BORING LOGS**

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**SAMPLE/SAMPLER TYPE GRAPHICS**

CALIFORNIA SAMPLER  
(3 in. (76.2 mm.) outer diameter)



STANDARD PENETRATION SPLIT SPOON SAMPLER  
(2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

**GROUND WATER GRAPHICS**

WATER LEVEL (level where first observed)



WATER LEVEL (level after exploration completion)



WATER LEVEL (additional levels after exploration)



OBSERVED SEEPAGE

**NOTES**

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, i.e., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 152 millimeters then 50/X indicates number of blows required to drive the identified sampler X millimeters with a 63.4 kg hammer falling 762 millimeters.

**UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)**

<b>GRAVELS</b> (More than half of coarse fraction is larger than the #200 sieve)	CLEAN GRAVEL WITH <5% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		$Cu < 4$ and/or $1 > Cc > 3$		GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
	GRAVELS WITH 5% TO 12% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$		GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
		$Cu \geq 4$ and $1 \leq Cc \leq 3$		GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		$Cu < 4$ and/or $1 > Cc > 3$		GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
		$Cu < 4$ and/or $1 > Cc > 3$		GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
	GRAVELS WITH > 12% FINES			GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
<b>SANDS</b> (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$		SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		$Cu < 6$ and/or $1 > Cc > 3$		SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
	SANDS WITH 5% TO 12% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$		SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
		$Cu \geq 6$ and $1 \leq Cc \leq 3$		SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		$Cu < 6$ and/or $1 > Cc > 3$		SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
		$Cu < 6$ and/or $1 > Cc > 3$		SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
	SANDS WITH > 12% FINES			SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES
<b>FINE GRAINED SOILS</b> (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)			ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY



PROJECT NO.: 20162433  
 DRAWN BY: MAP  
 CHECKED BY:  
 DATE: 12/9/2015  
 REVISED: -

**GRAPHICS KEY**

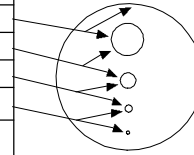
BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico

PLATE

A-A

**GRAIN SIZE**

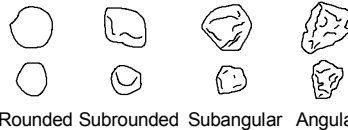
DESCRIPTION	SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders	>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles	3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse 3/4 - 3 in. (19 - 76.2 mm.)	3/4 - 3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine #4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse #10 - #4	0.075 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium #40 - #10	0.017 - 0.075 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine #200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines	Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller

**Munsell Color**

NAME	ABBR
Red	R
Yellow Red	YR
Yellow	Y
Green Yellow	GY
Green	G
Blue Green	BG
Blue	B
Purple Blue	PB
Purple	P
Red Purple	RP
Black	N

**ANGULARITY**

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

**Particles Present**

Amount	Percentage
trace	<5
few	5-10
little	15-25
some	30-45
and	50
mostly	50-100

**PLASTICITY**

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

**MOISTURE CONTENT**

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

**REACTION WITH HYDROCHLORIC ACID**

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

**APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL**

APPARENT DENSITY	SPT-N <sub>60</sub> (#blows/0.3m)	MODIFIED CA SAMPLER (#blows/0.3m)	CALIFORNIA SAMPLER (#blows/0.3m)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

**CONSISTENCY - FINE-GRAINED SOIL**

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (q <sub>u</sub> )(psf)	CRITERIA
Very Soft	< 1000	Thumb will penetrate soil more than 1 in. (25 mm.)
Soft	1000 - 2000	Thumb will penetrate soil about 1 in. (25 mm.)
Firm	2000 - 4000	Thumb will indent soil about 1/4-in. (6 mm.)
Hard	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail
Very Hard	> 8000	Thumbnail will not indent soil


NOTE: AFTER TERZAGHI AND PECK, 1948

**STRUCTURE**

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout


**CEMENTATION**

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

	PROJECT NO.: 20162433	SOIL DESCRIPTION KEY	PLATE  A-B
	DRAWN BY: MAP		
	CHECKED BY:	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	
	DATE: 12/9/2015		
	REVISED: -		


PLOTTED: 01/15/2016 09:12 AM BY: drossman

<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-1</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.50174° N Longitude: 107.50284° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)/ Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
1		ASPHALT: 76 mm				CL	15.4	104.4	96	57	39	25	
	Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, soft												
	bulk sample from 0.3 to 1.2 m.												

The boring was terminated at approximately 1.2 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-1	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-1
	DATE: 12/30/2015		
	REVISED: -		
		PAGE:	1 of 1


GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-2**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.50419° N Longitude: 107.50010° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
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The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-2		PLATE  <b>A-2</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		


<b>Date Begin - End:</b> 11/04/2015		<b>Drilling Company:</b> Enviro-Drill, Inc.		<b>BORING LOG Boring-3</b>	
<b>Logged By:</b> C. Lewallen		<b>Drill Crew:</b> Ed/Marcel			
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12		<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.	
<b>Plunge:</b> 90 degrees		<b>Drilling Method:</b> Hollow Stem Auger			
<b>Weather:</b> --		<b>Exploration Diameter:</b> 102 mm. O.D.			

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.50586° N Longitude: 107.49629° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
1		ASPHALT: 76 mm	BC=4 3 3		SC			94	44	35	17		
		AGGREGATE BASE: 76 mm											
		Clayey SAND (SC): medium plasticity, slightly moist, soft											
		<p>The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015</p> <p><u>GROUNDWATER LEVEL INFORMATION:</u> Groundwater was not encountered during drilling or after completion.</p> <p><u>GENERAL NOTES:</u></p>											
2													
3													

	PROJECT NO.: 20162433	BORING LOG Boring-3	PLATE  A-3
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	
DATE: 12/30/2015			
REVISED: -			

PAGE: 1 of 1

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-4**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.50750° N Longitude: 107.49240° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 102 mm											
		AGGREGATE BASE: 51 mm											
		Sandy Lean CLAY (CL): medium to high plasticity, slightly moist, soft				CL			94	57	43	28	
		bulk sample from 0.2 to 1.2 m.		BC=4 3 5									
1													
2													
3													


The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:




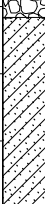
The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-4		PLATE  <b>A-4</b>
	DRAWN BY: DR	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		
	CHECKED BY: KD			
	DATE: 12/30/2015			
	REVISED: -			
PAGE: 1 of 1				

PLOTTED: 01/15/2016 09:12 AM BY: drossman

<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-5</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		


Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.50911° N Longitude: 107.48861° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
1		ASPHALT: 76 mm		BC=12		SC	17.3	105.7	87	50	47	29	
		AGGREGATE BASE: 102 mm											
		Clayey SAND (SC): medium to high plasticity, some lime, slightly moist, firm											
	bulk sample from 0.3 to 1.2 m.												
2		The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015											
		GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:											
3													

	PROJECT NO.: 20162433	BORING LOG Boring-5	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-5
DATE: 12/30/2015			
REVISED: -			PAGE: 1 of 1

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

PLOTTED: 01/15/2016 09:12 AM BY: drossman

<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-6</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.51072° N Longitude: 107.48477° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)≠ Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 127 mm											
		AGGREGATE BASE: 102 mm											
		Clayey SAND (SC): medium plasticity, some lime, slightly moist, soft											
		bulk sample from 0.3 to 1.2 m.		BC=10 3 4		SC			91	49	46	25	
1													
2													
3													


The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:


The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015


**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-6	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-6
	DATE: 12/30/2015		
	REVISED: -		
		PAGE: 1 of 1	


GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-7**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.51234° N Longitude: 107.48093° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 102 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, soft											
		bulk sample from 0.3 to 1.2 m.		BC=3 2 3		CL			90	52	43	22	
1							15.5	110.7					
				BC=12									
<div><div>The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015</div><div>GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:</div></div>													
2													
3													

	PROJECT NO.: 20162433	BORING LOG Boring-7		PLATE  <b>A-7</b>
	DRAWN BY: DR	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		
	CHECKED BY: KD			
	DATE: 12/30/2015			
	REVISED: -			
PAGE: 1 of 1				

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-8**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.51396° N Longitude: 107.47710° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											strong reaction to HCL
		AGGREGATE BASE: 51 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, very soft				CL			90	51	42	24	
		bulk sample from 0.2 to 1.2 m.		BC=3 2 2									
1													
2													
3													

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**



PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

### BORING LOG Boring-8

BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico




PLATE

A-8

PAGE: 1 of 1


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<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-9</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.51560° N Longitude: 107.47320° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 127 mm											
		Sandy Fat CLAY (CH): high plasticity, some lime, slightly moist, soft											
				BC=2 4 2		CH			91	61	59	40	
		bulk sample from 0.3 to 1.2 m.											
1							27.0	104.4					
				BC=12									

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015


**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-9	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-9
DATE: 12/30/2015			
REVISED: -			PAGE: 1 of 1

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
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**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-11**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.51903° N Longitude: 107.46569° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 89 mm											
		AGGREGATE BASE: 127 mm											
		Sandy Lean CLAY (CL): medium to high plasticity, some lime, slightly moist, soft											
		bulk sample from 0.3 to 1.2 m.	BC=24			CL	21.1	90.9	93	56	46	29	
1			BC=4 3 5										




The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-11		PLATE  <b>A-11</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		
PAGE: 1 of 1				


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<b>Date Begin - End:</b>	11/04/2015	<b>Drilling Company:</b>	Enviro-Drill, Inc.	<b>BORING LOG Boring-12</b>
<b>Logged By:</b>	C. Lewallen	<b>Drill Crew:</b>	Ed/Marcel	
<b>Hor.-Vert. Datum:</b>	NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		
<b>Plunge:</b>	90 degrees	<b>Drilling Method:</b>	Hollow Stem Auger	
<b>Weather:</b>	--	<b>Exploration Diameter:</b>	102 mm. O.D.	<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.52188° N Longitude: 107.46320° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 127 mm											
		Sandy Fat CLAY (CH): high plasticity, some lime, slightly moist, soft											
			BC=3 2 4		CH			93	63	50	33		
		bulk sample from 0.3 to 1.2 m.											
1													

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015




**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	<b>BORING LOG Boring-12</b>	<b>PLATE</b>  <b>A-12</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -		
BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		PAGE: 1 of 1	

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

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**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-14**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.52824° N Longitude: 107.45940° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 102 mm											
		Clayey SAND (SC): medium plasticity, some lime, slightly moist, very firm											
				BC=10 18 11		SC			93	49	31	18	
		bulk sample from 0.3 to 1.2 m.											
		sandstone cobble @ 0.76 m.											
1		sandstone below 1.06 m.											

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**



PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

### BORING LOG Boring-14


BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico

PLATE

A-14

PAGE: 1 of 1

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-15**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.53124° N Longitude: 107.45718° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 89 mm											
		AGGREGATE BASE: 102 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, firm											
			BC=28			CL	11.8	118.8	90	52	39	25	
		bulk sample from 0.3 to 1.2 m.	BC=5 5 6										
1													
2													
3													


The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:




The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-15	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-15
	DATE: 12/30/2015		
	REVISED: -		
		PAGE:	1 of 1

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<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-16</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.53377° N Longitude: 107.45419° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 76 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, firm											
		bulk sample from 0.3 to 1.2 m.		BC=6 5 10		SC			91	43	40	23	
		sandstone cobble @ 0.6 m.											

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**






PROJECT NO.: 20162433  
DRAWN BY: DR  
CHECKED BY: KD  
DATE: 12/30/2015  
REVISED: -

**BORING LOG Boring-16**  
  
BIA: Route N55 Near Alamo, NM  
Order No. A15PD00801, Req No. 0040235504  
Los Alamos, New Mexico

PLATE  
  
**A-16**  
  
PAGE: 1 of 1


PLOTTED: 01/15/2016 09:12 AM BY: drossman

Date Begin - End:	11/04/2015	Drilling Company:	Enviro-Drill, Inc.	BORING LOG Boring-17
Logged By:	C. Lewallen	Drill Crew:	Ed/Marcel	
Hor.-Vert. Datum:	NAD 83 - UTM Zone 12	Drilling Equipment:		
Plunge:	90 degrees	Drilling Method:	Hollow Stem Auger	
Weather:	--	Exploration Diameter:	102 mm. O.D.	
		Hammer Type - Drop:		63.5 kg. Auto - 762 mm.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.53605° N Longitude: 107.45081° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 76 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, firm											
				BC=3 5 7		CL			94	56	38	22	
			bulk sample from 0.3 to 1.2 m.										
1				BC=16			12.7	117.1					

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.  
GENERAL NOTES:

	PROJECT NO.: 20162433	BORING LOG Boring-17	PLATE  A-17
	DRAWN BY: DR		
	CHECKED BY: KD	DATE: 12/30/2015	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico
REVISED: -			

gint FILE: PROJECTWISE: 20162433\_gint.gpj  
gint TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-18**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION			LABORATORY RESULTS								
		Latitude: 34.53840° N Longitude: 107.44765° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)/ Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 102 mm											
		AGGREGATE BASE: 152 mm											
		Clayey SAND (SC): medium plasticity, some, slightly moist, hard		BC=5 32 45		SC			87	45	38	22	
		bulk sample from 0.3 to 0.9 m.											
		sandstone below 0.9 m.											
1		The boring was terminated at approximately 0.91 m. below ground surface due to practical auger refusal on sandstone. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015											
		GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:											
2													
3													



PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

### BORING LOG Boring-18


BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico

PLATE

A-18

PAGE: 1 of 1

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-19**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.54121° N Longitude: 107.44500° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 152 mm											
		Sandy Lean CLAY (CL): medium to high plasticity, some lime, slightly moist, soft											
		bulk sample from 0.3 to 1.2 m.		BC=2 2 3		CL			90	53	45	28	
1													
2													
3													

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**



PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

**BORING LOG Boring-19**  
 BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico






PLATE

A-19

PAGE: 1 of 1


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<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-20</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.54408° N Longitude: 107.44243° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 76 mm											
		Sandy Fat CLAY (CH): high plasticity, some lime, slightly moist, soft				CH			89	59	52	33	
		bulk sample from 0.2 to 1.2 m.		BC=5 4 5									
1							12.6	117.9					

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015


**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-20	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-20
	DATE: 12/30/2015		
	REVISED: -		
		PAGE:	1 of 1

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
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<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-21</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION			LABORATORY RESULTS								
		Latitude: 34.54695° N Longitude: 107.43986° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 152 mm											
		Sandy Lean CLAY (CL): medium to high plasticity, some lime, slightly moist, firm											
		bulk sample from 0.3 to 1.2 m.		BC=5 5 10		CL			92	67	48	30	

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015




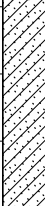
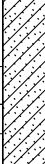
**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

 <b>KLEINFELDER</b> <i>Bright People. Right Solutions.</i>	PROJECT NO.: 20162433	<b>BORING LOG Boring-21</b>	<b>PLATE</b>  <b>A-21</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -		
KLEINFELDER - 1335 West Auto Drive   Tempe, AZ 85284   PH: 480.763.1200   FAX: 480.763.1212   www.kleinfelder.com			PAGE: 1 of 1

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PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-22</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION			LABORATORY RESULTS								
		Latitude: 34.54970° N Longitude: 107.43714° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 127 mm											
		LIME-STABILIZED SUBGRADE: 76 mm											
		Clayey SAND (SC): medium plasticity, some lime, slightly moist, firm		BC=3 4 8		SC			87	49	41	23	
		bulk sample from 0.3 to 1.2 m.											
1				BC=20			6.9	116.1					




The boring was terminated at approximately 1.14 m. below ground surface due to practical auger refusal on gravel/cobbles. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015


GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.  
GENERAL NOTES:

	PROJECT NO.: 20162433	BORING LOG Boring-22	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-22
	DATE: 12/30/2015		
	REVISED: -		
		PAGE: 1 of 1	





GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-23**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
		Latitude: 34.55216° N Longitude: 107.43392° W Surface Condition: Aggregate Base Coarse	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks	
		Lithologic Description												
		AGGREGATE BASE: 127 mm		BC=21 35 50/2"		CL			93	52	45	20		
		LIME-STABILIZED SUBGRADE: 51 mm												
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, hard												
		bulk sample from 0.3 to 0.9 m.  sandstone below 0.9 m.												
1	The boring was terminated at approximately 0.91 m. below ground surface due to practical auger refusal on sandstone. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015													
2	GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:													
3														

	PROJECT NO.: 20162433	BORING LOG Boring-23		PLATE  <b>A-23</b>
	DRAWN BY: DR	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		
	CHECKED BY: KD			
	DATE: 12/30/2015			
	REVISED: -			
PAGE: 1 of 1				

**Date Begin - End:** 11/04/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-24**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.55454° N Longitude: 107.43077° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
1		ASPHALT: 102 mm		BC=12 18 20		CL			93	54	40	24	
		AGGREGATE BASE: 102 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, very firm											
		bulk sample from 0.5 to 0.9 m.											
		sandstone below 1.0 m.											
	<div><div>The boring was terminated at approximately 0.99 m. below ground surface due to practical auger refusal on sandstone. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015</div><div>GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:</div></div>												
2													
3													



PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

**BORING LOG Boring-24**  
 BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico


PLATE


A-24

PAGE: 1 of 1

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<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-25</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		


Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.55697° N Longitude: 107.42758° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 89 mm											
		AGGREGATE BASE: 76 mm											
		Sandy Lean CLAY (CL): medium to high plasticity, some lime, slightly moist, very soft											
		lime-stabilized subgrade @ 0.5-0.6 m.		BC=6 2 2									
		bulk sample from 0.6 to 1.2 m.				CL			94	64	48	28	
1							22.5	95.3					
				BC=17									
The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015													
GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:													
2													
3													

	PROJECT NO.: 20162433	BORING LOG Boring-25	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-25
DATE: 12/30/2015			
REVISED: -			PAGE: 1 of 1

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PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b> 11/04/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-26</b>
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel	
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>	<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger	
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.	

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.55941° N Longitude: 107.42441° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 102 mm											
		AGGREGATE BASE: 102 mm											
		LIME-STABILIZED SUBGRADE: 51 mm											
		Sandy Lean CLAY (CL): medium plasticity, some lime, slightly moist, soft		BC=3 4 5									
		bulk sample from 0.5 to 1.2 m.											
1						CL			93	57	36	22	strong reaction to HCL

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 04, 2015


**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**


 <p><b>KLEINFELDER</b> Bright People. Right Solutions.</p>	PROJECT NO.: 20162433	<b>BORING LOG Boring-26</b>	<b>PLATE</b>  <b>A-26</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -		
			PAGE: 1 of 1

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

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<b>Date Begin - End:</b>	11/03/2015	<b>Drilling Company:</b>	Enviro-Drill, Inc.	<b>BORING LOG Boring-27</b>
<b>Logged By:</b>	C. Lewallen	<b>Drill Crew:</b>	Ed/Marcel	
<b>Hor.-Vert. Datum:</b>	NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		
<b>Plunge:</b>	90 degrees	<b>Drilling Method:</b>	Hollow Stem Auger	
<b>Weather:</b>	--	<b>Exploration Diameter:</b>	102 mm. O.D.	
		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.		





Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.56183° N Longitude: 107.42120° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC) Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 152 mm											
		LIME-STABILIZED SUBGRADE: 102 mm											
		Clayey SAND (SC): medium plasticity, some lime, slightly moist to moist, soft		BC=4 4 3									
		bulk sample from 0.6 to 1.2 m.				SC			90	47	40	23	
1							6.4						ring sample disturbed, no density testing performed
				BC=40									
The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015													
GROUNDWATER LEVEL INFORMATION: Groundwater was not encountered during drilling or after completion. GENERAL NOTES:													
2													
3													

	PROJECT NO.: 20162433	<b>BORING LOG Boring-27</b>	<b>PLATE</b>  <b>A-27</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -		
BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico		PAGE: 1 of 1	

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<b>Date Begin - End:</b> 11/03/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-28</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.56431° N Longitude: 107.41793° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC) Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 89 mm											
		AGGREGATE BASE: 178 mm											
		LIME-STABILIZED SUBGRADE: 76 mm											
		Sandy Lean CLAY (CL): medium to high plasticity, some lime, slightly moist, firm		BC=7 4 6									
		bulk sample from 0.6 to 1.2 m.				CL			91	58	46	27	strong reaction to HCL
1													





The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-28	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-28
DATE: 12/30/2015			
REVISED: -			
		PAGE: 1 of 1	

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

**Date Begin - End:** 11/03/2015 **Drilling Company:** Enviro-Drill, Inc. **BORING LOG Boring-29**  
**Logged By:** C. Lewallen **Drill Crew:** Ed/Marcel  
**Hor.-Vert. Datum:** NAD 83 - UTM Zone 12 **Drilling Equipment:** **Hammer Type - Drop:** 63.5 kg. Auto - 762 mm.  
**Plunge:** 90 degrees **Drilling Method:** Hollow Stem Auger  
**Weather:** -- **Exploration Diameter:** 102 mm. O.D.

Depth (meters)	Graphical Log	FIELD EXPLORATION			LABORATORY RESULTS								
		Latitude: 34.56673° N Longitude: 107.41478° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		ASPHALT: 76 mm											
		AGGREGATE BASE: 178 mm											
		LIME-STABILIZED SUBGRADE: 76 mm											
		Clayey SAND (SC): medium plasticity, some lime, some subrounded gravel, slightly moist, firm		BC=5 5 9									
		bulk sample from 0.6 to 1.2 m.				SC		90	45	40	24		

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.

**GENERAL NOTES:**



PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

### BORING LOG Boring-29

BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico


PLATE

A-29

PAGE: 1 of 1

PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b> 11/03/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-30</b>
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel	
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>	<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger	
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.	

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.56913° N Longitude: 107.41160° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
													
	ASPHALT: 89 mm												
	AGGREGATE BASE: 152 mm												
	LIME-STABILIZED SUBGRADE: 51 mm												
	Sandy Lean CLAY (CL): high plasticity, some lime, slightly moist, soft, trace amounts of gravel		BC=1 3 5										
	bulk sample from 0.6 to 1.2 m.				CL			91	58	49	32		
1			BC=27			8.5	120.9						

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.




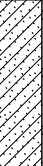
**GENERAL NOTES:**

<p><b>KLEINFELDER</b> <i>Bright People. Right Solutions.</i></p>	PROJECT NO.: 20162433	<b>BORING LOG Boring-30</b>	<b>PLATE</b>  <b>A-30</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -		
PAGE: 1 of 1			

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]


PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b> 11/03/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-31</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.57157° N Longitude: 107.40840° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 178 mm											
		LIME-STABILIZED SUBGRADE: 127 mm											
		Clayey SAND (SC): medium plasticity, some lime, slightly moist, soft		BC=10 4 4									
		bulk sample from 0.6 to 1.2 m.				SC			94	46	35	20	
1				BC=21			13.1	113.2					

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015


**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-31	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-31
DATE: 12/30/2015			
REVISED: -			PAGE: 1 of 1

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]


PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b>	11/03/2015	<b>Drilling Company:</b>	Enviro-Drill, Inc.	<b>BORING LOG Boring-32</b>
<b>Logged By:</b>	C. Lewallen	<b>Drill Crew:</b>	Ed/Marcel	
<b>Hor.-Vert. Datum:</b>	NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		
<b>Plunge:</b>	90 degrees	<b>Drilling Method:</b>	Hollow Stem Auger	
<b>Weather:</b>	--	<b>Exploration Diameter:</b>	102 mm. O.D.	<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.57401° N Longitude: 107.40520° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)≠ Uncorr. Blows/152 mm.	Recovery (NP=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 152 mm											
		LIME-STABILIZED SUBGRADE: 127 mm											
		Lean CLAY (CL): medium plasticity, some lime, slightly moist, very firm		BC=36 21 16									moderate reaction to HCL
		bulk sample from 0.6 to 0.9 m.				CL			98	95	28	16	
		sandstone below 0.9 m.		BC=26									no recovery in ring sample

1 The boring was terminated at approximately 0.91 m. below ground surface due to practical auger refusal on sandstone. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015


GROUNDWATER LEVEL INFORMATION:  
Groundwater was not encountered during drilling or after completion.  
GENERAL NOTES:

	PROJECT NO.: 20162433	BORING LOG Boring-32	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-32
	DATE: 12/30/2015		
	REVISED: -		
		PAGE:	1 of 1

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]


PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b> 11/03/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-33</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.57640° N Longitude: 107.40205° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 152 mm											
		LIME-STABILIZED SUBGRADE: 127 mm											
		Clayey SAND (SC): medium plasticity, some lime, slightly moist, very firm		BC=30 23 16									
		bulk sample from 0.6 to 1.2 m.				SC			99	44	29	18	

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015


**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-33	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	A-33
DATE: 12/30/2015			
REVISED: -			
		PAGE: 1 of 1	

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]


PLOTTED: 01/15/2016 09:13 AM BY: drossman

<b>Date Begin - End:</b> 11/03/2015	<b>Drilling Company:</b> Enviro-Drill, Inc.	<b>BORING LOG Boring-34</b>	
<b>Logged By:</b> C. Lewallen	<b>Drill Crew:</b> Ed/Marcel		
<b>Hor.-Vert. Datum:</b> NAD 83 - UTM Zone 12	<b>Drilling Equipment:</b>		<b>Hammer Type - Drop:</b> 63.5 kg. Auto - 762 mm.
<b>Plunge:</b> 90 degrees	<b>Drilling Method:</b> Hollow Stem Auger		
<b>Weather:</b> --	<b>Exploration Diameter:</b> 102 mm. O.D.		

Depth (meters)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
		Latitude: 34.57883° N Longitude: 107.39885° W Surface Condition: Asphalt Paved Roadway	Sample Type	Blow Counts(BC)= Uncorr. Blows/152 mm.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lithologic Description											
		ASPHALT: 76 mm											
		AGGREGATE BASE: 203 mm											
		LIME-STABILIZED SUBGRADE: 152 mm		BC=3 6 7									
		Lean CLAY (CL): medium plasticity, some lime, slightly moist, firm  bulk sample from 0.6 to 1.2 m.				CL			98	88	48	26	
				BC=20			18.8	102.0					

The boring was terminated at approximately 1.22 m. below ground surface. The boring was backfilled with auger cuttings and patched with asphalt cold patch on November 03, 2015

**GROUNDWATER LEVEL INFORMATION:**  
Groundwater was not encountered during drilling or after completion.  
**GENERAL NOTES:**

	PROJECT NO.: 20162433	BORING LOG Boring-34	PLATE  A-34
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	PAGE: 1 of 1
DATE: 12/30/2015			
REVISED: -			

GINT FILE: PROJECTWISE: 20162433\_gint.gpj  
 GINT TEMPLATE: PROJECTWISE: KLF\_STANDARD\_GINT\_LIBRARY\_2016.GLB [KLF\_BORING/TEST PIT SOIL LOG]

**APPENDIX B**  
**LABORATORY TEST RESULTS – SOIL**

---

Exploration ID	Depth (m.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
Boring-1	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	96	57	39	14	25	
Boring-2	0.15 - 1.22	SANDY LEAN CLAY (CL)			100	94	59	43	14	29	
Boring-3	0.3 - 1.22	CLAYEY SAND (SC)			100	94	44	35	18	17	
Boring-4	0.15 - 1.22	SANDY LEAN CLAY (CL)			100	94	57	43	15	28	
Boring-5	0.3 - 1.22	CLAYEY SAND (SC)			100	87	50	47	18	29	
Boring-6	0.3 - 1.22	CLAYEY SAND (SC)			100	91	49	46	21	25	
Boring-7	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	90	52	43	21	22	
Boring-8	0.15 - 1.22	SANDY LEAN CLAY (CL)			100	90	51	42	18	24	
Boring-9	0.3 - 1.22	SANDY FAT CLAY (CH)			100	91	61	59	19	40	
Boring-10	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	92	60	47	20	27	
Boring-11	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	93	56	46	17	29	
Boring-12	0.3 - 1.22	SANDY FAT CLAY (CH)			100	93	63	50	17	33	
Boring-13	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	93	64	42	15	27	
Boring-14	0.3 - 1.22	CLAYEY SAND (SC)			100	93	49	31	13	18	
Boring-15	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	90	52	39	14	25	
Boring-16	0.3 - 1.22	CLAYEY SAND (SC)			100	91	43	40	17	23	
Boring-17	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	94	56	38	16	22	
Boring-18	0.3 - 0.91	CLAYEY SAND (SC)			99	87	45	38	16	22	
Boring-19	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	90	53	45	17	28	
Boring-20	0.15 - 1.22	SANDY FAT CLAY (CH)			100	89	59	52	19	33	
Boring-21	0.3 - 1.22	SANDY LEAN CLAY (CL)			100	92	67	48	18	30	
Boring-22	0.3 - 1.22	CLAYEY SAND (SC)			100	87	49	41	18	23	
Boring-23	0.3 - 0.91	SANDY LEAN CLAY (CL)			100	93	52	45	25	20	
Boring-24	0.46 - 0.91	SANDY LEAN CLAY (CL)			100	93	54	40	16	24	
Boring-25	0.61 - 1.22	SANDY LEAN CLAY (CL)			100	94	64	48	20	28	
Boring-26	0.46 - 1.22	SANDY LEAN CLAY (CL)			100	93	57	36	14	22	
Boring-27	0.61 - 1.22	CLAYEY SAND (SC)			100	90	47	40	17	23	
Boring-28	0.61 - 1.22	SANDY LEAN CLAY (CL)			100	91	58	46	19	27	

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.  
NP = NonPlastic



PROJECT NO.: 20162433

DRAWN BY: MAP

CHECKED BY:

DATE: 12/9/2015

REVISED: -

### LABORATORY TEST RESULT SUMMARY

BIA: Route N55 Near Alamo, NM  
Order No. A15PD00801, Req No. 0040235504  
Los Alamos, New Mexico

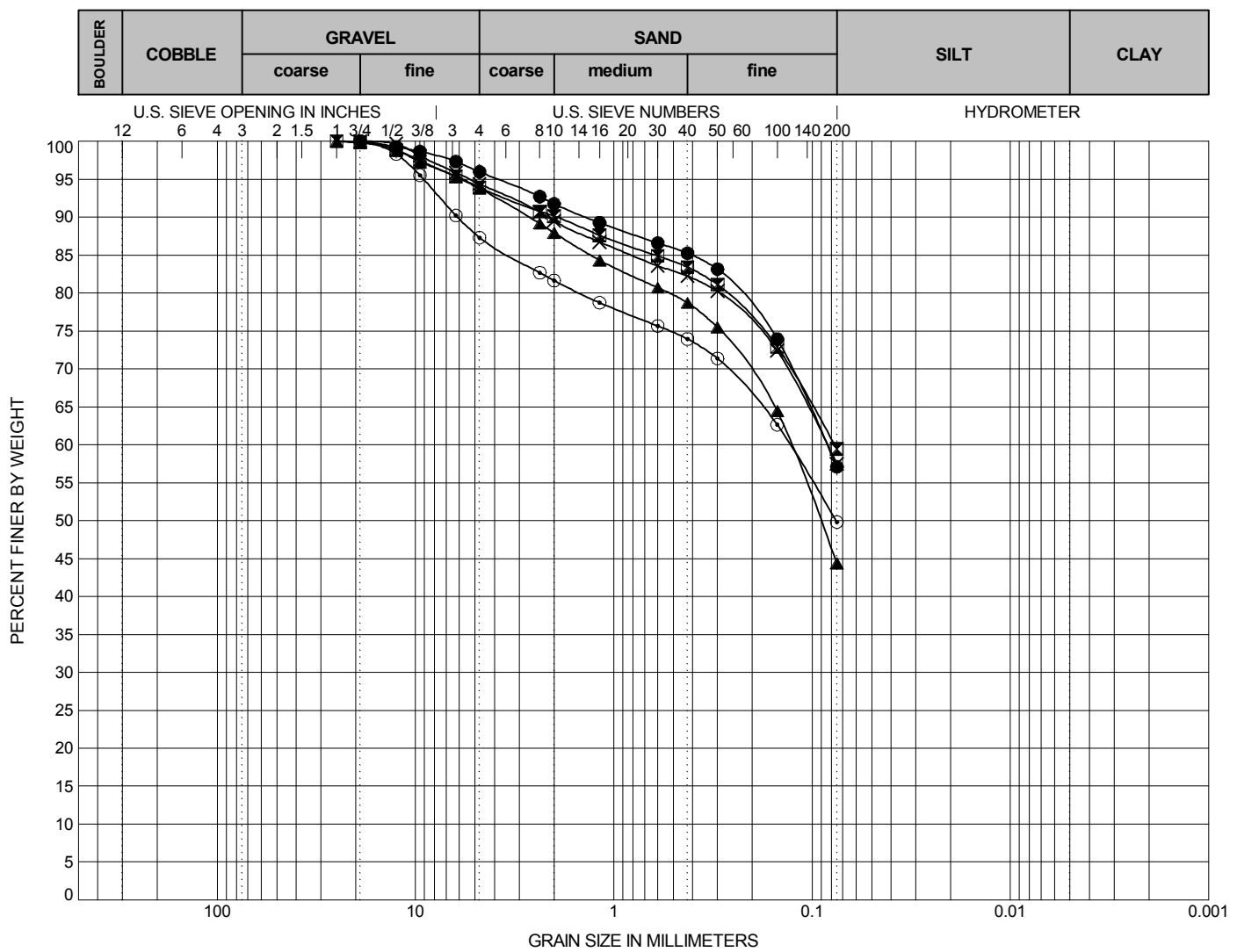
TABLE

B-1

Exploration ID	Depth (m.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
Boring-29	0.61 - 1.22	CLAYEY SAND (SC)			100	90	45	40	16	24	
Boring-30	0.61 - 1.22	SANDY LEAN CLAY (CL)			100	91	58	49	17	32	
Boring-31	0.61 - 1.22	CLAYEY SAND (SC)			100	94	46	35	15	20	
Boring-32	0.61 - 0.91	LEAN CLAY (CL)			100	98	95	28	12	16	
Boring-33	0.61 - 1.22	CLAYEY SAND (SC)			100	99	44	29	11	18	
Boring-34	0.61 - 1.22	LEAN CLAY (CL)			100	98	88	48	22	26	




Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above. NP = NonPlastic		PROJECT NO.: 20162433	LABORATORY TEST RESULT SUMMARY	TABLE  B-2
		DRAWN BY: MAP		
		CHECKED BY:	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	
DATE: 12/9/2015				
REVISED: -				

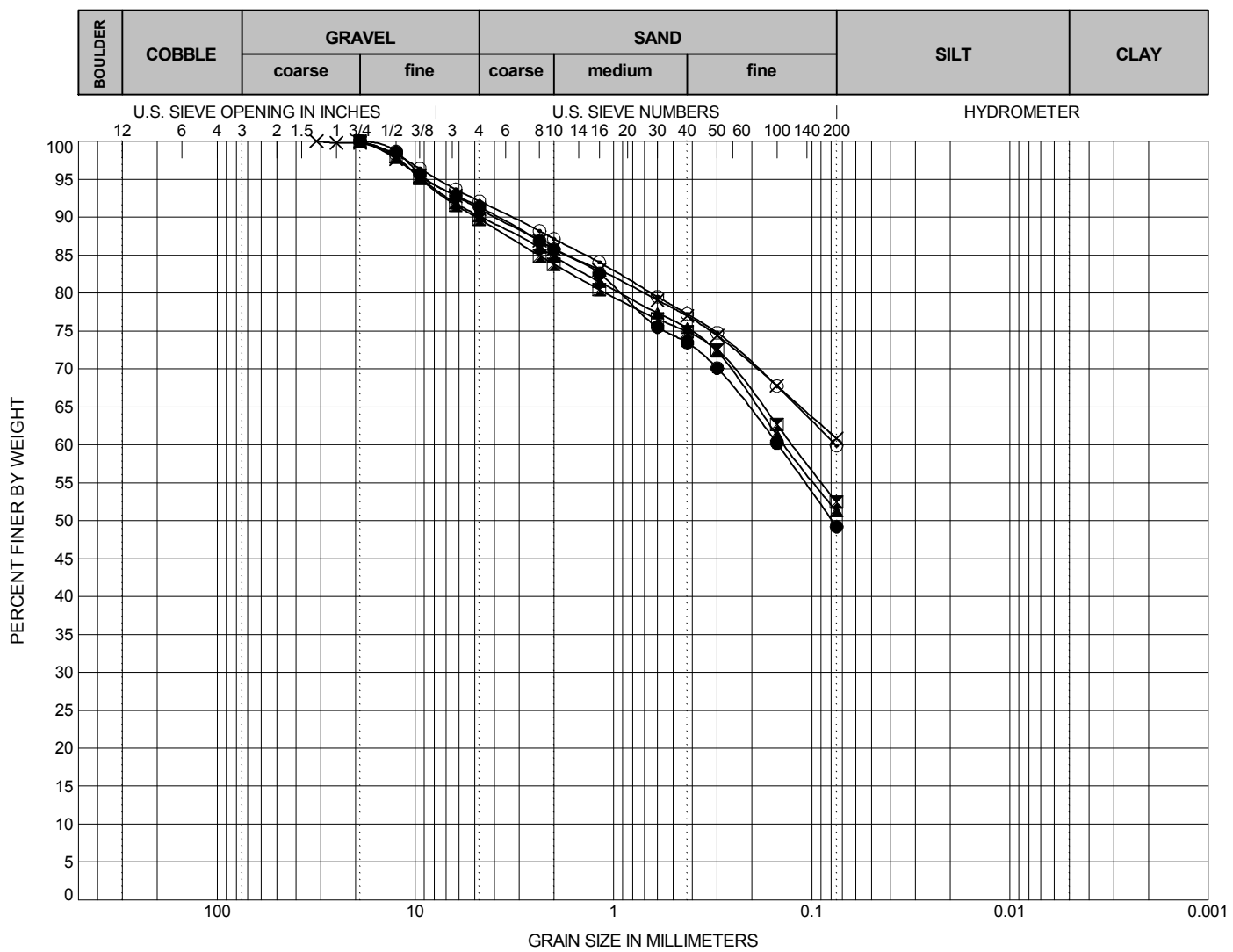


Exploration ID			Depth (m.)	Sample Description							LL	PL	PI	
●	Boring-1	0.3 - 1.22	SANDY LEAN CLAY (CL)							39	14	25		
☒	Boring-2	0.15 - 1.22	SANDY LEAN CLAY (CL)							43	14	29		
▲	Boring-3	0.3 - 1.22	CLAYEY SAND (SC)							35	18	17		
✕	Boring-4	0.15 - 1.22	SANDY LEAN CLAY (CL)							43	15	28		
◎	Boring-5	0.3 - 1.22	CLAYEY SAND (SC)							47	18	29		
Exploration ID			Depth (m.)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	Boring-1	0.3 - 1.22	19	0.085	NM	NM	NM	NM	NM	100	96	57	NM	NM
☒	Boring-2	0.15 - 1.22	25	0.077	NM	NM	NM	NM	NM	100	94	59	NM	NM
▲	Boring-3	0.3 - 1.22	25	0.129	NM	NM	NM	NM	NM	100	94	44	NM	NM
✕	Boring-4	0.15 - 1.22	19	0.084	NM	NM	NM	NM	NM	100	94	57	NM	NM
◎	Boring-5	0.3 - 1.22	19	0.13	NM	NM	NM	NM	NM	100	87	50	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.  
 NP = Nonplastic  
 NM = Not Measured

Coefficients of Uniformity -  $C_u = D_{60} / D_{10}$   
 Coefficients of Curvature -  $C_c = (D_{30})^2 / D_{60} D_{10}$   
 $D_{60}$  = Grain diameter at 60% passing  
 $D_{30}$  = Grain diameter at 30% passing  
 $D_{10}$  = Grain diameter at 10% passing


	PROJECT NO.: 20162433	SIEVE ANALYSIS	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	B-3
	DATE: 12/30/2015		
	REVISED: -		



Exploration ID		Depth (m.)	Sample Description								LL	PL	PI
●	Boring-6	0.3 - 1.22	CLAYEY SAND (SC)								46	21	25
☒	Boring-7	0.3 - 1.22	SANDY LEAN CLAY (CL)								43	21	22
▲	Boring-8	0.15 - 1.22	SANDY LEAN CLAY (CL)								42	18	24
✕	Boring-9	0.3 - 1.22	SANDY FAT CLAY (CH)								59	19	40
⊙	Boring-10	0.3 - 1.22	SANDY LEAN CLAY (CL)								47	20	27
Exploration ID		Depth (m.)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	Boring-6	0.3 - 1.22	19	0.148	NM	NM	NM	NM	100	91	49	NM	NM
☒	Boring-7	0.3 - 1.22	19	0.125	NM	NM	NM	NM	100	90	52	NM	NM
▲	Boring-8	0.15 - 1.22	19	0.138	NM	NM	NM	NM	100	90	51	NM	NM
✕	Boring-9	0.3 - 1.22	31.5	NM	NM	NM	NM	NM	100	91	61	NM	NM
⊙	Boring-10	0.3 - 1.22	19	0.076	NM	NM	NM	NM	100	92	60	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.  
 NP = Nonplastic  
 NM = Not Measured

Coefficients of Uniformity -  $C_u = D_{60} / D_{10}$   
 Coefficients of Curvature -  $C_c = (D_{30})^2 / D_{60} D_{10}$   
 $D_{60}$  = Grain diameter at 60% passing  
 $D_{30}$  = Grain diameter at 30% passing  
 $D_{10}$  = Grain diameter at 10% passing



**KLEINFELDER**  
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PROJECT NO.: 20162433

DRAWN BY: DR

CHECKED BY: KD

DATE: 12/30/2015

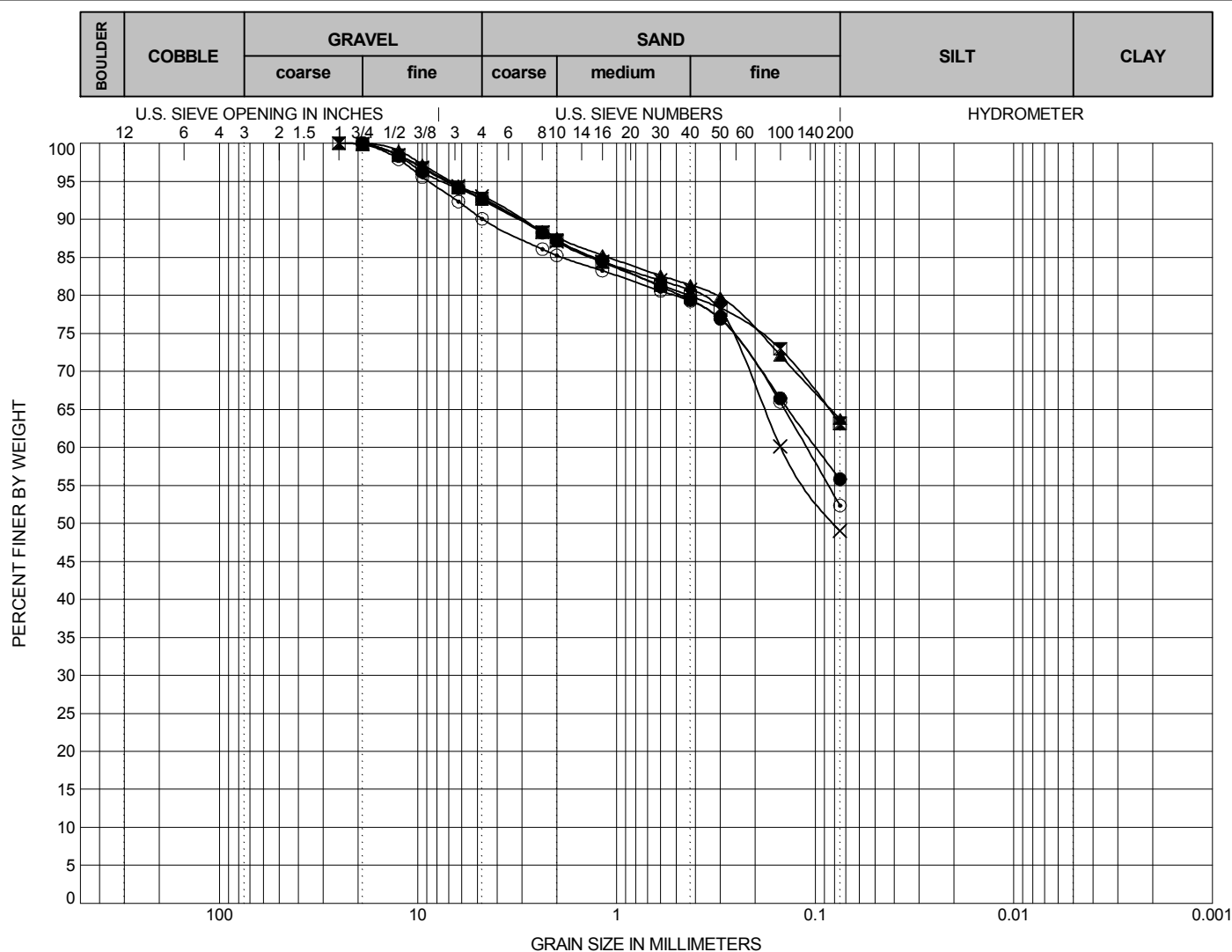
REVISED: -

**SIEVE ANALYSIS**

BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico

PLATE

**B-4**



Exploration ID		Depth (m.)	Sample Description									LL	PL	PI
●	Boring-11	0.3 - 1.22	SANDY LEAN CLAY (CL)									46	17	29
☒	Boring-12	0.3 - 1.22	SANDY FAT CLAY (CH)									50	17	33
▲	Boring-13	0.3 - 1.22	SANDY LEAN CLAY (CL)									42	15	27
✕	Boring-14	0.3 - 1.22	CLAYEY SAND (SC)									31	13	18
⊙	Boring-15	0.3 - 1.22	SANDY LEAN CLAY (CL)									39	14	25
Exploration ID	Depth (m.)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay		
●	Boring-11	0.3 - 1.22	19	0.099	NM	NM	NM	NM	100	93	56	NM	NM	
☒	Boring-12	0.3 - 1.22	25	NM	NM	NM	NM	NM	100	93	63	NM	NM	
▲	Boring-13	0.3 - 1.22	19	NM	NM	NM	NM	NM	100	93	64	NM	NM	
✕	Boring-14	0.3 - 1.22	25	0.149	NM	NM	NM	NM	100	93	49	NM	NM	
⊙	Boring-15	0.3 - 1.22	19	0.111	NM	NM	NM	NM	100	90	52	NM	NM	

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.

NP = Nonplastic  
NM = Not Measured

Coefficients of Uniformity -  $C_u = D_{60} / D_{10}$

Coefficients of Curvature -  $C_C = (D_{30})^2 / D_{60} D_{10}$

$D_{60}$  = Grain diameter at 60% passing

$D_{30}$  = Grain diameter at 30% passing

$D_{10}$  = Grain diameter at 10% passing



PROJECT NO.: 20162433

DRAWN BY: DR

CHECKED BY: KD

DATE: 12/30/2015

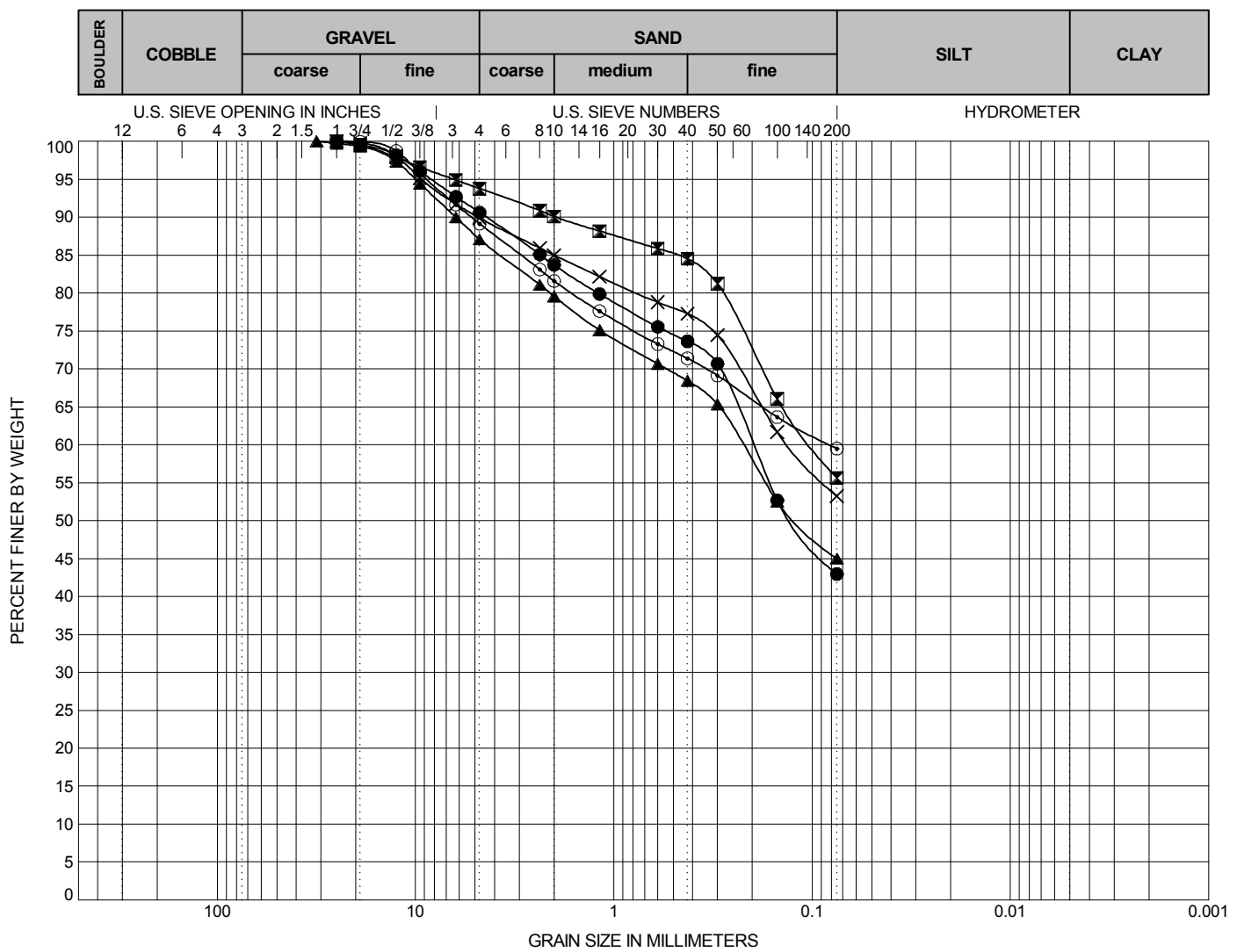
REVISÉ: -

## SIEVE ANALYSIS

BIA: Route N55 Near Alamo, NM  
Order No. A15PD00801, Req No. 0040235504  
Los Alamos, New Mexico

PLATE

**B-5**



Exploration ID	Depth (m.)	Sample Description	LL	PL	PI
● Boring-16	0.3 - 1.22	CLAYEY SAND (SC)	40	17	23
☒ Boring-17	0.3 - 1.22	SANDY LEAN CLAY (CL)	38	16	22
▲ Boring-18	0.3 - 0.91	CLAYEY SAND (SC)	38	16	22
✕ Boring-19	0.3 - 1.22	SANDY LEAN CLAY (CL)	45	17	28
⊙ Boring-20	0.15 - 1.22	SANDY FAT CLAY (CH)	52	19	33

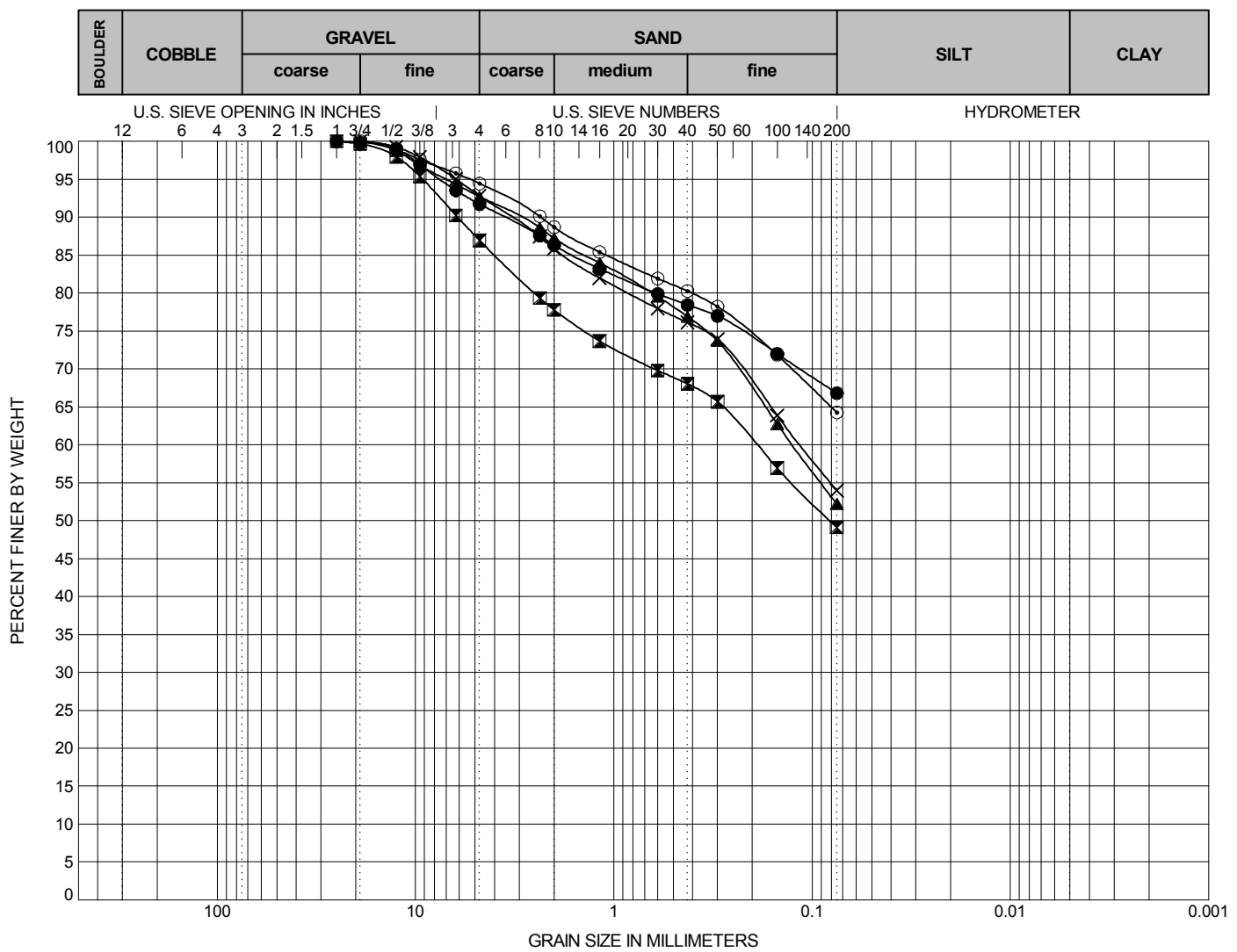
  

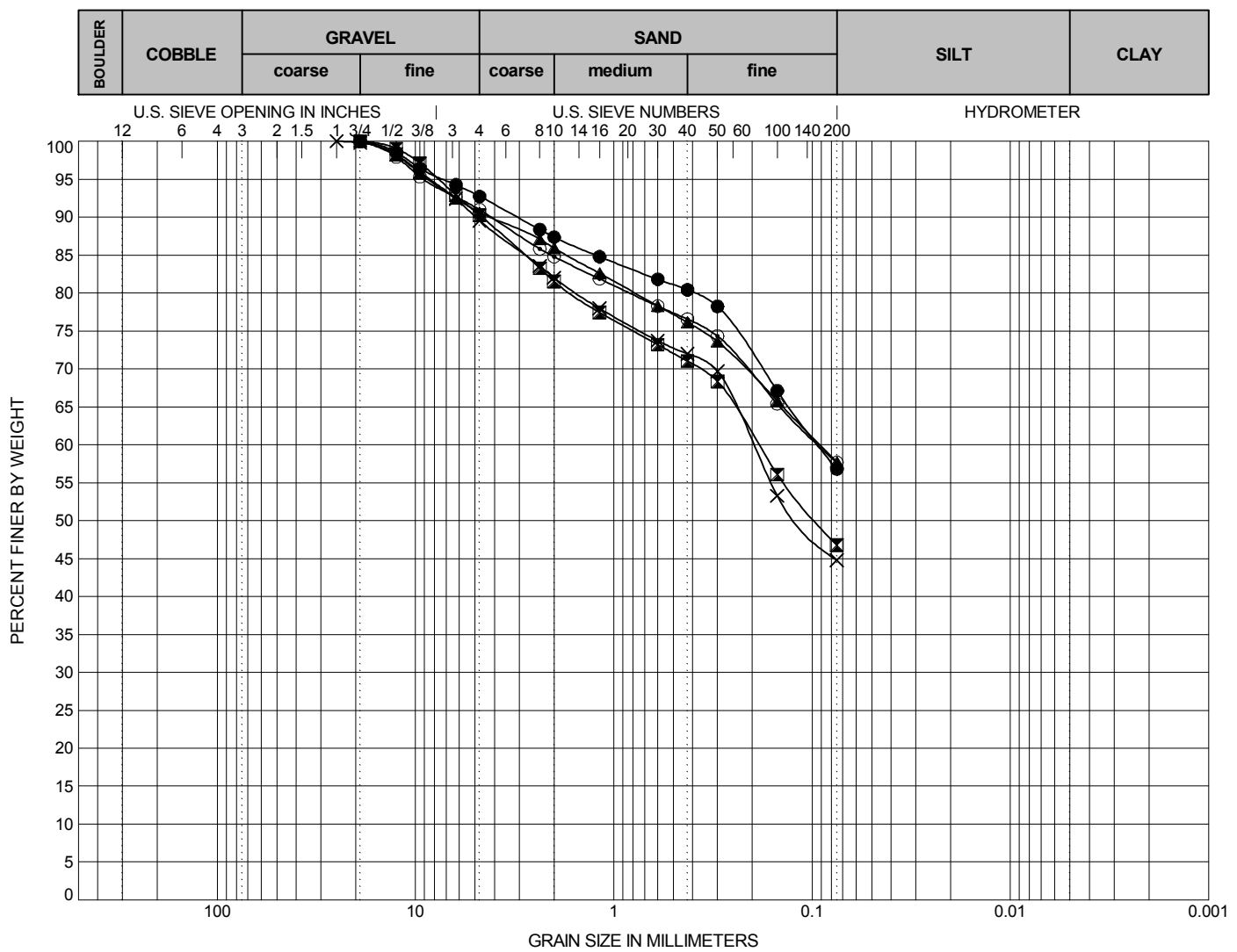
Exploration ID	Depth (m.)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
● Boring-16	0.3 - 1.22	25	0.199	NM	NM	NM	NM	100	91	43	NM	NM
☒ Boring-17	0.3 - 1.22	25	0.1	NM	NM	NM	NM	100	94	56	NM	NM
▲ Boring-18	0.3 - 0.91	31.5	0.225	NM	NM	NM	NM	99	87	45	NM	NM
✕ Boring-19	0.3 - 1.22	25	0.131	NM	NM	NM	NM	100	90	53	NM	NM
⊙ Boring-20	0.15 - 1.22	25	0.082	NM	NM	NM	NM	100	89	59	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.  
 NP = Nonplastic  
 NM = Not Measured

Coefficients of Uniformity -  $C_u = D_{60} / D_{10}$   
 Coefficients of Curvature -  $C_c = (D_{30})^2 / D_{60} D_{10}$   
 $D_{60}$  = Grain diameter at 60% passing  
 $D_{30}$  = Grain diameter at 30% passing  
 $D_{10}$  = Grain diameter at 10% passing

	PROJECT NO.: 20162433	SIEVE ANALYSIS	PLATE
	DRAWN BY: DR		
	CHECKED BY: KD	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	B-6
	DATE: 12/30/2015		
	REVISED: -		




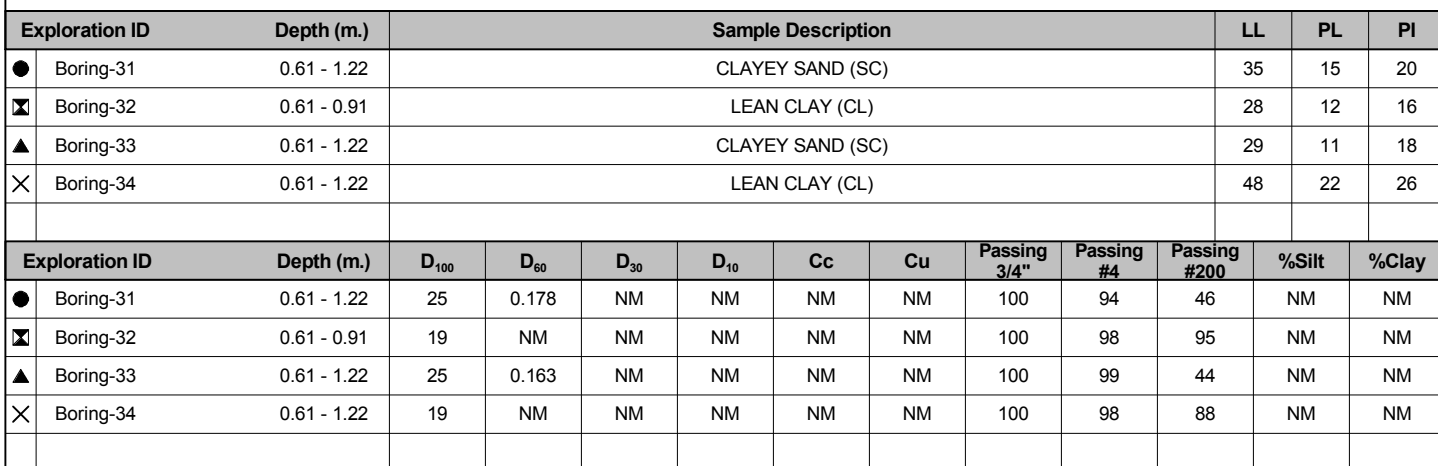


Exploration ID			Depth (m.)	Sample Description							LL	PL	PI	
●	Boring-26	0.46 - 1.22	SANDY LEAN CLAY (CL)							36	14	22		
☒	Boring-27	0.61 - 1.22	CLAYEY SAND (SC)							40	17	23		
▲	Boring-28	0.61 - 1.22	SANDY LEAN CLAY (CL)							46	19	27		
✕	Boring-29	0.61 - 1.22	CLAYEY SAND (SC)							40	16	24		
⊙	Boring-30	0.61 - 1.22	SANDY LEAN CLAY (CL)							49	17	32		
Exploration ID			Depth (m.)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	C <sub>c</sub>	C <sub>u</sub>	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	Boring-26	0.46 - 1.22	19	0.093	NM	NM	NM	NM	NM	100	93	57	NM	NM
☒	Boring-27	0.61 - 1.22	19	0.187	NM	NM	NM	NM	NM	100	90	47	NM	NM
▲	Boring-28	0.61 - 1.22	19	0.091	NM	NM	NM	NM	NM	100	91	58	NM	NM
✕	Boring-29	0.61 - 1.22	25	0.199	NM	NM	NM	NM	NM	100	90	45	NM	NM
⊙	Boring-30	0.61 - 1.22	19	0.092	NM	NM	NM	NM	NM	100	91	58	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.  
 NP = Nonplastic  
 NM = Not Measured

Coefficients of Uniformity -  $C_u = D_{60} / D_{10}$   
 Coefficients of Curvature -  $C_c = (D_{30})^2 / D_{60} D_{10}$   
 $D_{60}$  = Grain diameter at 60% passing  
 $D_{30}$  = Grain diameter at 30% passing  
 $D_{10}$  = Grain diameter at 10% passing

	PROJECT NO.: 20162433	SIEVE ANALYSIS	PLATE  B-8
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -	BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	

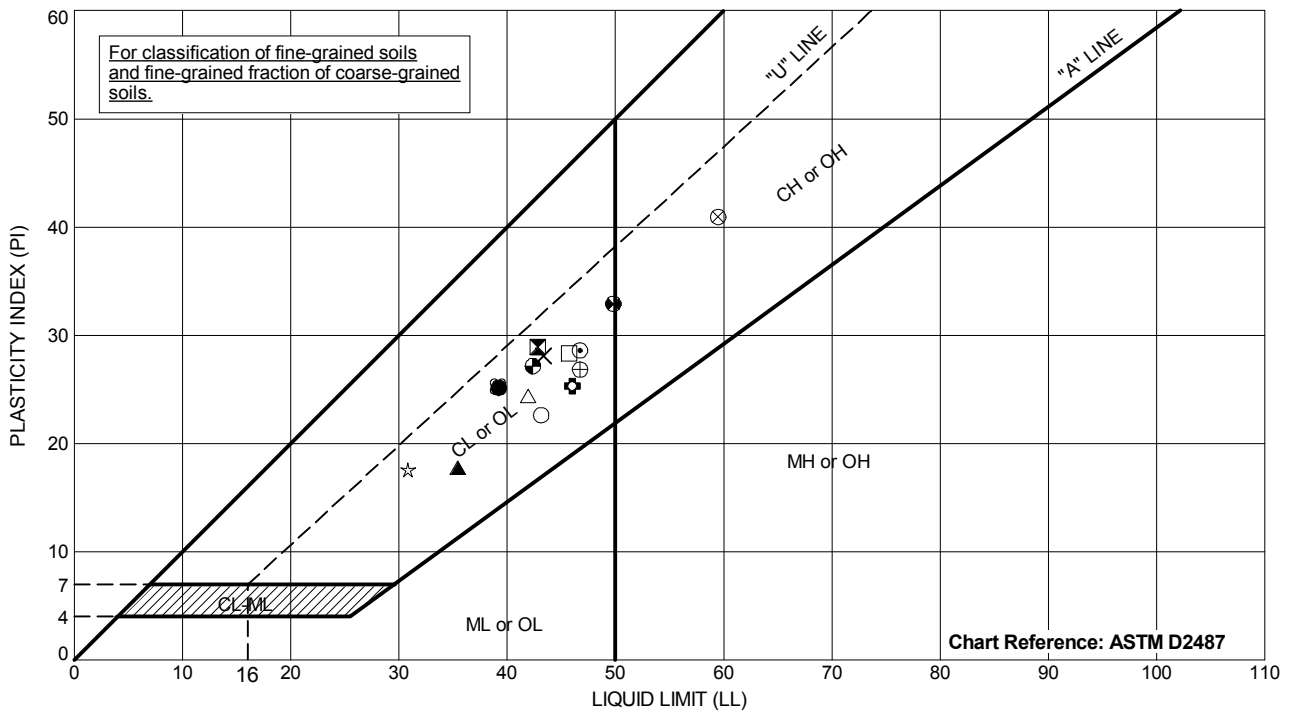


Coefficients of Uniformity -  $C_u = D_{60} / D_{10}$   
 Coefficients of Curvature -  $C_c = (D_{30})^2 / D_{60} D_{10}$   
 $D_{60}$  = Grain diameter at 60% passing  
 $D_{30}$  = Grain diameter at 30% passing  
 $D_{10}$  = Grain diameter at 10% passing



BIA: Route N55 Near Alamo, NM  
Order No. A15PD00801, Req No. 0040235504  
Los Alamos, New Mexico

B-9



Exploration ID	Depth (m.)	Sample Description	Passing #200	LL	PL	PI
● Boring-1	0.3 - 1.22	SANDY LEAN CLAY (CL)	57	39	14	25
⊠ Boring-2	0.15 - 1.22	SANDY LEAN CLAY (CL)	59	43	14	29
▲ Boring-3	0.3 - 1.22	CLAYEY SAND (SC)	44	35	18	17
⊗ Boring-4	0.15 - 1.22	SANDY LEAN CLAY (CL)	57	43	15	28
⊙ Boring-5	0.3 - 1.22	CLAYEY SAND (SC)	50	47	18	29
⊕ Boring-6	0.3 - 1.22	CLAYEY SAND (SC)	49	46	21	25
○ Boring-7	0.3 - 1.22	SANDY LEAN CLAY (CL)	52	43	21	22
△ Boring-8	0.15 - 1.22	SANDY LEAN CLAY (CL)	51	42	18	24
⊗ Boring-9	0.3 - 1.22	SANDY FAT CLAY (CH)	61	59	19	40
⊕ Boring-10	0.3 - 1.22	SANDY LEAN CLAY (CL)	60	47	20	27
□ Boring-11	0.3 - 1.22	SANDY LEAN CLAY (CL)	56	46	17	29
⊕ Boring-12	0.3 - 1.22	SANDY FAT CLAY (CH)	63	50	17	33
⊕ Boring-13	0.3 - 1.22	SANDY LEAN CLAY (CL)	64	42	15	27
☆ Boring-14	0.3 - 1.22	CLAYEY SAND (SC)	49	31	13	18
⊗ Boring-15	0.3 - 1.22	SANDY LEAN CLAY (CL)	52	39	14	25

Testing performed in general accordance with ASTM D4318.  
 NP = Nonplastic  
 NM = Not Measured



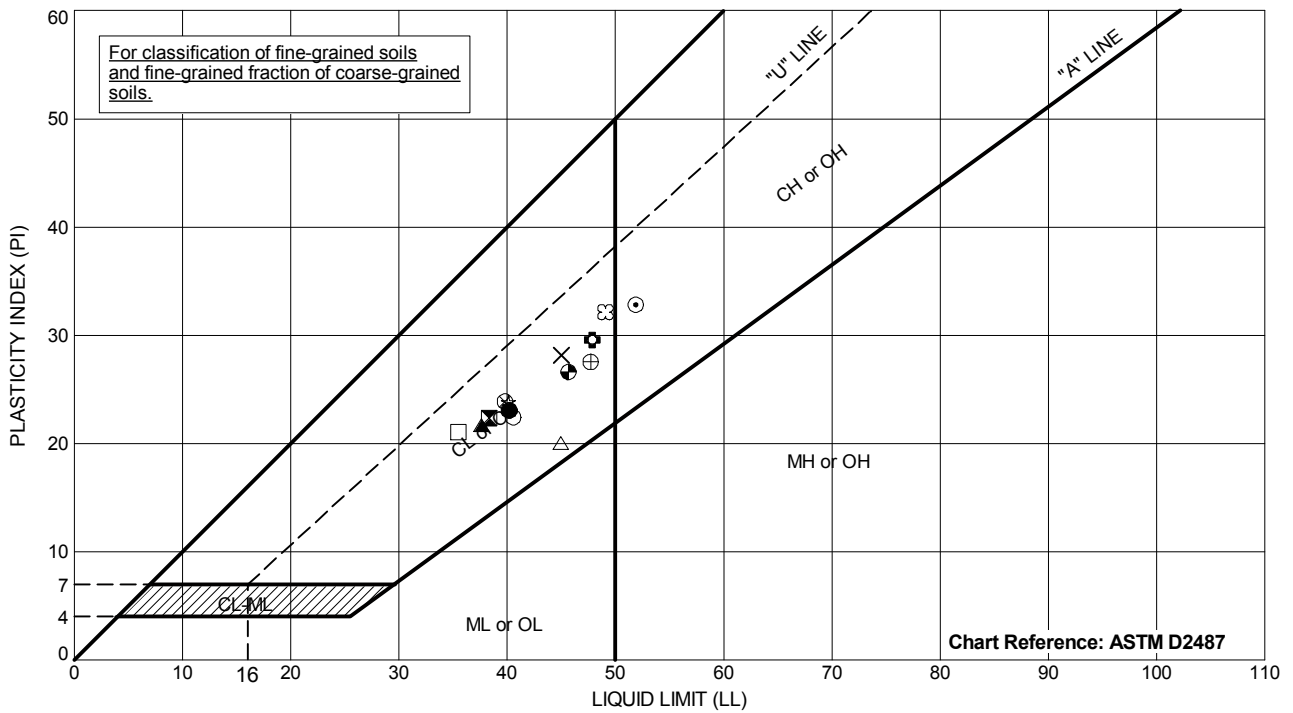
PROJECT NO.: 20162433  
 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

#### ATTERBERG LIMITS

BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico

PLATE

B-10



Exploration ID	Depth (m.)	Sample Description	Passing #200	LL	PL	PI
● Boring-16	0.3 - 1.22	CLAYEY SAND (SC)	43	40	17	23
☒ Boring-17	0.3 - 1.22	SANDY LEAN CLAY (CL)	56	38	16	22
▲ Boring-18	0.3 - 0.91	CLAYEY SAND (SC)	45	38	16	22
✕ Boring-19	0.3 - 1.22	SANDY LEAN CLAY (CL)	53	45	17	28
⊙ Boring-20	0.15 - 1.22	SANDY FAT CLAY (CH)	59	52	19	33
⊕ Boring-21	0.3 - 1.22	SANDY LEAN CLAY (CL)	67	48	18	30
○ Boring-22	0.3 - 1.22	CLAYEY SAND (SC)	49	41	18	23
△ Boring-23	0.3 - 0.91	SANDY LEAN CLAY (CL)	52	45	25	20
⊗ Boring-24	0.46 - 0.91	SANDY LEAN CLAY (CL)	54	40	16	24
⊕ Boring-25	0.61 - 1.22	SANDY LEAN CLAY (CL)	64	48	20	28
□ Boring-26	0.46 - 1.22	SANDY LEAN CLAY (CL)	57	36	14	22
⊗ Boring-27	0.61 - 1.22	CLAYEY SAND (SC)	47	40	17	23
⊕ Boring-28	0.61 - 1.22	SANDY LEAN CLAY (CL)	58	46	19	27
☆ Boring-29	0.61 - 1.22	CLAYEY SAND (SC)	45	40	16	24
⊗ Boring-30	0.61 - 1.22	SANDY LEAN CLAY (CL)	58	49	17	32

Testing performed in general accordance with ASTM D4318.  
 NP = Nonplastic  
 NM = Not Measured



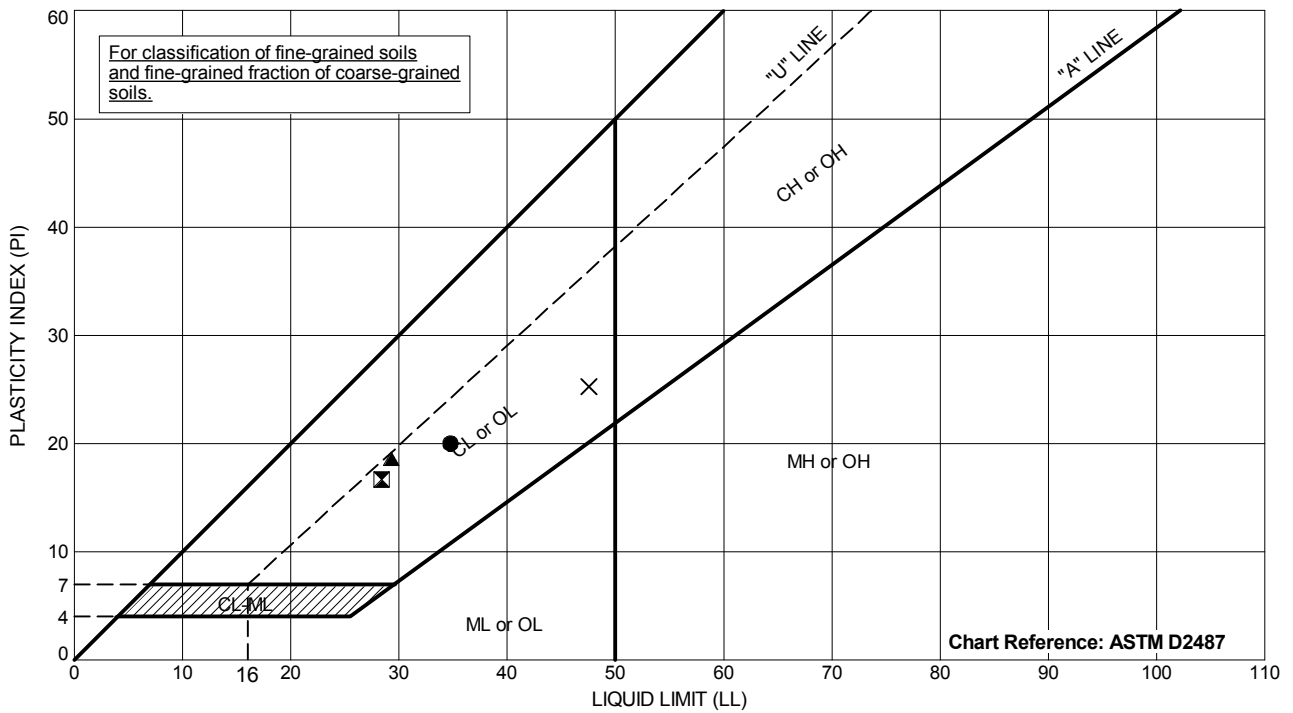
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 DRAWN BY: DR  
 CHECKED BY: KD  
 DATE: 12/30/2015  
 REVISED: -

#### ATTERBERG LIMITS

BIA: Route N55 Near Alamo, NM  
 Order No. A15PD00801, Req No. 0040235504  
 Los Alamos, New Mexico

PLATE

B-11



Exploration ID	Depth (m.)	Sample Description	Passing #200	LL	PL	PI
● Boring-31	0.61 - 1.22	CLAYEY SAND (SC)	46	35	15	20
⊠ Boring-32	0.61 - 0.91	LEAN CLAY (CL)	95	28	12	16
▲ Boring-33	0.61 - 1.22	CLAYEY SAND (SC)	44	29	11	18
X Boring-34	0.61 - 1.22	LEAN CLAY (CL)	88	48	22	26

Testing performed in general accordance with ASTM D4318.  
 NP = Nonplastic  
 NM = Not Measured

	PROJECT NO.: 20162433	<b>ATTERBERG LIMITS</b>  BIA: Route N55 Near Alamo, NM Order No. A15PD00801, Req No. 0040235504 Los Alamos, New Mexico	<b>PLATE</b>  <b>B-12</b>
	DRAWN BY: DR CHECKED BY: KD DATE: 12/30/2015 REVISED: -		

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

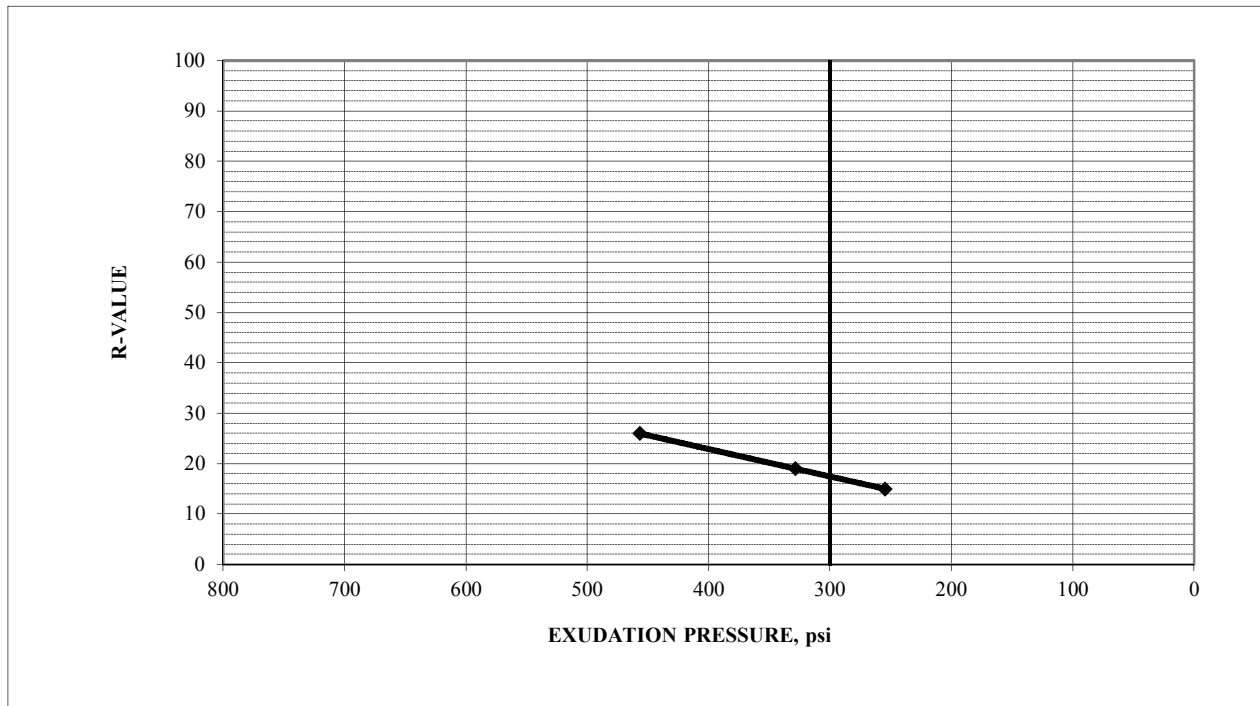
**Sample No.:** A

**Sample Location:** Composite B-1, B-2 & B-3

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	17.4	18.4	16.5
Dry Unit Weight at Test, pcf	113.8	111.5	117.5
Expansion Pressure, psf	0	9	26
Exudation Pressure, psi	329	255	457
Resistance Value	19	15	26
R - Value at 300 psi Exudation Pressure:			18

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

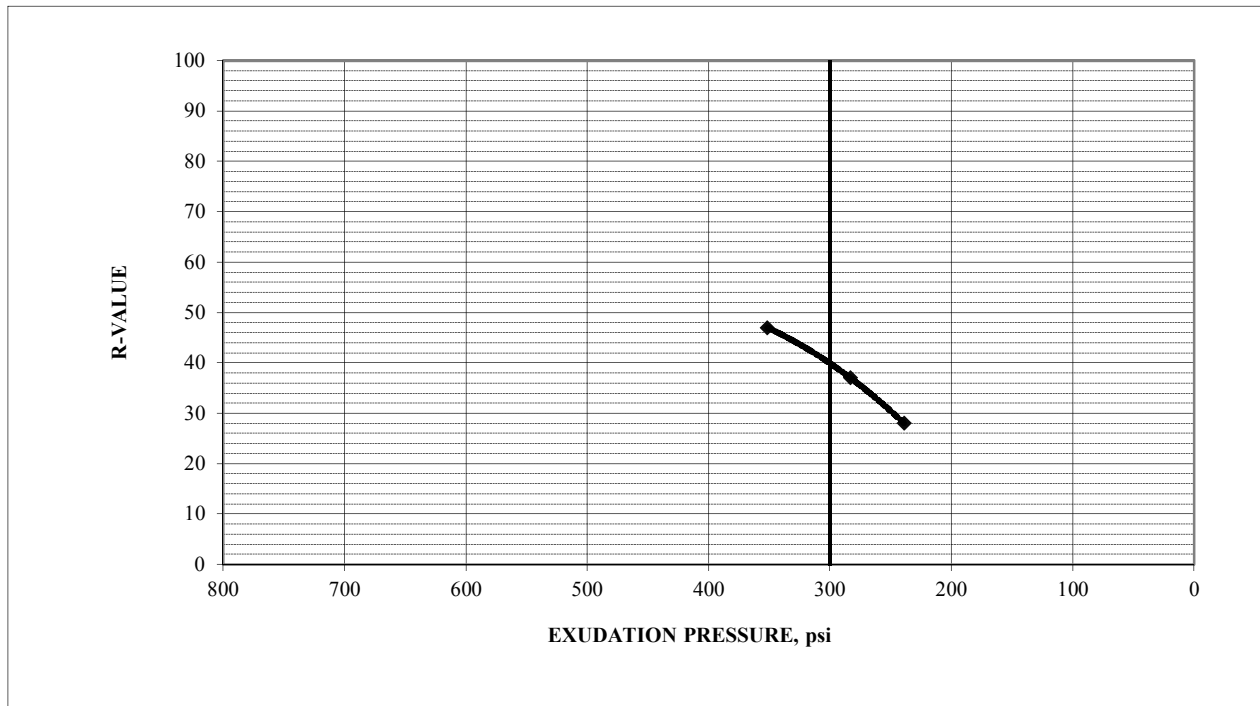
**Sample No.:** B

**Sample Location:** Composite B-4, B-5 & B-6

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	18.1	17.1	16.2
Dry Unit Weight at Test, pcf	111.2	112.4	115.1
Expansion Pressure, psf	26	22	39
Exudation Pressure, psi	239	283	352
Resistance Value	28	37	47
R - Value at 300 psi Exudation Pressure:			40

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

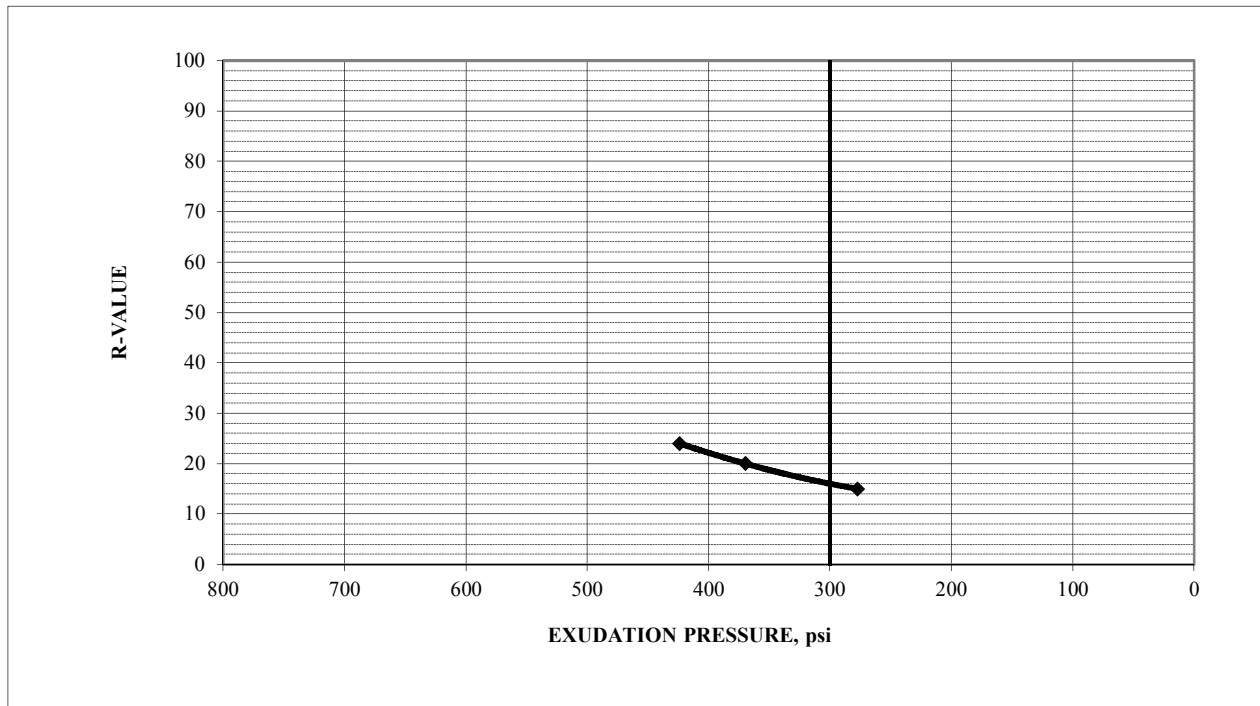
**Sample No.:** C

**Sample Location:** Composite B-9, B-10, B-11 & B-12

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	19.4	20.4	21.4
Dry Unit Weight at Test, pcf	112.0	108.5	107.3
Expansion Pressure, psf	39	13	22
Exudation Pressure, psi	424	370	278
Resistance Value	24	20	15
R - Value at 300 psi Exudation Pressure:			16

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

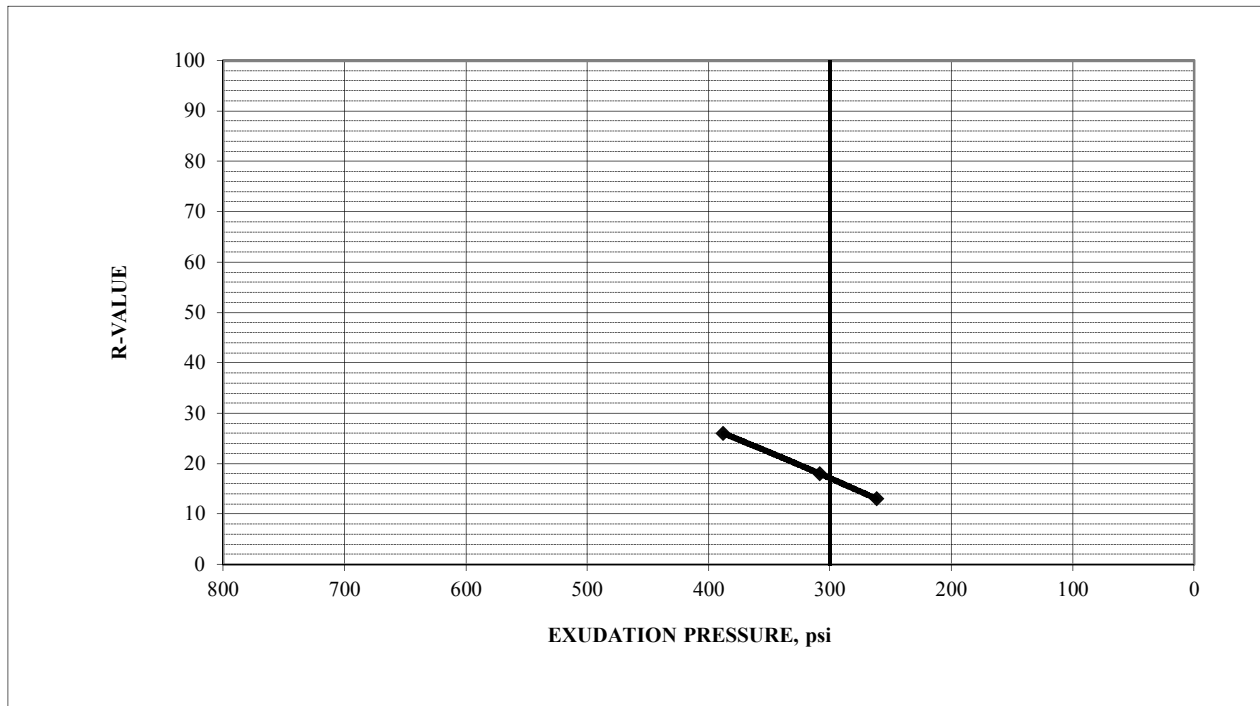
**Sample No.:** D

**Sample Location:** Composite B-15, B-16, B-17 & B-18

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	16.9	16.0	15.0
Dry Unit Weight at Test, pcf	114.4	119.3	120.0
Expansion Pressure, psf	35	13	52
Exudation Pressure, psi	262	308	388
Resistance Value	13	18	26
R - Value at 300 psi Exudation Pressure:			17

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

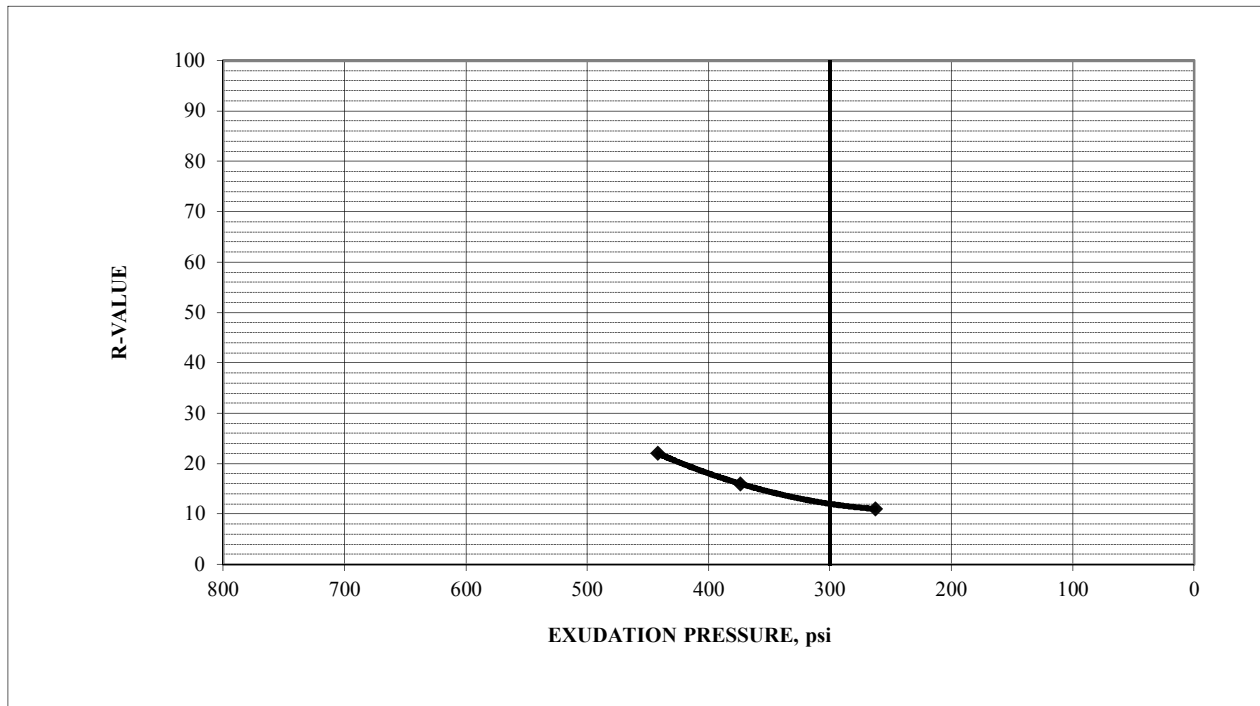
**Sample No.:** E

**Sample Location:** Composite B-19, B-20 & B-21

**Material Description:**

**Report Date:** December 19, 2015

## **Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)**



Briquette No.	A	B	C
Moisture at Test, %	20.4	19.5	18.6
Dry Unit Weight at Test, pcf	112.5	110.9	109.5
Expansion Pressure, psf	13	22	17
Exudation Pressure, psi	262	374	442
Resistance Value	11	16	22
R - Value at 300 psi Exudation Pressure:			12

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

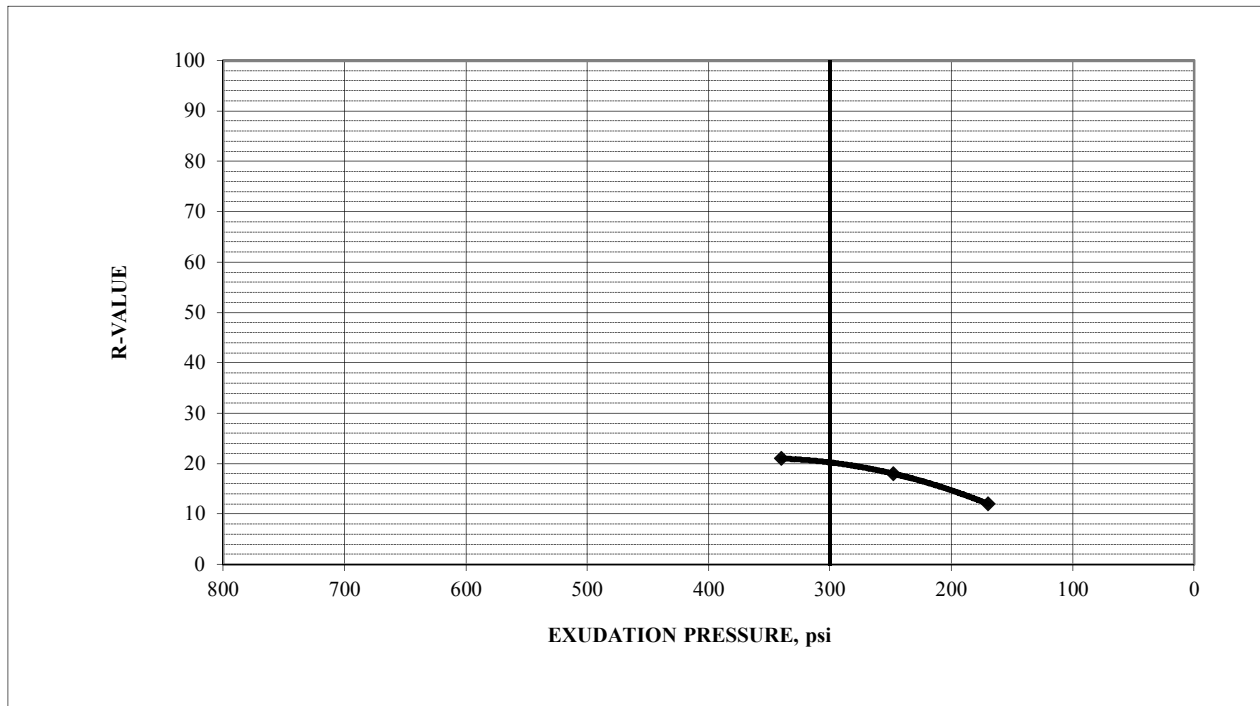
**Sample No.:** G

**Sample Location:** Composite B-24, B-25 & B-26

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	18.5	17.5	16.6
Dry Unit Weight at Test, pcf	111.6	113.4	115.0
Expansion Pressure, psf	30	30	48
Exudation Pressure, psi	170	248	340
Resistance Value	12	18	21
R - Value at 300 psi Exudation Pressure:			20

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

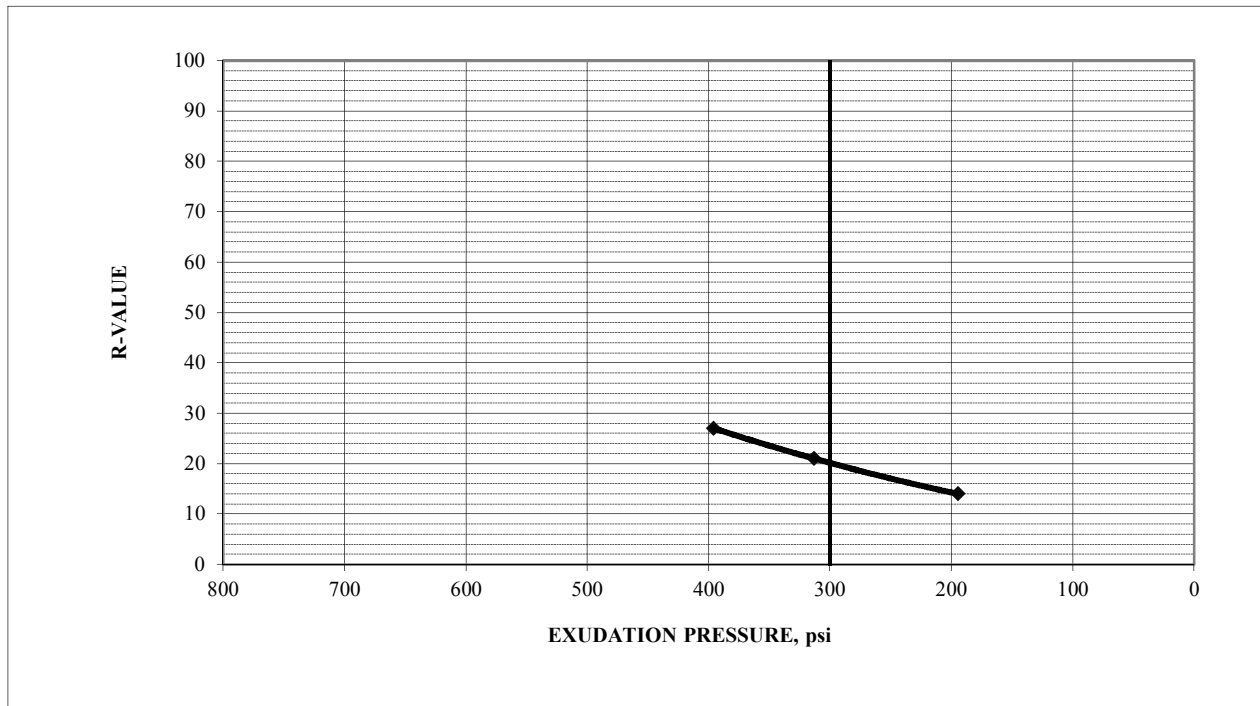
**Sample No.:** H

**Sample Location:** Composite B-27, B-28, B-29 & B-30

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	17.6	16.7	15.7
Dry Unit Weight at Test, pcf	113.4	117.0	119.2
Expansion Pressure, psf	17	0	0
Exudation Pressure, psi	195	313	396
Resistance Value	14	21	27
R - Value at 300 psi Exudation Pressure:			20

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

# Laboratory Test Report

**Project Name:** BIA: Route N55 Near Alamo

**Project No.:** 20162433.001A

**Lab No.:** 31285

**Sample Date:** November 5, 2015

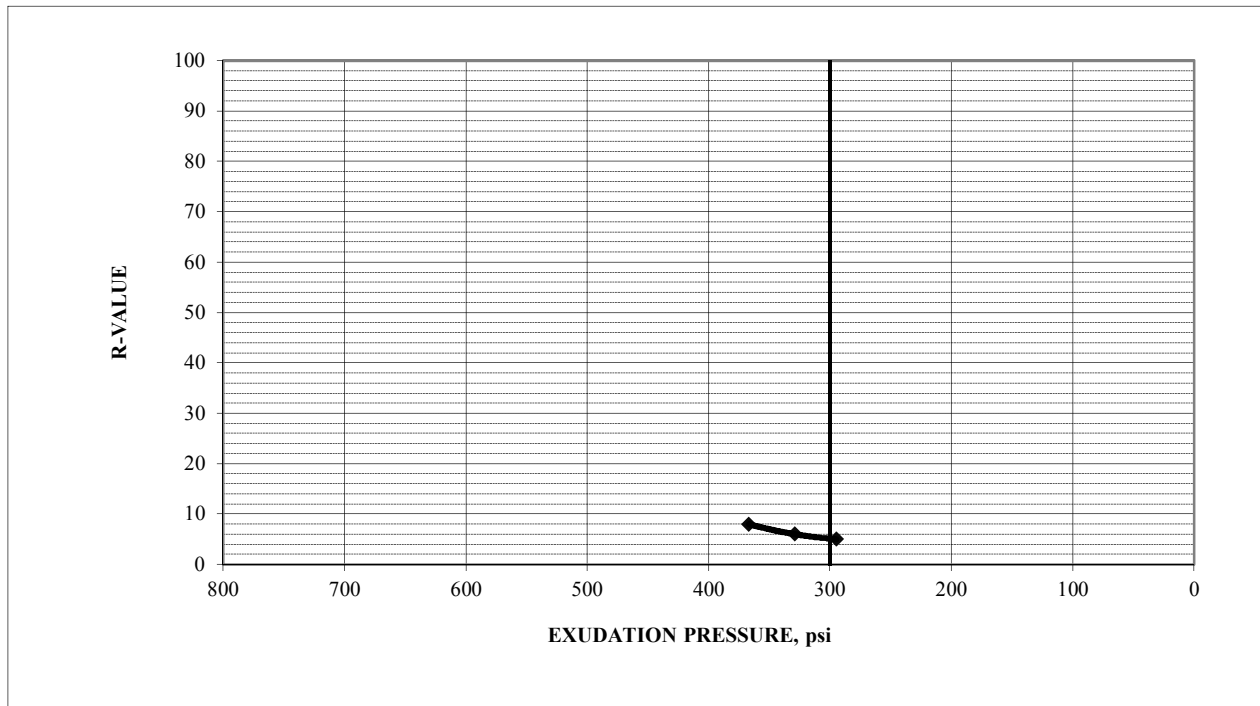
**Sample No.:** I

**Sample Location:** Composite B-32 & B-34

**Material Description:**

**Report Date:** December 19, 2015

## Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



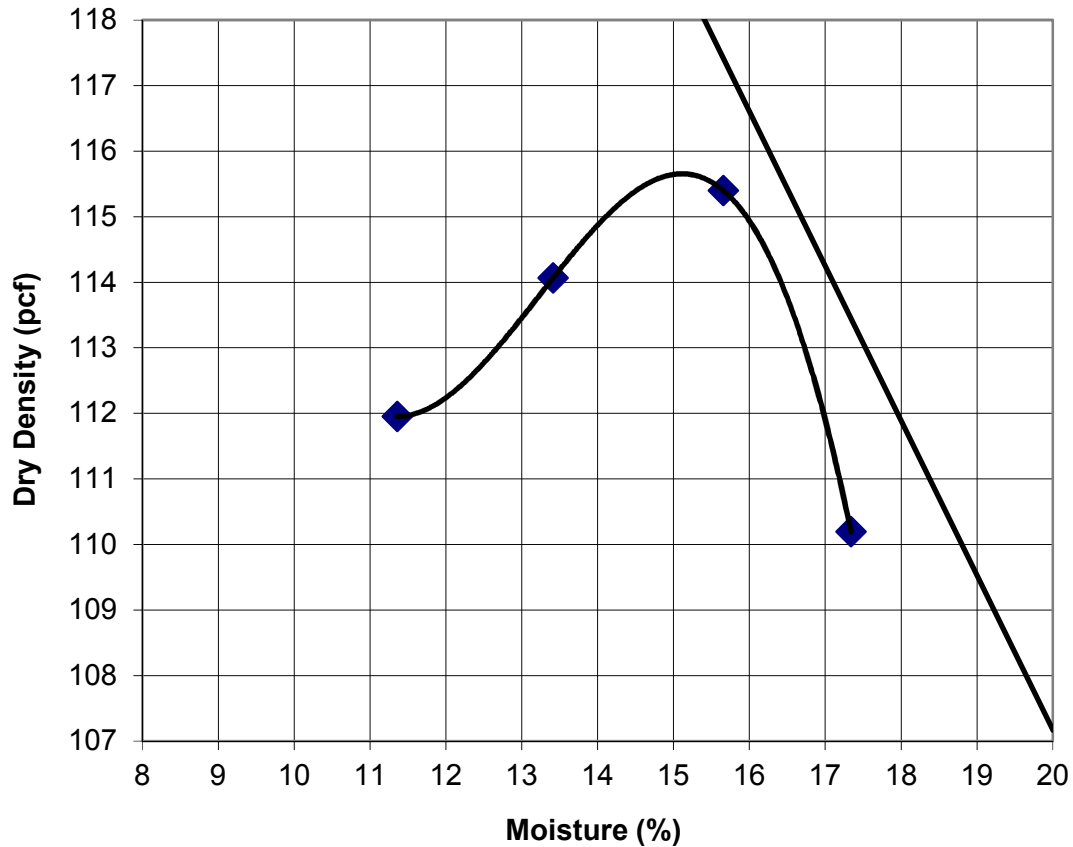
Briquette No.	A	B	C
Moisture at Test, %	21.0	22.9	22.0
Dry Unit Weight at Test, pcf	106.8	103.6	106.2
Expansion Pressure, psf	104	82	91
Exudation Pressure, psi	367	294	329
Resistance Value	8	5	6
<b>R - Value at 300 psi Exudation Pressure:</b>			<b>5</b>

Reviewed By: DR

*Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.*

SAMPLE ID: **31258-B**  
SAMPLE SOURCE: **B4, B5, B6 (COMPOSITE)**

Maximum Dry Density: **115.7 pcf**  
Optimum Moisture Content: **15.1 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-21**

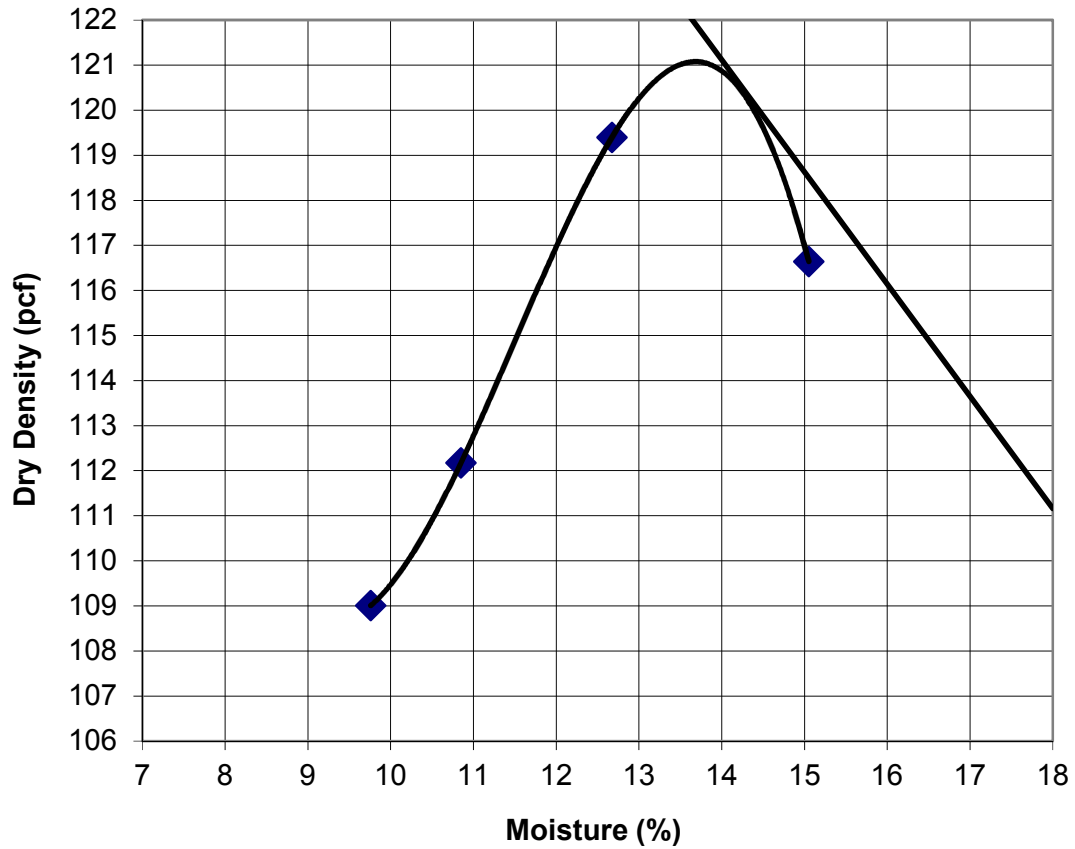
Report Date:  
January 2016

Project Number:  
20162433

31258-B

SAMPLE ID: **31258-C**  
SAMPLE SOURCE: **B9, B10, B11, B12 (COMPOSITE)**

Maximum Dry Density: **121.1 pcf**  
Optimum Moisture Content: **13.7 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-22**

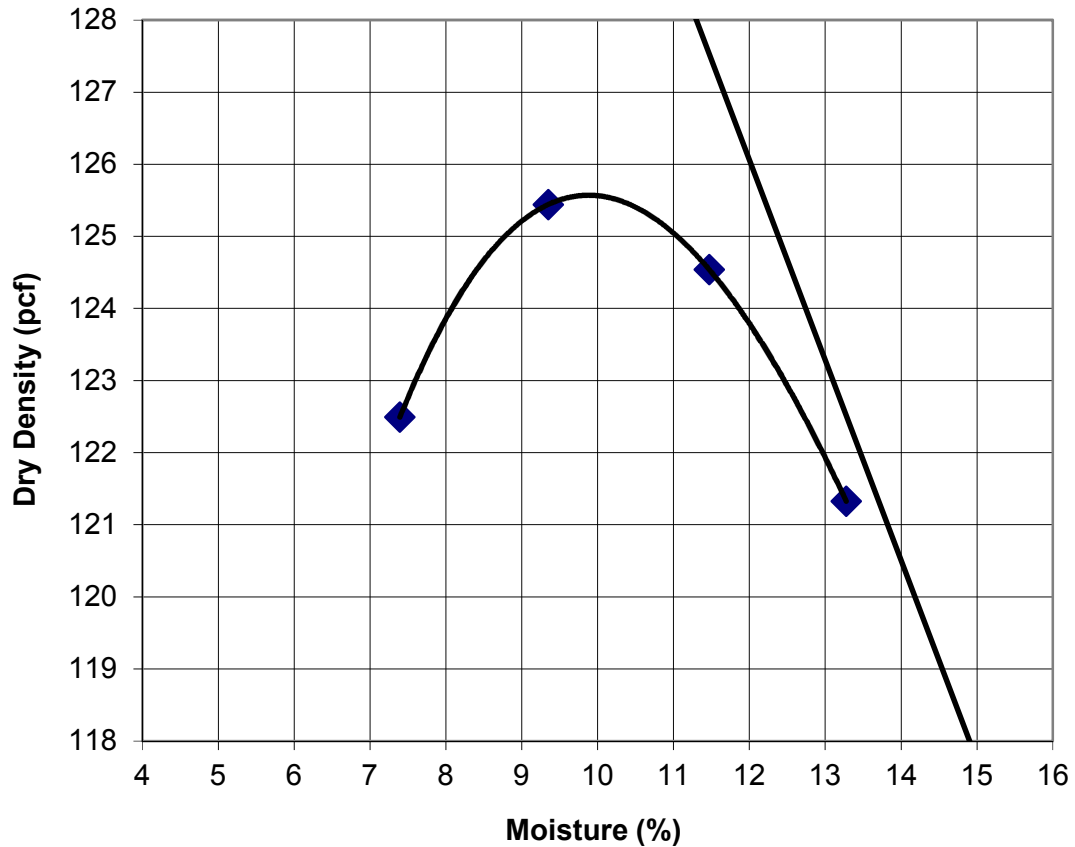
Report Date:  
January 2016

Project Number:  
20162433

31258-C

SAMPLE ID: **31258-D**  
SAMPLE SOURCE: **B15, B16, B17, B18 (COMPOSITE)**

Maximum Dry Density: **125.6 pcf**  
Optimum Moisture Content: **9.9 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-23**

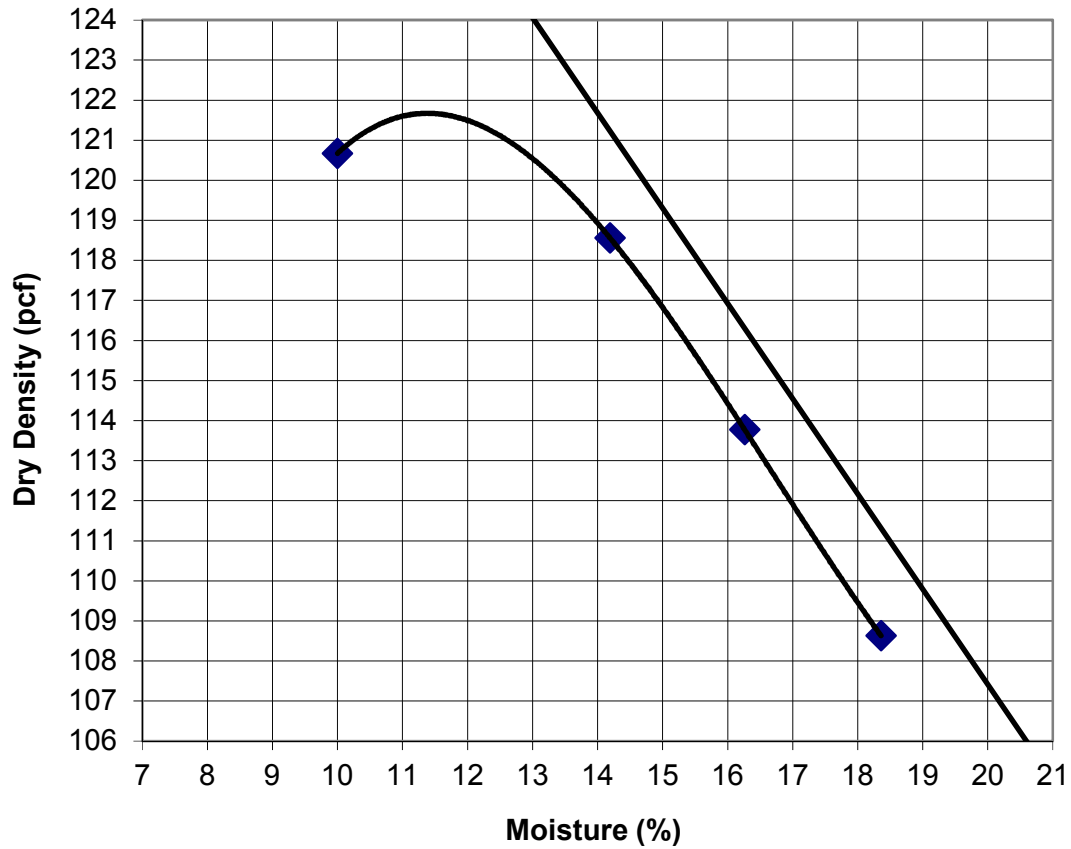
Report Date:  
January 2016

Project Number:  
20162433

31258-D

SAMPLE ID: **31258-F**  
SAMPLE SOURCE: **B22, B23 (COMPOSITE)**

Maximum Dry Density: **121.7 pcf**  
Optimum Moisture Content: **11.4 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-24**

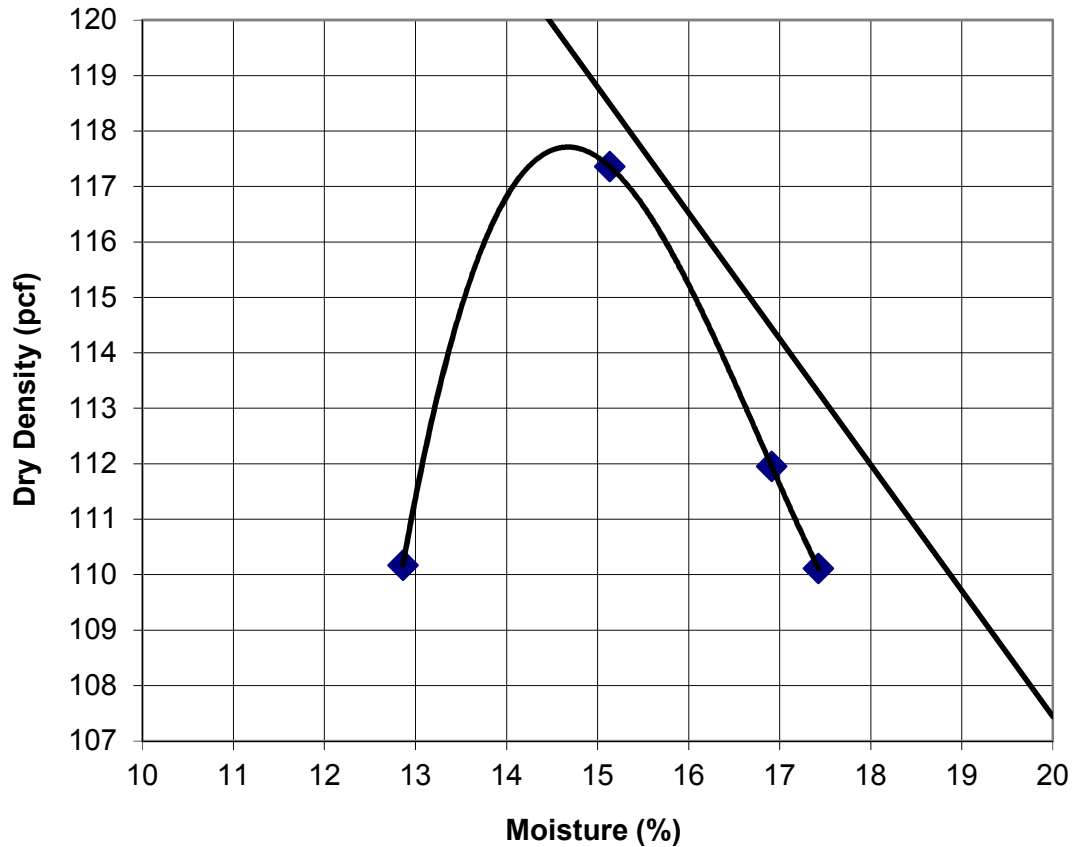
Report Date:  
January 2016

Project Number:  
20162433

31258-F

SAMPLE ID: **31258-G**  
SAMPLE SOURCE: **B24, B25, B26 (COMPOSITE)**

Maximum Dry Density: **117.7 pcf**  
Optimum Moisture Content: **14.7 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-25**

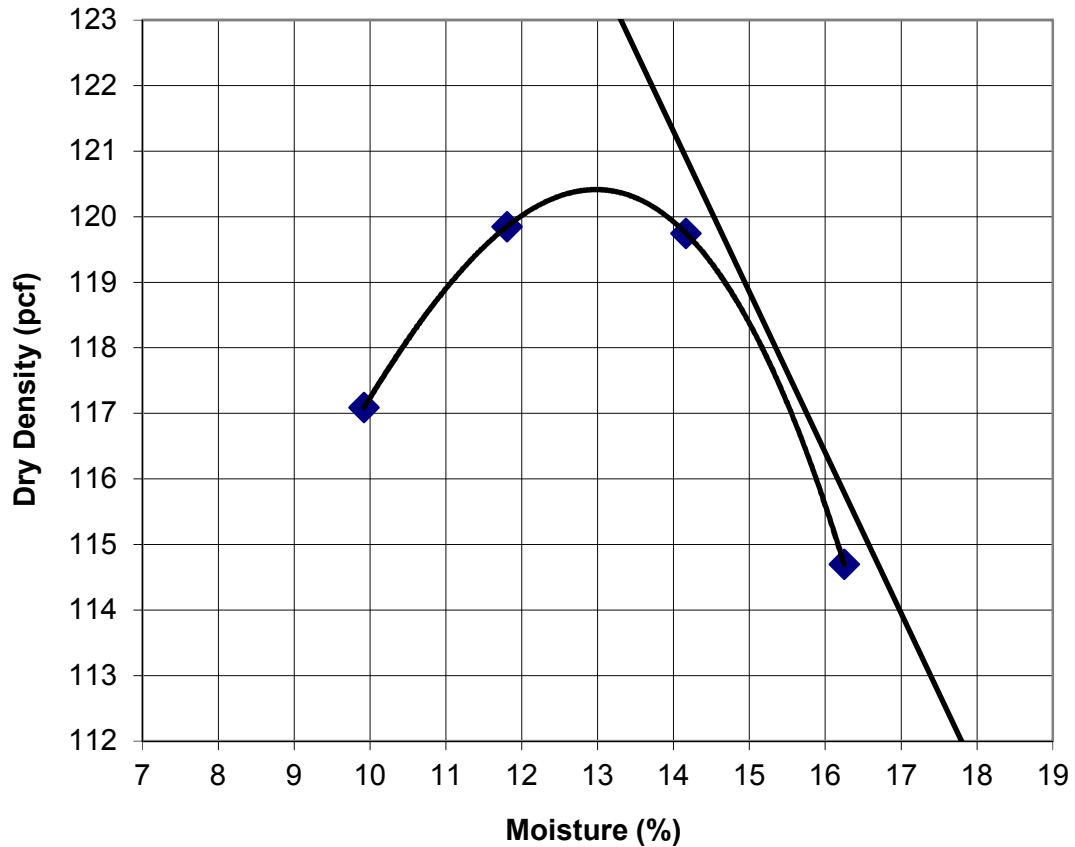
Report Date:  
January 2016

Project Number:  
20162433

31258-G

SAMPLE ID: **31258-H**  
SAMPLE SOURCE: **B27, B28, B29, B30 (COMPOSITE)**

Maximum Dry Density: **120.4 pcf**  
Optimum Moisture Content: **13.0 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-26**

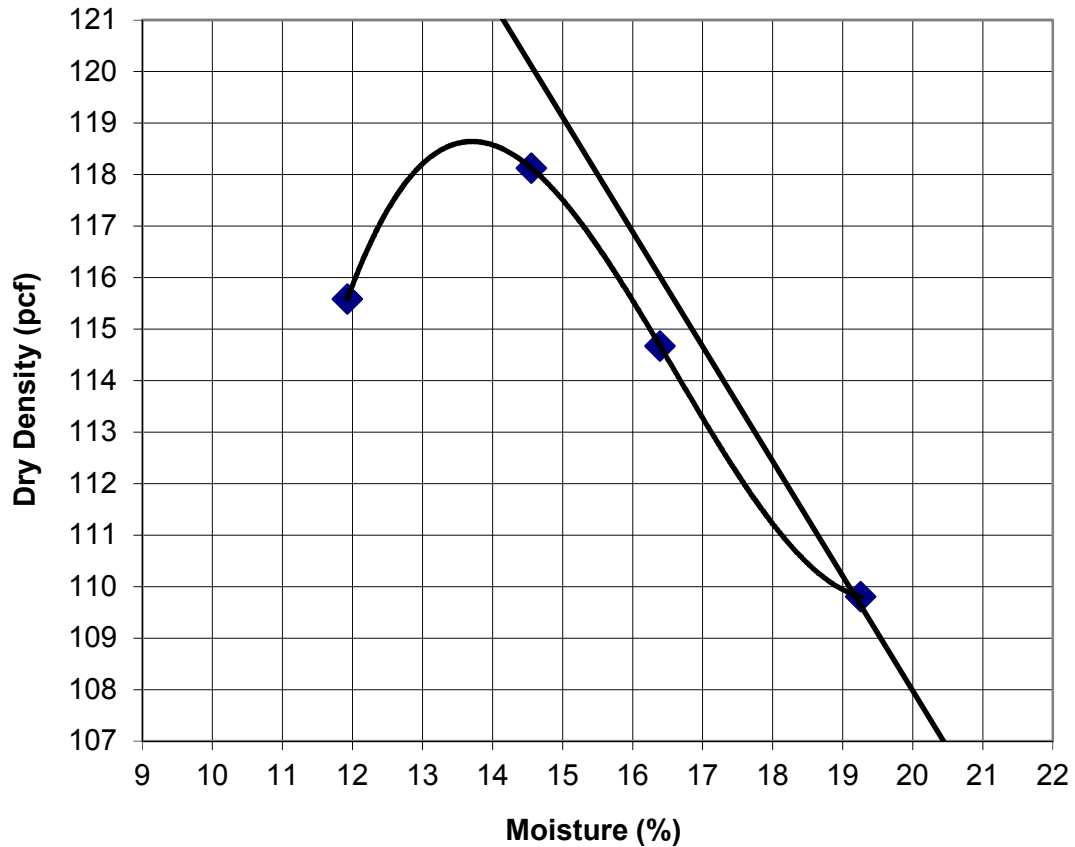
Report Date:  
January 2016

Project Number:  
20162433

31258-H

SAMPLE ID: **31258-I**  
SAMPLE SOURCE: **B32, B34 (COMPOSITE)**

Maximum Dry Density: **118.6 pcf**  
Optimum Moisture Content: **13.7 %**



The zero air void curve represents an assumed specific gravity of 2.65



**MODIFIED PROCTOR (ASTM D1557 A)**  
BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

**B-27**

Report Date:  
January 2016

Project Number:  
20162433

31258-I

TEST METHOD:	ARIZ 236b**	ARIZ 236b**	ARIZ 733**	ARIZ 736**
SAMPLE LOCATION	pH	Minimum Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)
B2 @ 0.15 - 1.2 m	8.8	1,050	556	25
B4 @ 0.15 - 1.2 m			744	41
B6 @ 0.30 - 1.2 m	9.3	860	816	126
B8 @ 0.15 - 1.2 m	--	--	693	18
B10 @ 0.30 - 1.2 m	--	--	853	18
B12 @ 0.30 - 1.2 m	9.0	690	569	38
B14 @ 0.30 - 1.2 m	--	--	230	36
B16 @ 0.30 - 1.2 m	--	--	895	153
B18 @ 0.30 - 0.91 m	9.5	1,110	483	17
B21 @ 0.30 - 1.2 m	--	--	3,935	84
B23 @ 0.30 - 0.91 m	--	--	5,245	20
B25 @ 0.61 - 1.2 m	--	--	852	10
B27 @ 0.61 - 1.2 m	--	--	799	29
B29 @ 0.61 - 1.2 m	9.9	950	868	10
B32 @ 0.61 - 0.91 m	--	--	161	19
B34 @ 0.61 - 1.2 m	9.5	560	83	16

\*\* Testing performed by MotZZ Laboratory, Inc.



Report Date:  
January 2016

#### SOIL CORROSION CHARACTERISTICS

BIA Route N55  
Navajo Nation, New Mexico (near Alamo)  
Bureau of Indian Affairs

PLATE

B-28

**APPENDIX C**  
**LABORATORY TEST RESULTS - ASPHALT**

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# Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Surface Cores 1 thru 7 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544520  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

## Gradation

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	98	
1/2"	81	
3/8"	68	
1/4"	56	
#4	51	
#8	38	
#10	36	
#16	30	
#30	24	
#40	22	
#50	19	
#100	13	
#200	8.3	

## Bitumen Content By Solvent Extraction

Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%):	4.24	

### Note:

*Pockets of clay balls were observed in the mix when breaking down the asphalt cores to combine.*

## Voids Analysis

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:	2.573	160.2
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

## Superpave Gyrotory

Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

## Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Base Cores 1 thru 7 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001

AMEC FW Lab No.: 1544521

Date Sampled: 11-04-2015

Date Received: 11-18-2015

Report Date: 12-03-2015

### Gradation

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	97	
1/2"	89	
3/8"	79	
1/4"	65	
#4	59	
#8	45	
#10	42	
#16	34	
#30	27	
#40	24	
#50	21	
#100	15	
#200	9.6	

### Bitumen Content By Solvent Extraction

Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%)	5.12	

### Voids Analysis

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.541	158.2
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

### Superpave Gyratory

Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

Note: \_\_\_\_\_


Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

## Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Surface Cores 8 thru 14 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001

AMEC FW Lab No.: 1544522

Date Sampled: 11-04-2015

Date Received: 11-18-2015

Report Date: 12-03-2015

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	97	
1/2"	88	
3/8"	79	
1/4"	67	
#4	61	
#8	45	
#10	42	
#16	33	
#30	26	
#40	23	
#50	20	
#100	14	
#200	9.4	

Bitumen Content By Solvent Extraction		
Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%):	4.72	

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.593	161.4
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

Superpave Gyratory			
Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

### Note:

*Pockets of clay balls were observed in the mix when breaking down the asphalt cores to combine.*

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

# Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Base Cores 8 thru 14 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544523  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

## Gradation

Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	99	
1/2"	86	
3/8"	75	
1/4"	62	
#4	56	
#8	42	
#10	40	
#16	33	
#30	27	
#40	25	
#50	22	
#100	15	
#200	9.9	

## Bitumen Content By Solvent Extraction

Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%):	4.75	

Note: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Voids Analysis

Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:	2.564	159.6
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

## Superpave Gyratory

Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

# Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Surface Cores 15 thru 21 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544524  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	99	
1/2"	85	
3/8"	73	
1/4"	59	
#4	54	
#8	39	
#10	37	
#16	31	
#30	25	
#40	22	
#50	19	
#100	14	
#200	8.6	

Bitumen Content By Solvent Extraction		
Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%):	4.49	

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.608	162.3
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

Superpave Gyrotory			
Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

## Note:

Pockets of clay balls were observed in the mix  
when breaking down the asphalt cores to  
combine.

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

## Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Base Cores 15 thru 21 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001

AMEC FW Lab No.: 1544525

Date Sampled: 11-04-2015

Date Received: 11-18-2015

Report Date: 12-03-2015

### Gradation

Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	98	
1/2"	91	
3/8"	81	
1/4"	64	
#4	56	
#8	41	
#10	38	
#16	31	
#30	25	
#40	22	
#50	19	
#100	13	
#200	9.1	

### Bitumen Content By Solvent Extraction

Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%)	4.89	

### Voids Analysis

Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:	2.585	160.9
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

### Superpave Gyrotory

Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

Note: \_\_\_\_\_

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\_\_\_\_\_  
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\_\_\_\_\_

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

## Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Surface Cores 22 thru 28 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544526  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	98	
1/2"	86	
3/8"	72	
1/4"	59	
#4	54	
#8	40	
#10	37	
#16	31	
#30	25	
#40	22	
#50	19	
#100	13	
#200	8.0	

Bitumen Content By Solvent Extraction		
Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%)	4.51	

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.583	160.8
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

Superpave Gyrotory			
Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

**Note:**

*Pockets of clay balls were observed in the mix when breaking down the asphalt cores to combine.*

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

# Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Base Cores 22 thru 28 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544527  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	98	
1/2"	86	
3/8"	76	
1/4"	62	
#4	54	
#8	40	
#10	37	
#16	31	
#30	26	
#40	23	
#50	20	
#100	14	
#200	9.0	

Bitumen Content By Solvent Extraction		
Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%):	4.68	

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.591	161.3
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

Superpave Gyrotory			
Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

Note: \_\_\_\_\_

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\_\_\_\_\_  
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Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

## Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Surface Cores 29 thru 34 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544528  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

Gradation		
Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	99	
1/2"	85	
3/8"	74	
1/4"	60	
#4	54	
#8	41	
#10	38	
#16	32	
#30	26	
#40	23	
#50	20	
#100	14	
#200	8.4	

Bitumen Content By Solvent Extraction		
Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%)	4.64	

Voids Analysis		
Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.582	160.7
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

Superpave Gyratory			
Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

**Note:**

Pockets of clay balls were observed in the mix when breaking down the asphalt cores to combine.

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

# Asphalt Concrete Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A Route N55  
Project No.: 20162433  
Material 6" AC Cores  
Material Source: Sampled from Roadway  
Sample ID: Base Cores 29 thru 34 combined  
Sample Location: 5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544529  
Date Sampled: 11-04-2015  
Date Received: 11-18-2015  
Report Date: 12-03-2015

## Gradation

Test Method: AASHTO T30		
Screen Size	% Passing	(spec)
1 1/4"		
1"	100	
3/4"	98	
1/2"	87	
3/8"	77	
1/4"	62	
#4	55	
#8	42	
#10	39	
#16	33	
#30	27	
#40	24	
#50	22	
#100	15	
#200	9.9	

## Bitumen Content By Solvent Extraction

Test Method: AASHTO T164		
Bitumen Content	(%)	(spec)
By Total wt. of Mix (%):	4.84	

## Voids Analysis

Bulk Density		
Test Method:		
	Gmb	PCF
Bulk Density:		
Theoretical Maximum Density		
Test Method: AASHTO T209		
	Gmm	PCF
Max. Density:		
	2.559	159.3
Air Voids		
	(%)	(spec)
Air Voids:		
Marshall Stability and Flow		
Test Method:		
	(lb)	(spec)
Stability:		
		(spec)
Flow:		

## Superpave Gyrotory

Test Method:			
Gyrations	Gmb	% Gmm	%Gmm Spec
Nini (8)			
Ndes (100)			
Nmax (160)			

Note: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager

# AC Core Density Summary

amec foster wheeler



Client: Kleinfelder  
Project Name: B.I.A. Route N55  
Project No. 20162433  
Material: 6" AC Cores  
Material Source: Sampled from various locations  
5.5 miles North of Alamo, NM.

AMEC FW Job No.: 19-2013-3001  
AMEC FW Lab No.: 1544520-1544529  
Date Received: 11-18-2015  
Date Sampled: 11-04-2015  
Report Date: 12-03-2015  
Pave Date: np

Core Density Results			Test Method: AASHTO T166 / T209		
Core Number	Laboratory I.D. Number	Thickness (in.)	Core Density (#/cu.ft.)	Rice Density (#/cu.ft.)	Percent Compaction
1 (Surface)	1544520	1.502	147.6	160.2	92.1%
1 (Base)	1544521	1.719	146.6	158.2	92.7%
8 (Surface)	1544522	1.342	152.9	161.4	94.7%
8 (Base)	1544523	1.397	150.1	159.6	94.0%
15 (Surface)	1544524	1.375	144.9	162.3	89.3%
15 (Base)	1544525	1.886	149.3	160.9	92.8%
22 (Surface)	1544526	1.555	149.0	160.8	92.7%
22 (Base)	1544527	1.641	147.4	161.3	91.4%
29 (Surface)	1544528	1.114	149.8	160.7	93.2%
29 (Base)	1544529	1.250	150.4	159.3	94.4%

Core Number	Location
1 (Surface)	5.5 miles North of Alamo, NM.
1 (Base)	5.5 miles North of Alamo, NM.
8 (Surface)	5.5 miles North of Alamo, NM.
8 (Base)	5.5 miles North of Alamo, NM.
15 (Surface)	5.5 miles North of Alamo, NM.
15 (Base)	5.5 miles North of Alamo, NM.
22 (Surface)	5.5 miles North of Alamo, NM.
22 (Base)	5.5 miles North of Alamo, NM.
29 (Surface)	5.5 miles North of Alamo, NM.
29 (Base)	5.5 miles North of Alamo, NM.

Remarks:

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Reviewed By:

Brian A. Waterbury, Bituminous Laboratory Manager



	Project Name:	B.I.A. Route N55				
	Project No.:	20162433				
	TRACS No.:	na				
	Sample ID.:	Surface #1-7	Base #1-7	Surface #8-14		
	AMEC FW Lab No.:	1544520	1544521	1544522		
	Date Received:	11-18-2015	11-18-2015	11-18-2015		
	Sample Date:	11-04-2015	11-04-2015	11-04-2015		
	Sample Type:	Submittal	Submittal	Submittal		
Tests on Original Asphalt		Test Method	Spec			
Absolute Viscosity, 140°F, Poise		AASHTO T202	Report	30,941	20,057	32,861
Penetration, (77°F), 100g, 5s, dmm		AASHTO T49	Report	23	28	23
Remarks:						
Asphalt binder was recovered by Rotavapor Method ASTM D5404.						

Di Walter

PLATE C-12

[illegible]

B. Walter

PLATE C-13

[illegible]

P. Wether

PLATE C-14

[illegible]

Er. W. A. L.

PLATE C-15

## APPENDIX D

### SITE PHOTOGRAPHS

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Heaving outside of wheelpath at location of boring B-2



Longitudinal cracking outside of wheelpath at location of boring B-7



Rutting in wheelpath at location of boring B-10



Longitudinal/transverse cracking in location of boring B-19



**SITE PHOTOGRAPHS**  
 BIA: Route N55 Near Alamo, NM  
 Project Number: 20162433.001A  
 Photos Taken: November 3<sup>rd</sup> and 4<sup>th</sup>, 2015

PLATE

**D-1**

**APPENDIX E**  
**ADDENDUM REPORT INCLUDING EN-1 TESTING**

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February 9, 2016  
Project No.: 20162433

Ms. Ella M. Dempsey  
BIA-Navajo Regional Office  
Division of Acquisition Field Operations  
(301 W. Hill, Room 346)  
Gallup, NM 87301

**SUBJECT: Addendum to Draft Geotechnical Report (File No. TEM16R33330)  
Unconfined Compression Test Results  
BIA Route N55  
BIA Project N55(1-1)2&4  
Navajo Nation, New Mexico**


Dear Ms. Dempsey:

Kleinfelder is pleased to present our addendum to the report titled "Draft Geotechnical Report – BIA Route N55 (1-1)2&4" (submitted January 15, 2016) for the planned reconstruction and paving of Route N55 on the Navajo Nation, located approximately 10 kilometers north of Alamo, New Mexico. This addendum presents the results of the EN-1 unconfined compression laboratory testing as well as our engineering analyses and recommendations. The results of the unconfined compression testing suggest that the EN-1 solution increased the compressive strength of four prepared and tested samples of subgrade soils by 9.7% to 83.1%. Based on these findings, the original pavement design per Section 5.2 of the referenced report was determined to be sufficient and can be considered final.

We appreciate the opportunity to be of service to you. Should any questions arise concerning this addendum or if you require any additional information regarding this project, please contact us.

Respectfully submitted,

**KLEINFELDER**

  
Daniel Rossman, EIT  
Staff Professional I

  
Keith Dahlen, PE  
Senior Geotechnical Engineer

Reviewed by:

  
Dave Peterson, PG  
Operations Manager, VP

## SCOPE OF WORK

To determine the effectiveness of the EN-1 soil stabilizer, unconfined compression tests were performed on multiple specimens consisting of blended existing subgrade soils mixed with the EN-1 solution. Compression tests were also performed on the same blended soil samples without the EN-1 additive in order to evaluate the potential improvements on the structural properties of the subgrade by using this brand of stabilizer. Prior to performing the EN-1 testing, the optimum moisture content for each blended subgrade sample was established by performing a Proctor test. Subgrade samples were then mixed at optimum moisture content using both water only and a mix of water and 3 percent EN-1 solution. The specimens were molded in 102 mm x 152 mm cylindrical molds using a compactive effort of 2200 kN-m/m<sup>3</sup>. The samples were cured for 17 days prior to unconfined compressive strength testing.

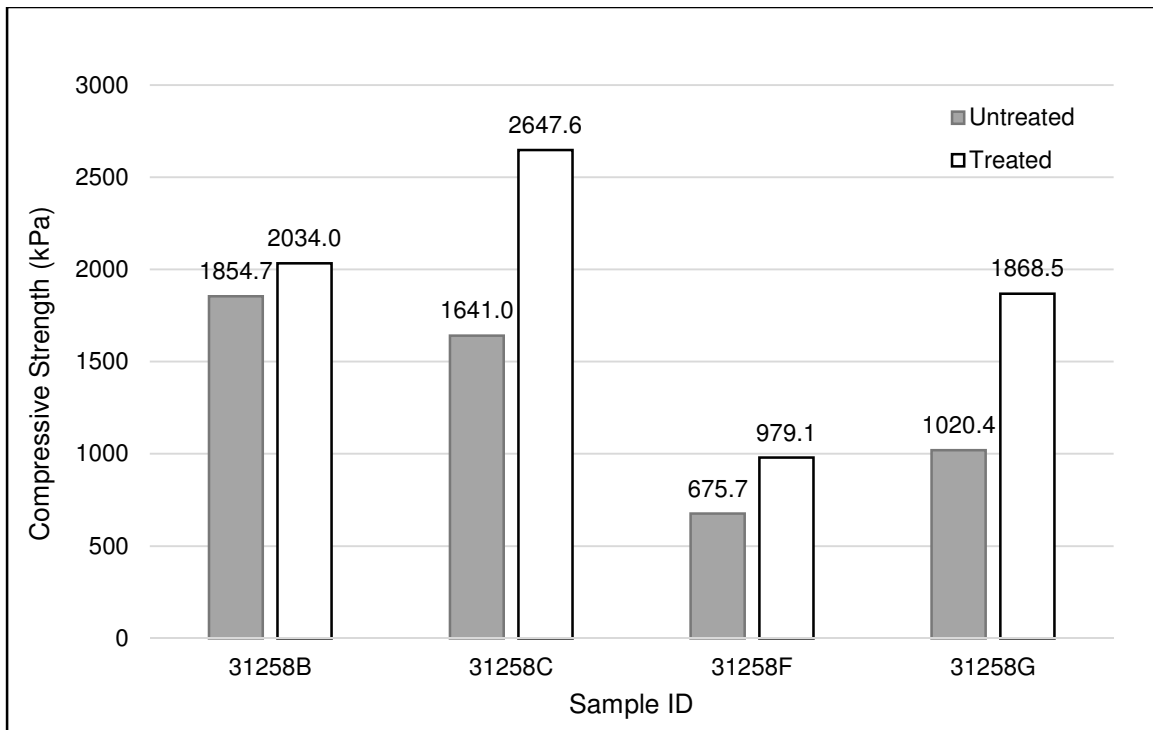
The testing was performed on four samples that represent a composite of subgrade soils with similar characteristics along the existing alignment. Samples were composited based on soils having similar fines contents and plasticity index (PI) values. For each composite sample, two specimens were molded, cured and tested (one treated with EN-1 solution, and one untreated), resulting in a total of eight compression specimens for this project. The compression test data associated with each specimen is located in Appendix A – Unconfined Compression Test Data.

## RESULTS

A summary of the unconfined compression test results is presented below in Table 1, accompanied by a graphical summary presented in Figure 1.

**Table 1 – Summary of Unconfined Compression Test Results**

Sample ID	Composite Source	Soil Classification	PI Range	Compressive Strength (kPa)		% Increase
				Untreated	Treated	
31258B	B4,B5,B6	SC,CL	25-29	1854.7	2034.0	9.7
31258C	B9,B10,B11,12	CL,CH	27-40	1641.0	2647.6	61.3
31258F	B22,B23	SC,CL	20-23	675.7	979.1	44.9
31258G	B24,B25,B26	CL	22-28	1020.4	1868.5	83.1
<b>AVERAGE</b>				<b>1297.9</b>	<b>1882.3</b>	<b>49.8</b>



**Figure 1 – Summary of Unconfined Compression Test Results**

## ANALYSIS & RECOMMENDATIONS

The average compressive strength for the untreated specimens was 1297.9 kPa. For specimens that were treated with the EN-1 solution, the average compressive strength was 1882.3 kPa, corresponding to an average increase in strength of approximately 49.8%. For sample 31258B the strength increase due to the EN-1 solution was only 9.7%, however, this untreated sample also had a relatively high untreated compressive strength. In general, the strengthening effect of the EN-1 solution was the most significant in subgrade soils having relatively lower untreated compressive strengths, although data suggests that some increases can still be achieved in all soils. Test specimens associated with sample 31258F had the lowest untreated and treated compressive strengths, with values of 675.7 kPa and 979.1 kPa, respectively. It is likely that zones or lenses of this weaker soil are present in various areas throughout the site. In order to establish a pavement design that is sufficient for all soils present, soil properties from sample 31258F were used in the final pavement design.

In Section 5.2 of our report titled “Draft Geotechnical Report – BIA Route N55 (1-1)2&4” (submitted January 15, 2016), the structural layer coefficient for the clayey subgrade soils present at the site was assumed to be 0.06. Based on correlations for structural coefficients provided by the Arizona DOT Preliminary Engineering and Design Manual, (Figure 202.02-4), and the treated unconfined compressive strength of sample 31285F (979.1 kPa), the actual structural layer coefficient of the treated subgrade soils can be assumed to be at least 0.16. It is recommended that the original pavement design be used, as it is conservative and will be sufficient for weaker soils that are present along various sections along the alignment. It is unknown what effect the treatment may have on the PI of the clayey soils and thus the soils should still be considered moisture sensitive as noted in our Draft Geotechnical Report. However, it is noted that the manufacturer of the EN-1 solution claims that the treated soil is more resistant to water penetration. A summary of the original pavement design is provided in Table 2 below.

**Table 2: Original Pavement Design**

<b>Design Years</b>	<b>AC Thickness (mm)</b>	<b>ABC Thickness (mm)</b>	<b>Total Thickness (mm)</b>	<b>Req'd Structural Number</b>	<b>Actual Structural Number</b>
20	75	150	225	1.70	2.06

Due to the variability of the soils encountered during the field exploration, it is recommended that the EN-1 stabilizer solution be used for the entire proposed reconstructed alignment.

## **LIMITATIONS**

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of the geotechnical profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on visual reconnaissance, literature research, a field test boring program, laboratory testing, and engineering analyses.

Kleinfelder makes no other representation, guarantee or warranty, expression or implication, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and other registered design professionals in association with the project, and only for the purposes stated and within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

## **EN-1 COMPRESSION TEST RESULTS**



6380 S. Polaris Avenue  
Las Vegas, NV 89118  
Phone: (702) 736-2936 Fax: (702) 361-9094

## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-29-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** NA**Soil Stabilization Type:** None**Stabilizer Content:** NA**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-4 @ 0.5'-4", B-5 @ 1'-4', B-6 @ 1'-4'  
Composite Samples

**Date Sample Prep:** 01-12-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258B	01-29-2016	17	3.999		12.56		3380	269
Average Strength (psi):								269
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-29-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** Roadbond EN1**Soil Stabilization Type:** EN1 Stabilizer**Stabilizer Content:** 3% of the target moisture**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-4 @ 0.5'-4", B-5 @ 1'-4', B-6 @ 1'-4'  
Composite Samples

**Date Sample Prep:** 01-12-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258B	01-29-2016	17	3.999		12.56	EN-1 Mix	3707	295
Average Strength (psi):								295
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-29-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** NA  
**Soil Stabilization Type:** None  
**Stabilizer Content:** NA  
**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-9 @ 1'-4", B-10 @ 1'-4', B-11 @ 1'-4',  
B-12 @ 1'-4' Composite Samples

**Date Sample Prep:** 01-12-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258C	01-29-2016	17	3.999		12.56		2985	238
Average Strength (psi):								238
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-21-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** Roadbond EN1**Soil Stabilization Type:** EN1 Stabilizer**Stabilizer Content:** 3% of the target moisture**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-9 @ 1'-4', B-10 @ 1'-4', B-11 @ 1'-4'  
& B-12 @ 1'-4' Composite Samples

**Date Sample Prep:** 01-04-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258C	01-21-2016	17	3.999		12.56	EN-1 Mix	4827	384
Average Strength (psi):								384
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-29-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** NA  
**Soil Stabilization Type:** None  
**Stabilizer Content:** NA  
**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-22 @ 1'-4", B-23 @ 1'-3'  
Composite Samples

**Date Sample Prep:** 01-12-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258F	01-29-2016	17	3.999		12.56		1232	98
Average Strength (psi):								98
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-29-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** Roadbond EN1**Soil Stabilization Type:** EN1 Stabilizer**Stabilizer Content:** 3% of the target moisture**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-22 @ 1'-4", B-23 @ 1'-3'  
Composite Samples

**Date Sample Prep:** 01-12-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258F	01-29-2016	17	3.999		12.56	EN-1 Mix	1785	142
Average Strength (psi):								142
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-29-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** NA**Soil Stabilization Type:** None**Stabilizer Content:** NA**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-24 @ 1.5'-3", B-25 @ 2'-4', B-26 @  
1.5'-4' Composite Samples

**Date Sample Prep:** 01-12-2016**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258G	01-29-2016	17	3.999		12.56		1854	148
Average Strength (psi):								148
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



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## CONCRETE CYLINDER COMPRESSIVE STRENGTH REPORT, ASTM D1633 Method A

**Report To:**

BIA – Bureau of Indian Affairs  
Navajo Acct Operations,  
Bureau of Indian Affairs  
PO Box 1060 Gallup, New Mexico, 87305

**Report Date:** 01-15-2016**Project No.:** 20162433.001A**Project:** BIA: Route N55 Near Alamo**Task:** 03-0000

### MIX DESIGN DATA

**Supplier:** Roadbond EN1**Soil Stabilization Type:** EN1 Stabilizer**Stabilizer Content:** 3% of the target moisture**Design Strength:** NA

### SAMPLE DATA

**Source of Sample:** B-24 @ 1.5'-3', B-25 @ 2'-4' &  
B-26 @ 1.5'-4' Composite Samples

**Date Sample Prep:** 12-29-2015**Sample Prep By:** Rene Walter**Tested By:** Song Lim**Submitted By:** Song Lim**Curing Method:** Air Dry & Bag Sealed

### LABORATORY DATA

**Capping Method:** None

Sample Number	Date Tested	Age (days)	Dimensions (in)		Avg. Cross Sectional Area (in <sup>2</sup> )		Ultimate Load (lbs)	Compressive Strength (psi)
			Average Diameter					
31258G	01-15-2016	17	3.999		12.56	EN-1 Mix	3399	271
Average Strength (psi):								271
Required Strength (psi) @ 17 days:								

**Remarks:**

Unless prior arrangements have been made all HOLD specimens will be discarded if required strength is attained.  
Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.

**APPENDIX F**  
**PAVEMENT DESIGN CALCULATION SUMMARY SHEET**

---



PROJECT: BIA Route N55 (1-1) 2&4  
SUBJECT: AASHTO Pavement Design Summary  
AC/AB/Stabilized Subgrade

PROJECT NO: 20162433.001A  
PREPARED BY: D. Rossman  
REVIEWED BY: Scott Sounart

CLIENT: BIA  
DATE: 8/8/2016  
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## AASHTO Flexible Pavement Design

### Design Parameters:

Standard Normal Deviate	-0.674
Combined Standard Error	0.45
Design Serviceability Loss	1.6
Desired Level of Reliability (percent)	75
New Asphalt Concrete Layer Coefficient	0.44
New Aggregate Base Layer Coefficient	0.14
Stabilized Subgrade Layer Coefficient	0.06
Stabilized Subgrade Drainage Coefficient	1.0

### Flexible Pavement Structural Design:

Allowable 18-kip ESAL Repetitions	12,940
Resilient Modulus (psi)	5,484
New Asphalt Concrete Thickness (inches)	3
New AB Thickness (inches)	6
Stabilized Subgrade thickness (inches)	9
Design Structural Number	2.70
Required Structural Number	1.70
Design Life (years)	20

<b>New AC Thickness</b>	<b>3 inches</b>	<b>75 millimeters</b>
<b>New AB Thickness</b>	<b>6 inches</b>	<b>150 millimeters</b>
<b>Satbilized Subgrade Thickness</b>	<b>9 inches</b>	<b>225 millimeters</b>