GEOTECHNICAL EXPLORATION REPORT
US95 / KYLE CANYON ROAD (SR157) INTERCHANGE
LAS VEGAS, NEVADA
KLEINFELDER PROJECT NO. 20162633

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GEOTECHNICAL EXPLORATION REPORT
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1 INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical exploration for the proposed US95 / Kyle Canyon Road (SR157) Interchange project located in Las Vegas Nevada. The approximate location of the site is shown on Figure 1, General Site Vicinity Map.

Kleinfelder was requested to provide design recommendations regarding subgrade preparation, embankment fill, retaining walls, and shallow bridge foundations for the US95 / Kyle Canyon Road (SR157) Interchange project in Las Vegas, Nevada. We understand the information provided herein will be used by others in performing analyses and design of the two 2-span bridge structures, interchange ramps, embankments, retaining walls, and storm drain facilities for this project.

Work for the geotechnical exploration report included site reconnaissance, subsurface exploration, soil sampling, field and laboratory testing, engineering analyses, and preparation of this report. A scope of services for this work is presented in our proposal dated September 22, 2015 (Kleinfelder Proposal No.50-0010).

The recommendations contained in this report are subject to the limitations presented in the 'Limitations' section of this report. In addition, a brochure prepared by Geoprofessional Business Association (GBA) has been included as Appendix D of this report. We recommend that all individuals using this report read the limitations along with the attached brochure.

1.2 PROJECT DESCRIPTION

We understand that the project will consist of constructing two 2-span overpass bridge structures on US95 at Kyle Canyon Road (SR 157) as shown on the attached Figure 1, General Site Vicinity Map. The proposed interchange will be located approximately 600 feet south of the existing Kyle

Canyon Road. The existing Kyle Canyon Road will be realigned to better accommodate the proposed interchange. Based on preliminary design sketches, we understand that the proposed overpasses will be two 2-span bridges, approximately 61-foot wide and 184-foot long and will be founded on shallow foundations. The abutment foundations will bear on either existing US95 embankment fill or native subgrade at approximate elevations ranging between 2786 to 2792 feet. The center bent shallow foundations will bear approximately 30 feet below existing US95 grade, at an approximate elevation of 2772 feet. We anticipate embankment fills and cut slopes up to 25 feet in height with slopes as steep as 2:1 (horizontal:vertical). We anticipate the bridges will be designed using the most current AASHTO LRFD code. We anticipate abutment and column footing loads up to 2000 kips factored and up to 1500 kips for service loads.

The project also includes rerouting and extending Kyle Canyon Road to the east and west of US95 with cuts on the order of 20 feet. We understand that a retaining wall will be constructed along the west portion of Kyle Canyon Road. The wall will be approximately 300 feet in length and up to 15 feet in height. We anticipate that retained backfill will be level and that the wall may be founded on a slope. Kleinfelder should be provided this information when available to complete our retaining wall analyses. Existing drainage culverts/boxes will be extended with the possibility of adding an additional box culvert crossing beneath US95.

The site is relatively undeveloped and undisturbed outside the existing US95 and Kyle Canyon Road. Our work was performed within NDOT right-of-ways (ROW).

2 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling 11 borings. The following table summarizes the boring location, depth, and associated improvement for each exploration.

TABLE 2-1

EXPLORATION SUMMARY

Exploration Number	Depth (feet)	Associated Improvement
B-1	10	Kyle Canyon Road
B-2	40	Retaining Wall
B-3	10	Kyle Canyon Road
B-4	20	Drainage Structure
B-5	60	Bridge Structure
B-6	40	Bridge Structure
B-7	100	Bridge Structure
B-8	40	Bridge Structure
B-9	60	Bridge Structure
B-10	20	Drainage Structure
B-11	10	Kyle Canyon Road

The borings were located off of roadways and shoulders and drilled in undisturbed and undeveloped medians or properties adjacent to the roadways. Borings were located in the field using GPS coordinates in conjunction with existing site features depicted on aerial imagery. Logs of the subsurface conditions, as encountered in the explorations, were recorded at the time of exploration and are presented on the Boring Logs in Appendix A.

Drilling was accomplished with a truck-mounted drill rig with hollow-stem auger equipped for soil sampling. Representative soil samples were obtained with Standard Penetration Test (SPT) and Modified California (lined with 2.5-inch rings) samplers. The samplers were driven with a 140-pound, hydraulically-actuated hammer, free-falling through a distance of 30 inches. Unless noted otherwise on the Boring Logs, the sampler driving resistance was recorded as number of blows per 6 inches of penetration. The penetration test results are presented on the Boring Logs at the corresponding sampling depth. Kleinfelder geotechnical personnel prepared a log of soils encountered during drilling from each boring. Portions of each sample were packaged and transported to our laboratory for additional testing.

3 LABORATORY TESTING

Soil samples from the borings were tested in the laboratory to support our field classification and to provide information regarding engineering characteristics and properties of the subsurface soils. The laboratory testing program consisted of:

- Seven (7) moisture content tests (AASHTO T265) performed to measure the in-place moisture conditions of the soils.
- Seven (7) grain size distribution analyses (Nev. T206) and Seven (7) Atterberg limits tests (Nev. T210, T211, and T212) performed to characterize the subsurface soils and to support our field classifications.
- Two (2) R-value tests (Nev. T115) performed to measure the subgrade resistance to wheel loads.
- Two (2) chemical test suites performed to provide data regarding potential corrosivity towards metal and concrete.

The results of the laboratory tests are presented on the Boring Logs in Appendix A and the laboratory test data sheets in Appendices B and C.

4 GENERAL SITE CONDITIONS

4.1 SURFACE CONDITIONS

The site is located along the existing interchange of the US95 freeway and Kyle Canyon Road in Clark County, Nevada. Surface conditions along the existing roadways consist mainly of concrete and asphalt pavement that vary in thickness. Properties adjacent to the project are currently undeveloped.

4.2 SUBSURFACE CONDITIONS

Subsurface conditions for this geotechnical exploration report are based on information collected by Kleinfelder for this project. The subsurface soils in the project area generally consist of native soils consisting primarily of dense to very dense gravel or sand with varied amounts of silt and clay.

Practical auger refusal was encountered at approximately 42 feet in Boring B-6 on cemented soils. Layers of partially cemented sands and gravel of variable thickness are present throughout the subsurface to the depths drilled.

Groundwater was not observed in any of the borings to an approximate elevation of 2,570 feet or approximately 100 feet below the existing ground surface. It is possible that variations in groundwater levels could occur due to precipitation, seasonal changes, irrigation, or construction activities.

5 GENERAL SITE GEOLOGY

5.1 GEOLOGIC SETTING

The site is located within the northwest corner of the Las Vegas Valley. The Las Vegas Valley is within the Basin and Range province. The Valley is bounded by the Spring Mountains on the west, the Las Vegas and Sheep Ranges on the north, Frenchman Mountain and the River Mountains on the east, and the McCullough Mountains on the south.

The Las Vegas Valley is a fault-bounded structural basin containing several thousand feet of late Tertiary- and Quaternary-age sedimentary deposits (Bell, 1981). These sediments consist of relatively incompressible, coarse-grained alluvial-fan deposits around the valley margins and moderately to highly compressible, fine-grained sediment in the middle of the valley (Bell, 1981). Coarse-grained basin-fill deposits derived from the surrounding mountains consist of large coalescing alluvial fans that occur on the outer edges of the valley and grade downslope to the valley bottom where there are extensive areas of fine-grained sediment indicative of groundwater discharge during Pleistocene time (Page et al. 2005). The project area is mapped on the Geologic Map of the Tule Springs Park Quadrangle (Bell and others, 1998). Based on the mapped data, the site area is underlain by alluvial fan deposits derived from the Spring Mountains to the west.

5.2 SEISMICITY AND SOIL PROFILE TYPE

Numerous earthquakes of Richter magnitude 3.0 or greater have been recorded in the Las Vegas area. Most of the recorded ground motions were a result of underground blasting (some as high as Richter magnitude 5.8) at the Nevada Test Site, which remained the major source of seismic activity in the Las Vegas area until 1992 when testing was suspended. Within the last few decades, several earthquakes of up to Richter Magnitude 3.5 have occurred within the Las Vegas Valley. Ground shaking from large earthquakes outside the Las Vegas Valley has also occurred. The nearest mapped Quaternary fault is located approximately 7 to 7-1/2 miles southeast of the site (USGS, 2006).

Stresses resulting in fissures have in many cases occurred in localized areas near faults. Fissures are cracks in the ground which originate at depth as a result of stresses associated with subsidence due to groundwater withdrawal. Fissures are typically manifested at the ground surface as open cracks or aligned sinkholes and depressions. Normal fissure width due to tensional stresses is thought to be typically on the order of a few inches or less. Subsequent surface and subsurface erosion may erode fissures to widths of several feet. The nearest mapped fissure zone is located approximately 8 miles to the southeast (dePolo and Bell, 2000).

The project site is located at an approximate latitude and longitude 36.32623 degrees north and 115.31113 degrees west, respectively. According to the Clark County seismic map and based on our boring logs a seismic Site Class C as defined in the AASTHO LRFD Bridge Design specifications may be used for design. A peak ground acceleration of 0.13g was obtained for the MCE event at this location (7 percent probability of exceedance in 75 years) using the United States Geologic Survey (USGS) US Seismic Design Maps calculator v.3.1.0, dated July 11, 2013, and accessed December 4, 2015. The Nevada Department of Transportation (NDOT) requires a minimum PGA of 0.15g. Table 5.2-1 presents the site class, the mapped spectral response accelerations for short and 1-second periods for the Maximum Considered Earthquake (MCE), and site coefficients for the proposed site. This peak ground acceleration (PGA) corresponds to the acceleration of bedrock and has not been adjusted for Site Class.

TABLE 5.2-1

2012 AASHTO SEISMIC DESIGN PARAMETERS

Site Class	S_S	S_1	F_a	F_v
C	0.37g	0.19g	1.2	1.7

6 ENGINEERING ANALYSES AND RECOMMENDATIONS

6.1 GENERAL

The primary geotechnical considerations for the proposed project is the potential for total and differential settlement of structures due to structure loads and the overall stability of proposed slopes and walls.

The following sections of this report present our recommendations regarding site preparation and grading, embankment fill, foundations, retaining walls, resistance to lateral loads, moisture protection, corrosive soil conditions, temporary excavations, and construction considerations.

6.2 SITE PREPARATION AND GRADING

Existing concrete and asphalt pavement sections should be removed along with trash, debris, vegetation (including roots), and other deleterious materials should be cleared, stripped, and removed from the site prior to construction. Although not anticipated, loose to medium dense or soft to medium stiff native soils, where encountered, along with existing undocumented spread fill material should be scarified, moisture conditioned and compacted below roadway subgrades, improvements, and structural foundations. The above materials, where present to depths greater than one foot, should be overexcavated to expose dense undisturbed native soil or competent fill soils in all areas of proposed improvements.

In areas where overexcavation is required, the excavations for loose or soft soils should extend laterally to a distance equal to the depth of excavation.

Following excavation of unsuitable soils as discussed above, the exposed natural soils or fill soils should be scarified six to eight inches, moistened to within two percent of optimum moisture content for granular soils and compacted to at least 90 percent of maximum dry density. Scarification and recompaction is not necessary where cemented soils are encountered. All compaction recommendations stated in this report refer to methods established by Test Method No. Nev. T108 or AASHTO T-180. All embankment should meet the requirements and be placed according to the recommendations presented in Section 6.3, Fill Materials. The exposed ground surface should be observed and approved by the geotechnical engineer's representative prior to placement of embankment fill material.

6.3 FILL MATERIALS

Fill materials should meet the requirements in Sections 203.02.04, 203.03.13, and elsewhere as outlined in the 2014 NDOT Standard Specifications for Road and Bridge Construction (Silver Book). Embankment fill material within a depth of five feet of roadway aggregate base material should have an R-value of 45 or greater as determined by Test Method No. Nev T115.

Fill materials should be free of vegetation, organics, and debris; and contain no rocks or clumps larger than six inches nominal diameter. Embankment fill should be placed in six- to eight-inch-thick loose lifts, brought to within two percent of optimum moisture content for granular soils and between 0 and three percent above optimum moisture content for cohesive soils, and compacted to at least 95 percent of maximum dry density. Embankment fill placed and compacted on sloping ground steeper than 4:1 (horizontal:vertical) should be continuously benched. Benches should be wide enough to permit placement and compaction equipment and limited to a maximum height of three feet.

Due to the cemented nature of some of the native soils typical of this location, processing may be required to meet minimum particle size requirements. Imported materials should meet the previously presented requirements for embankment fill. Imported fill soils should be inspected, tested, and approved at the source prior to importation to the site.

6.4 EMBANKMENTS

We anticipate embankment fills and cut slopes up to 25 feet in height with slopes as steep as 2:1 (horizontal:vertical). Evaluations of embankment settlement were performed assuming fills up to 25 feet in height and global stability was checked for both cut and fill slopes of 25 feet with 2:1 (H:V) slopes.

We anticipate settlement of embankment fill to occur relatively quickly and during construction. Simple settlement monitoring techniques after fill placement should be considered to confirm settlement of fill soils is generally complete prior to establishing final grade.

6.4.1 Global Stability Background

Global stability failure can typically be described as a critical deep-seated deformation of an embankment caused when the driving forces within the embankment exceed the resisting forces from the embankment and the underlying native soils. Driving forces include live loads, gravity, and seismic loads while resisting forces include soil shear strength. In evaluating global stability, it is convenient to convey the results of the analyses in the form of a factor of safety (FOS), which is defined as the ratio of the resisting forces to the driving forces.

6.4.2 Methodologies Used

Methodologies used in the evaluation of global stability involves developing a cross section of the existing embankment and the proposed new embankment, developing a Generalized Soil Profile and soil strength parameters, and calculating the FOS under various embankment stress conditions.

Our global stability analyses were performed in accordance with the requirements of AASHTO LRFD Bridge Design Specifications, Sixth Edition, Design & Construction Guidelines FHWA NHI-10-024 (FHWA, 2009).

The fill slope was evaluated assuming a silty gravel with sand to represent an embankment fill with an R-45 material. A friction angle of 34 degrees and 100 pounds per square feet (psf) of "apparent" cohesion were used for this material.

Slope stability analyses were performed using two-dimensional limit equilibrium methods. We utilized Spencer's method of slices in our analyses, which satisfies both force and moment equilibrium. Spencer's method assumes that interslice forces are parallel, and that the normal force on each slice acts at the center of the base of each slice. We used the slope stability program SLOPE/W™ by Geo-Slope International to perform our analyses.

The minimum bedrock acceleration allowed per NDOT is 0.15g based on a 7 percent probability of occurrence in 75 years. One-half the bedrock acceleration was used to model the seismic lateral force coefficient.

Our evaluation of global stability considered stress conditions representative of the service life of the embankment. We have represented this condition using drained strength parameters in the cohesionless soils. Service limit loads up to 5 ksf for foundations bearing in embankment were provided by GCW and used in our analyses. In addition, where applicable, we have added a permanent traffic surcharge live load to the top of the final embankment equal to 250-pounds per square foot (psf), which is roughly equivalent in weight to 2-feet of compacted fill.

The minimum FOSs used to evaluate embankment stability for design are those found in AASHTO LRFD Bridge Design Specifications, Sixth Edition, Sections 11.6.2.3 for static stability and 11.6.5 for seismic stability. The required resistance factors and their associated FOS are summarized in Table 6.4-1.

TABLE 6.4-1

REQUIRED FACTORS OF SAFETY FOR STATIC AND SEISMIC GLOBAL STABILITY

Load/Site Condition	LRFD Resistance (Factor (Φ))	Associated FOS (1/Φ)
For overall stability of the slope when earthquake loading is included	0.9	1.1
Static/Geotechnical parameters are well defined, and the slope does not contain or support a structural element	0.75	1.3
Static/Geotechnical parameters are based on limited information, or the slope contains or supports a structural element	0.65	1.5

6.4.3 Global Stability Analysis Results

Results from our global stability analyses are presented in Table 6.4-2. The subsurface soil profiles developed for this report represent our opinion of conservative case scenarios based on the subsurface explorations performed at that site.

Detailed outputs of the slope stability analyses with fill heights up to 25 feet are shown on Figures 6 and 7. The results presented in Table 6.4-2 represent the critical FOSs. The calculated factors of safety are equal to or higher than the minimum factors of safety required by AASHTO.

TABLE 6.4-2

GLOBAL STABILITY RESULTS

Slope Type	Slope Height (feet)	Slope Inclination (H:V)	Seismic	Long Term
			FOS: (1.1 min)	FOS: (1.5 min)
Fill	25	2:1	1.4	1.5

Close monitoring of the embankment should be performed by quality assurance field personnel during construction, particularly where detention ponds or other surface water sources are situated at the ground surface or at the bottom of the slope.

The global stability results shown above are based on evaluations of slopes anticipated to be representative of the site conditions.

6.4.4 Temporary Slope Stability

As a general guideline, temporary slopes may be cut at a maximum inclination in accordance with OSHA recommendations for a Type C soil (Federal Register 29 CFR, Part 1926). Cuts below groundwater are not anticipated.

Temporary cut and fill slopes at heights up to 25 feet as steep as 2:1 (H:V) may be constructed. However, explorations at temporary slope locations should be performed along with additional laboratory testing and analysis to confirm soil conditions at the particular slope location prior to beginning excavations. Observations for distress, cracking, or slope instability should be performed and care should be taken to divert surface runoff away from the face of the slope.

6.5 SHALLOW FOUNDATIONS

Foundation excavations for the abutments are anticipated in both in existing US95 embankments fill areas and foundations for bridge bents and retaining walls are anticipated to be in native soils. The bearing soils underlying shallow foundations should have similar supporting properties in an effort to reduce differential settlements. Partially- to fully-cemented soils exist at the site and may be utilized to support the loads from the proposed structures. However, in no case should shallow foundations for a single structure be supported by a combination of cemented and non-cemented soils. If both cemented and non-cemented soils are encountered in foundation excavations for a single structure, then the shallow foundations should either be extended to bear entirely on cemented soils in all areas, or the cemented soils should be overexcavated at least 1-foot so that structural/embankment fill may be placed between the bottom of the footing and cemented soils in all areas. General recommendations for the preparation of native subgrade soils are presented in Section 6.2, Site Preparation and Grading. Similarly, general recommendations for the placement of structural/embankment fill material are presented in Section 6.3, Fill Materials.

Shallow continuous and individual column foundations for the support of proposed bridge structures at the site are anticipated to have minimum embedded depths of 4 feet below finished grades. Foundations are anticipated to be proportioned for the resistances and limit cases based on Figures 3 and 4. Bearing resistance versus effective footing width for Service Limit State equal to ½-inch and 1 inch of settlement for individual square footings, abutment footings, and retaining wall footings, respectively, are presented on Figures 3, 4, and 5.

A summary of resistance factors presented in the AASHTO LRFD code that should be applied during shallow foundation design is presented in the following table.

TABLE 6.5-1

RESISTANCE FACTORS FOR SHALLOW FOUNDATIONS

Type/Case	Resistance Factor	Conditions
Bearing	0.45	--
Sliding	0.80	Cast-in-place concrete on sand
	0.50*	Passive earth pressure component of sliding resistance
Settlement	1.0	--
Horizontal Movement	0.65	Overall stability
	0.9	Seismic stability

**For foundations located in sloping ground, passive earth pressure should be neglected.*

Foundation design at the service limit state considers settlement, horizontal movements, and overall stability. Acceptable foundation movements are based on structure tolerance to total and differential movements. Based on the available project data and our evaluations, we anticipate the settlements will be uniform and occur rapidly during construction.

6.6 RETAINING WALLS

6.6.1 Conventional Retaining Walls

Proposed conventional retaining walls (cantilevered or non-yielding) at the site may be supported by shallow continuous foundations. Foundation excavations for the proposed walls are anticipated in both native soils and in proposed embankments fill areas. The bearing soils underlying shallow foundations should have similar supporting properties in an effort to reduce differential settlements. Partially- to fully-cemented soils exist at the site and may be utilized to support the loads from the proposed wall structures. However, in no case should any shallow foundations for a single retaining structure be supported by a combination of cemented and non-cemented soils. If both cemented and non-cemented soils are encountered in foundation excavations for a single structure, then the shallow foundations should either be extended to bear entirely on cemented soils in all areas, or the cemented soils should be overexcavated at least 1-foot so that structural/embankment fill may be placed between the bottom of the footing and cemented soils in all areas. The footing subgrade should be observed by a representative of the engineer of record prior to placing concrete or structural fill. Consideration to incorporating a construction joint in the wall at each transition is also a viable option. General recommendations for the preparation of native subgrade soils are presented in Section 6.2, Site Preparation and Grading. Similarly, general recommendations for the placement of structural/embankment fill material are presented in Section 6.3, Fill Materials.

Abutment wall foundations and shallow continuous retaining wall foundations for the support of proposed walls at the site should have a minimum embedment depth of four and two feet below finished grades, respectively. Graphs of the factored bearing resistance for the subject walls for level toe bearing conditions are presented in Figures 4 and 5. Kleinfelder should review shop drawings for these walls. Slopes in front of the toe result in a significant reduction of the factored bearing resistance. If the wall is designed with a toe slope, Kleinfelder should be immediately notified to review plans and provide applicable bearing resistance.

Lateral earth coefficients were calculated based on soil parameters using a combination of NDOT recommended values and engineering judgment based on anticipated native soils that would qualify as wall backfill material. These estimates assume level backfill and no hydrostatic pressure. The values presented below are unfactored (nominal) for imported or native granular soil and applicable reduction factors should be used. If the retained soil can potentially become saturated, the wall should be designed to resist the hydrostatic forces acting on the wall, in addition to the soil forces. Kleinfelder should be contacted when more information regarding surcharge loads is available to develop specific design recommendations. A value of 0.15g for acceleration was used for seismic analyses of the following retaining walls. Half the acceleration value, 0.075g, was used in the modified Mononobe-Okabe equation. A summary of values is presented in Table 6.6-1 below.

TABLE 6.6-1

RETAINING WALL DESIGN PARAMETERS

Assumed Parameters	Imported or Granular Native Soils (reused as Backfill)
Minimum R-Value	45
Maximum Percent Passing No. 200	20
Moist Unit Weight (pcf)	120
Internal Friction Angle (degrees)	32
Cohesion (psf)	50
Coefficient of Friction (Sliding)	0.62*
Static - Active Lateral Earth Coefficient (applies to surcharge, too)	0.31*
Static – Active Equivalent Fluid Weight (pcf) (Level Backfill)	37*
Seismic – Active Equivalent Fluid Weight (pcf) –Additional Pressure	5.8*
Static – At-Rest Lateral Earth Coefficient (applies to surcharge, too)	0.47*
Static – At-Rest Equivalent Fluid Weight (pcf) (Level Backfill)	56*
Static – Passive Lateral Earth Coefficient (pcf)	3.3*
Static – Passive Equivalent Fluid Weight (pcf)	390*
Equivalent Soil Surcharge (vehicular traffic - psf)	250

** - Values provided are nominal. An appropriate load or resistance factor should be applied to these values.*

6.6.1.1 Cantilevered Retaining Walls

Cantilevered retaining walls (i.e. unrestrained) with level backfill, no surcharge load and no seepage or groundwater, may be designed to resist backfill soil pressures in the active (Ka) lateral earth pressure state (i.e., where some lateral movement at the top of the wall is permitted during or after backfill placement). For design purposes, a backfill soil pressure equivalent to that developed as a fluid with a density of 37 pounds per cubic foot (pcf) would be appropriate for imported or native granular soil. Additional loads on cantilevered walls due to uniform surcharges may be estimated using a coefficient of 0.31 for imported or native granular soil. Additional incremental dynamic pressures due to seismic forces can be approximated using a triangular distribution with an equivalent fluid weight of 5.3 pcf for imported or native granular soil and is in addition to the above-stated static loads. The seismic resultant force can be assumed to act at a height of 0.33H as presented in A11.3.1 of AASHTO.

6.6.1.2 Non-Yielding Retaining Walls

Non-yielding (restrained) retaining walls which cannot deflect to mobilize the active soil pressure should be designed for the At-Rest or (Ko) lateral earth pressure state. An equivalent fluid lateral earth pressure design value of 56 pcf would be appropriate for imported or native granular soil. Additional loads on non-yielding walls due to uniform surcharges may be estimated using a coefficient of 0.47 for imported or native granular soil. Incremental dynamic pressures due to seismic forces are not applicable for the on-site walls designed for the At-Rest condition due to low design ground accelerations.

Any surcharge (live, including traffic, or dead load) located within retained zone should be added to the lateral earth pressures. Walls adjacent to areas subject to vehicular traffic should be designed for a minimum 2-foot equivalent soil surcharge (250 psf) or as recommended in the AASHTO LRFD Bridge Design Specifications, whichever is greater. Wall backfill should be placed in uniform lifts and compacted according to the requirements in the Section 6.2 'Site Preparation and Grading' of this report or provided by the designer and that are in line with the project documents.

6.6.1.3 Retaining Wall Overall Stability

The design of retaining walls includes the evaluation of internal and external stability. Our evaluations include bearing capacity and global stability. Design for sliding, overturning, and internal stability is required to evaluate the minimum width and length. The sliding, overturning, and internal stability analyses of the walls presented above will be performed by others.

Plans and details for the retaining walls were not available at the time of this report. Kleinfelder should be allowed to review final wall plans so that applicability of our recommendations can be assessed and revisions may be made, if necessary.

The factored bearing resistance for retaining walls was evaluated in accordance with AASHTO LRFD Bridge Design Specifications 2013 interims, 6th Edition. We understand that these walls may be constructed with possible toe and/or back slopes. Specific wall details were not available at the time of this report. Our analyses included a 15-foot retaining wall assuming level toe and back slopes. Additional analysis will be required when additional information is available as the back slope will increase the pressures on the wall and the toe slope will affect the bearing resistance and stability of the wall.

Global stability analysis was performed assuming a 15-foot tall wall with level back and toe slopes using the computer software SLOPE/W© 2012 and the engineering parameters outlined below. Based on the AASHTO 2013 (Section 11.6.2.3), a minimum FOS for overall long term (i.e., effective stress condition) stability should be 1.5, which is equivalent to a resistance factor of 0.65, as an acceptance criteria. A minimum FOS for the seismic condition should be 1.1, which is equivalent to a resistance factor of 0.9. The global stability results are presented in Table 6.6-2 and in Figures 8 and 9.

TABLE 6.6-2

RETAINING WALL OVERALL STABILITY

Wall Height (feet)	Slope Inclination (H:V)	Seismic	Long Term
		FOS: (1.1 min)	FOS: (1.5 min)
15	Level Back and Toe Slopes	1.7	1.9

Kleinfelder should review cross sections of the final wall design so that global stability can be checked. Adjustments may be required pending design changes.

6.7 RESISTANCE TO LATERAL LOADS (SHALLOW SPREAD FOOTINGS)

Horizontal loads acting on foundations cast in open excavations against undisturbed native soil or properly placed and compacted fill will be resisted by friction acting along the base of the footing and by passive earth pressures against the loaded side of the bridge structure or retaining wall footing. If design makes use of passive earth pressure against backfill, it is important that a representative of Kleinfelder be present to monitor and test backfill placement and compaction.

The friction acting along the base of the footings founded on suitable foundation soils may be computed using a nominal coefficient of friction equal to 0.62 with the normal dead load for imported or native granular soil. A nominal lateral passive earth pressure may be computed using an equivalent fluid weighing 390 pounds per cubic foot (pcf) for the sides of footings cast against undisturbed soil or properly placed and compacted granular backfill. The maximum passive pressure for shallow foundations should not exceed 1,500 pounds per square foot. Passive pressure in the upper foot should be neglected unless confined by concrete slab-on-grade or pavement. The values given above may be increased by one-third for transient wind or seismic loads. The values presented above are nominal. An appropriate resistance factor must be applied to these values. Once factored, the values can be combined to resist sliding.

6.8 MOISTURE PROTECTION

Long-term performance of foundations requires that the subgrade soils be protected against excessive water infiltration and/or saturation. Positive drainage should be established away from foundations and structures. Positive drainage is defined herein as a minimum slope of two percent across asphalt or concrete surfaces, or a minimum slope of five percent across all other surfaces. All utility trenches should be backfilled with properly placed and compacted non-pervious fill material.

Weepholes and/or perforated drainpipe and collector gravel drain systems should be placed behind retaining walls to assure positive drainage, or as specified by NDOT standards. We recommend that all walls not designed to resist hydrostatic pressures be constructed with drainage provisions. Hydrostatic buildup, over stressing, and moisture penetration of retaining walls are problems that can arise well after the completion of construction. We recommend that a full height wall drain be constructed.

The upper 12 inches of backfill should consist of compacted, impervious soils to prevent rapid infiltration of surface water into the drainage layer.

6.9 SLOPE PROTECTION

It is recommended that all slopes be protected against erosion. Measures should be taken to ensure water is diverted from running down slope faces or that the slope is sufficiently protected from water eroding the surface of the slope.

6.10 SOIL CORROSION

Based on our experience and data provided, on-site soils should be classified as providing negligible sulfate exposure as defined in Table 4.3.1 of the 2011 American Concrete Institute

(ACI) Manual 318. We recommend all concrete in contact with the on-site soils should be formulated with an appropriate cement type, water-cement ratio, and an appropriate minimum compressive strength to resist sulfate attack for soils in the "severe" category, as outlined in Table 4.3.1 of the 2011 American Concrete Institute (ACI) Manual 318, as referenced by the 2012 IBC.

In addition, special protection to buried metal pipes and water lines is important for long-term performance of these underground utilities. If corrosion of underground utilities is a concern, the on-site soils should be evaluated and a corrosion protection system should be designed by a qualified corrosion engineer.

6.11 CONSTRUCTION CONSIDERATIONS

Hard and fully cemented deposits are common throughout the area, and vary in depth, thickness, and consistency. Practical auger refusal was encountered at approximately 42 feet in Boring B-6 on cemented soils. Excavations for foundations, utility trenches, and general site grading may encounter cemented soils which will likely require the use of heavy-duty earthwork equipment.

7 CLOSURE

7.1 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are preliminary and are based on a limited number of observations and data. The information presented in this report is preliminary and this report was prepared with limited data from previous projects at and in the vicinity of the site. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

This report may be used only by the Client and their representatives, and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site), or other factors may change over time, and additional work may be required with the passage of time. Any party other than the Client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. It should be recognized that definition and evaluation of geologic and environmental conditions are a difficult and inexact science. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service that provide adequate information for their purposes at acceptable levels of risk. More extensive studies, including subsurface studies or field tests, should be performed to reduce uncertainties. Acceptance of this report will indicate that the Client has reviewed the document and determined that it does not need or want a greater level of service than provided.

8 REFERENCES

AASHTO, 2009, AASHTO Guide Specifications for LRFD Seismic Bridge Design.

AASHTO, 2012. LRFD Bridge Design Specifications.

John W. Bell, 1981, Subsidence in the Las Vegas Valley, Nevada Bureau of Mines and Geology Bulletin 95, 84 pp.

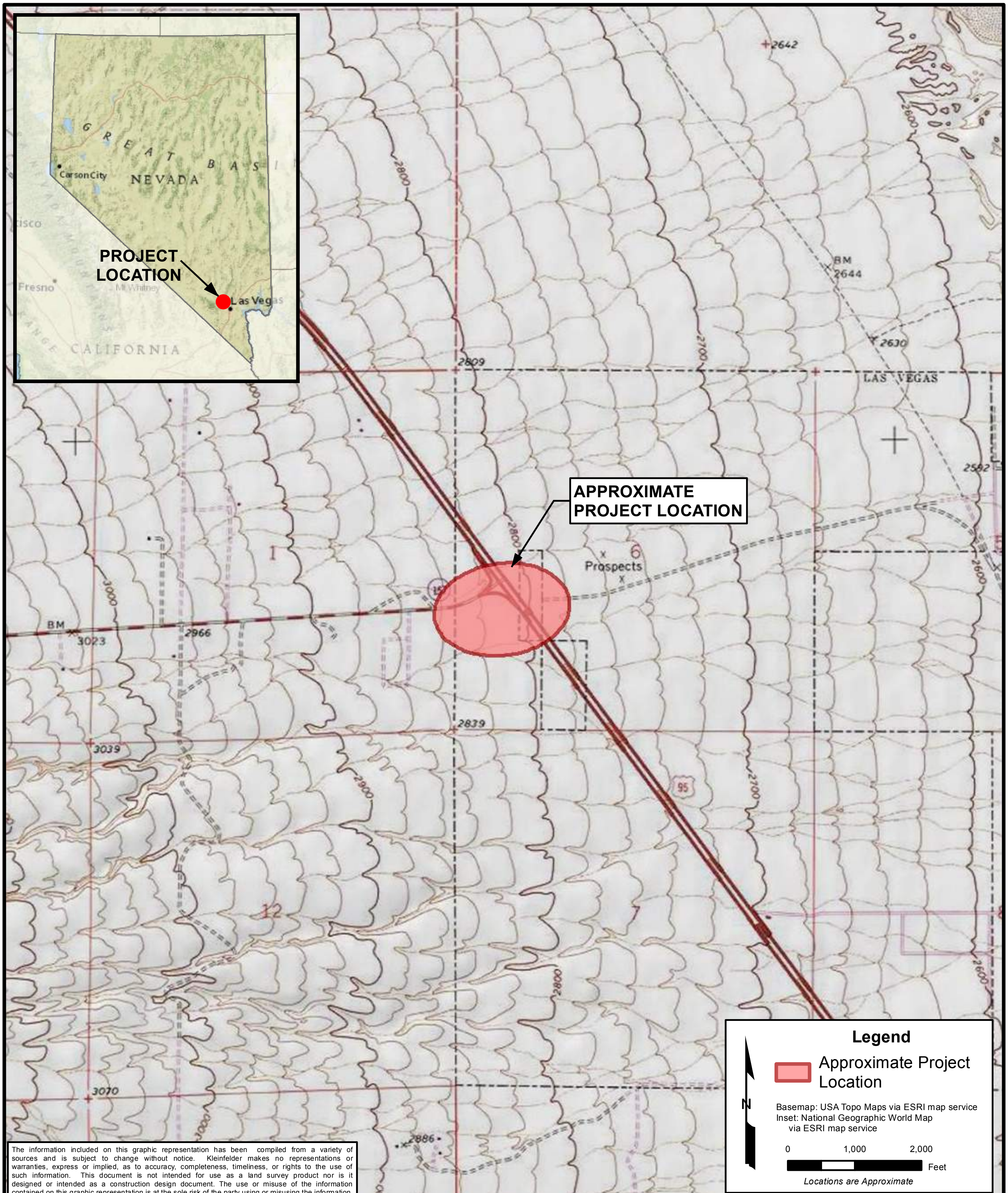
Bell, J.W., Ramelli, A.R., and Caskey, S.J., 1998, Geologic Map of the Tule Springs Park Quadrangle, Nevada: Nevada Bureau of Mines and Geology, Map 113, scale 1:24,000

dePolo, C. M., and Bell, John W., Map of Faults and Earth Fissures in the Las Vegas Area, 2000, Nevada Bureau of Mines and Geology, in Bell, John, Ramelli, Alan, and Craig M. dePolo, 2001, Las Vegas Valley 1998 Subsidence Report, Nevada Bureau of Mines and Geology NBMG Open-File Report 01-4, Plate 1, 1:62,500.

Unites States Geological Survey and Nevada Bureau of Mines and Geology, 2006, Quaternary fault and fold database for the United States, accessed December 7, 2105, from USGS web site: http//earthquake.usgs.gov/hazards/qfaults/

FIGURES

Figures 1 - 9



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PROJECT NO.	20162633
DRAWN:	DEC 2015
DRAWN BY:	K.Hagan
CHECKED BY:	D.Salter
FILE NAME:	Figure1.mxd

GENERAL SITE VICINITY MAP

Kyle Canyon / US95 Interchange
Las Vegas, Clark County, Nevada

FIGURE

1

N

0 100 200

Feet

Locations are Approximate

Legend

⊕ Approximate Boring Location

Aerial imagery: USDA NAIP 2013 via ESRI map service

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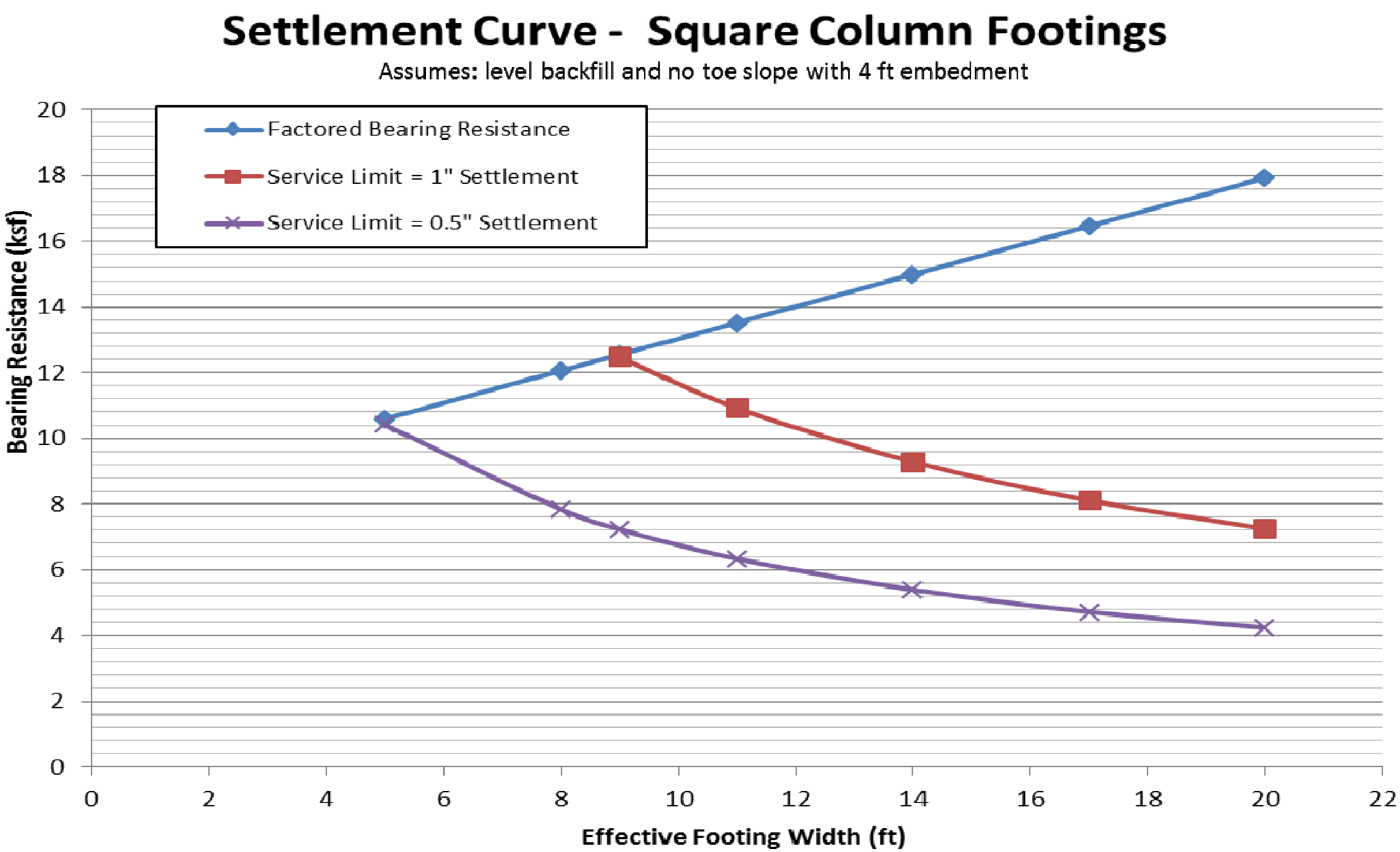
PROJECT NO.: 20162633
DRAWN: DEC 2015
DRAWN BY: K.Hagan
CHECKED BY: D.Salter
FILE NAME: Figure2.mxd

BORING LOCATION MAP

Kyle Canyon / US95 Interchange
Las Vegas, Clark County, Nevada

FIGURE

2



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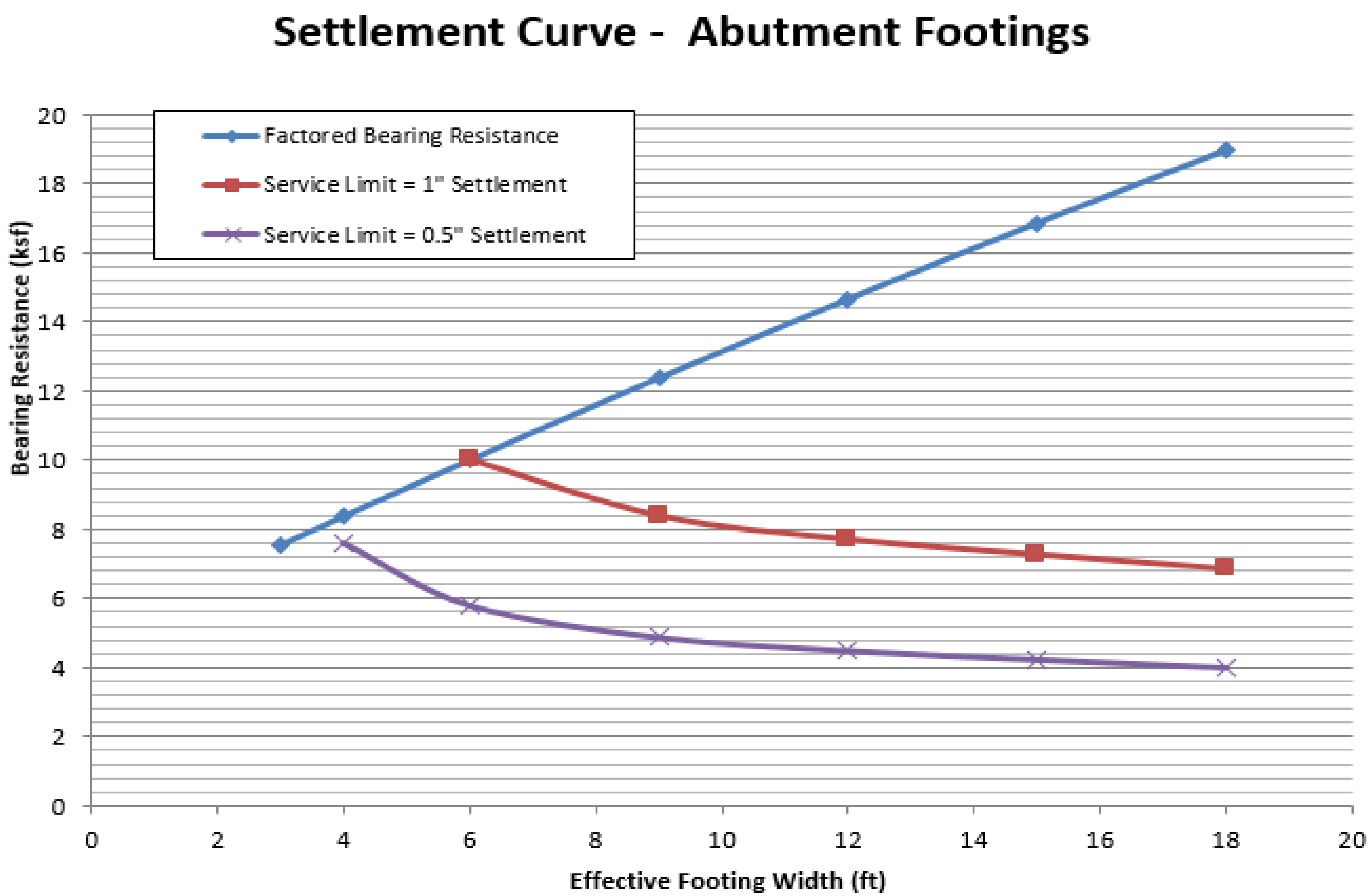
PROJECT NO.	20162633
DRAWN:	12/4/2015
DRAWN BY:	JAF
CHECKED BY:	
FILE NAME:	

Settlement Curve for Square Column Footings

Geotechnical Exploration Report
Kyle Canyon / US-95 Interchange
Clark County, Nevada

FIGURE

3



Assumes: level backfill and no toe slope with 4 ft embedment

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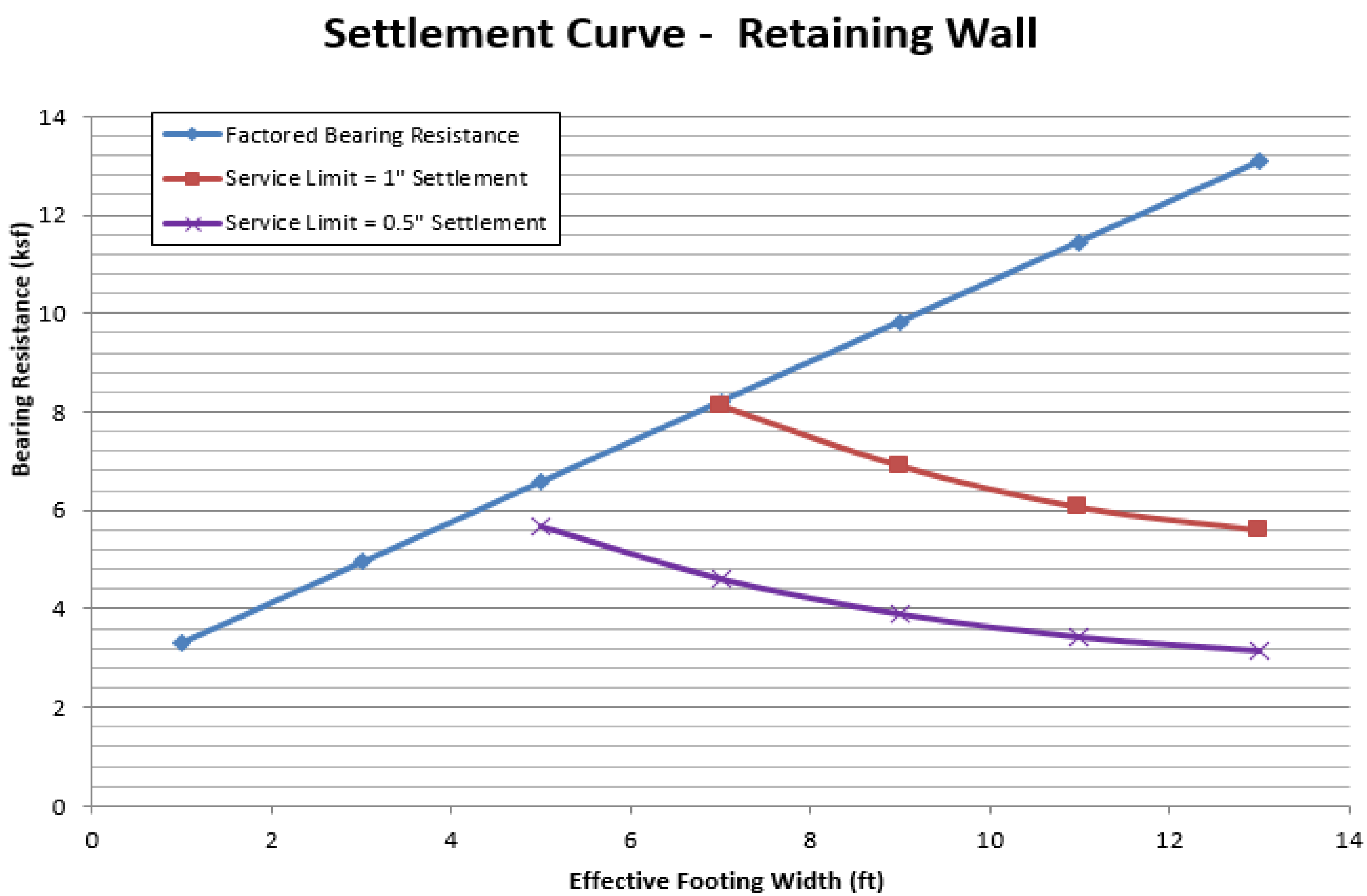
PROJECT NO.	20162633
DRAWN:	12/4/2015
DRAWN BY:	JAF
CHECKED BY:	
FILE NAME:	

Settlement Curve for Abutment Footings

Geotechnical Exploration Report
Kyle Canyon / US-95 Interchange
Clark County, Nevada

FIGURE

4



Assumes: level backfill and no toe slope with 2 ft embedment

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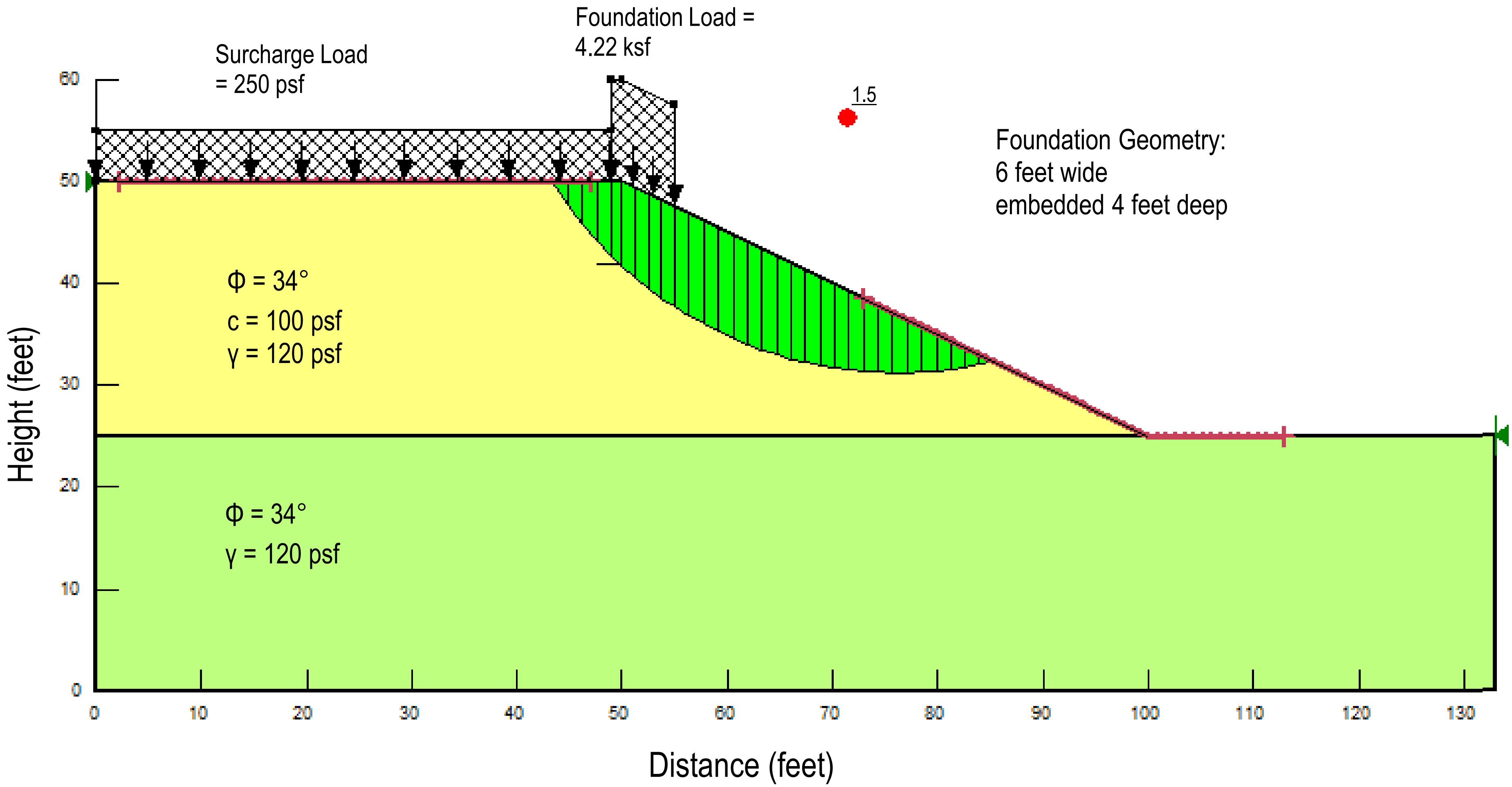
PROJECT NO.	20162633
DRAWN:	5/23/2016
DRAWN BY:	JAF
CHECKED BY:	
FILE NAME:	

Settlement Curve for Retaining Wall Footings

Geotechnical Exploration Report
Kyle Canyon / US-95 Interchange
Clark County, Nevada

FIGURE

5



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PROJECT NO.	20162633
DRAWN:	12/4/2015
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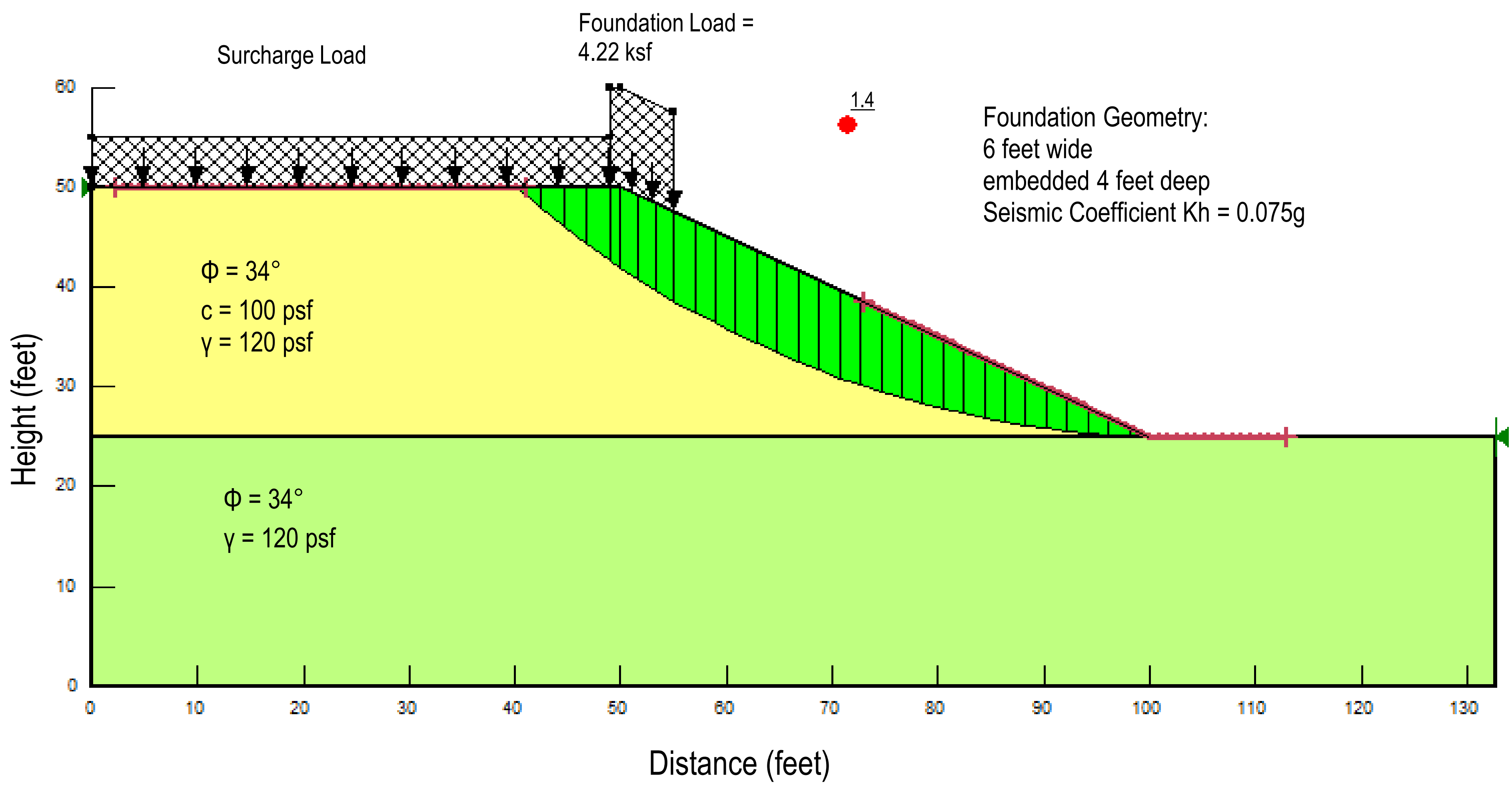
FILE NAME:	

Embankment Overall Stability
Long Term

Geotechnical Exploration Report
Kyle Canyon / US-95 Interchange
Clark County, Nevada

FIGURE

6



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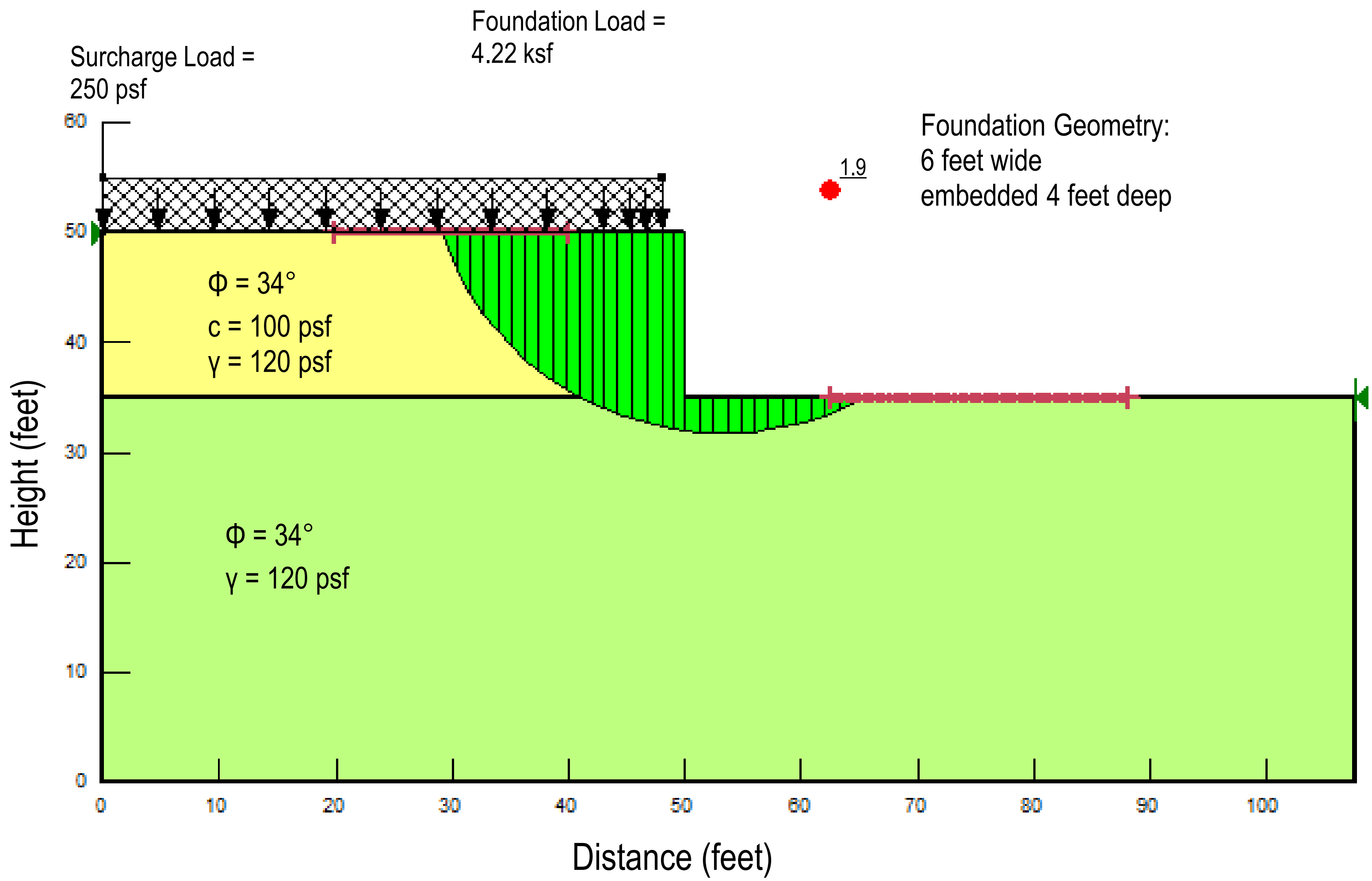
PROJECT NO.	20162633
DRAWN:	12/4/2015
DRAWN BY:	JAF
CHECKED BY:	
FILE NAME:	

Embankment Overall Stability Seismic

Geotechnical Exploration

FIGURE

7



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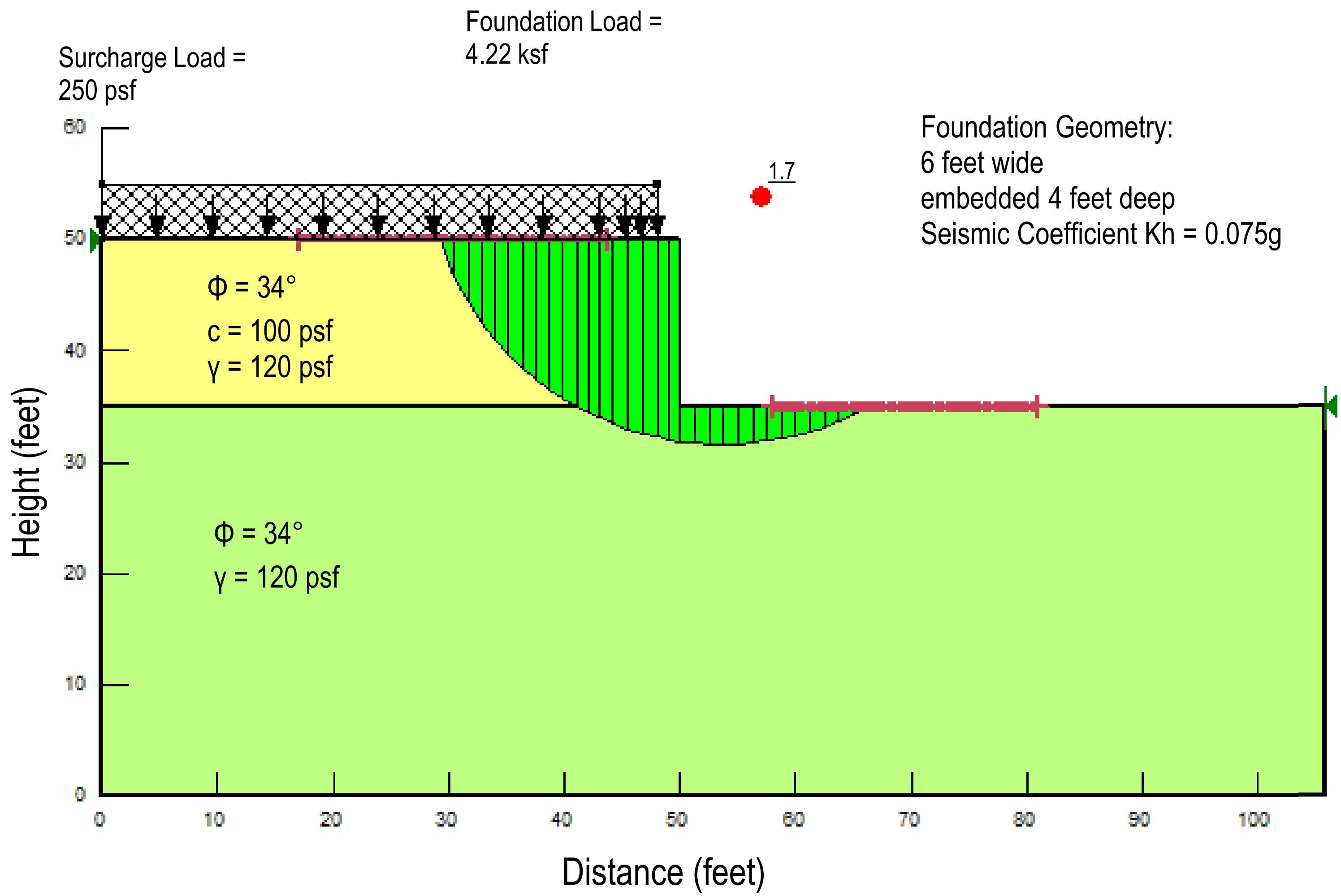
PROJECT NO.	20162633
DRAWN:	12/4/2015
DRAWN BY:	JAF
CHECKED BY:	
FILE NAME:	

Retaining Wall Overall Stability Long Term

Geotechnical Exploration Report
Kyle Canyon / US-95 Interchange
Clark County, Nevada

FIGURE

8



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FILE NAME:	

Retaining Wall Overall Stability
Seismic

Geotechnical Exploration Report
Kyle Canyon / US-95 Interchange
Clark County, Nevada

FIGURE
9

APPENDIX A

Boring Logs

SAMPLE/SAMPLER TYPE GRAPHICS

- BULK SAMPLE
- 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, ie., 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 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥4 and 1≤ Cc≤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 ≥4 and 1≤ Cc≤3	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				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
				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
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥6 and 1≤ Cc≤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 ≥6 and 1≤ Cc≤3	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				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
				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

FINE GRAINED SOILS (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

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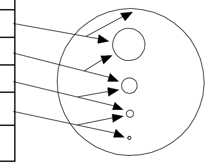
PROJECT NO.: 20162633	GRAPHICS KEY	PLATE	
DRAWN BY: CLW			
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	A-1a	
DATE: 11/18/2015			
REVISED: -			

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	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 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

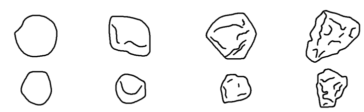


Munsell Color

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_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	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

NOTE: AFTER TERZAGHI AND PECK, 1948

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (q_u)(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

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

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PROJECT NO.:	20162633	SOIL DESCRIPTION KEY	PLATE
DRAWN BY:	CLW		
CHECKED BY:	DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	A-1b
DATE:	11/18/2015		
REVISED:	-		

Date Begin - End:	11/02/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-1**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION

Latitude: 36.32666° N
Longitude: 115.31519° W
Approximate Ground Surface Elevation (ft.): 2,831.00
Surface Condition: minimal vegetation

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2830			**Silty Clayey GRAVEL with Sand (GC-GM)**: fine-grained, some coarse gravel, tan, light brown to gray, slightly moist, very dense, weakly cemented				GC-GM	1.9		38	17	22	5	Rig chatter
2825	5		- moderately cemented, very dense below 5 feet		BC=17 50/5"	6"								
														Reduced rig chatter below 6.5 feet
2820	10		- moist below 10 feet		BC=50/2"	2"								
2815	15													
2810	20													
2805	25													
2800	30													

The boring was terminated at approximately 10 ft. below ground surface. The boring was backfilled with auger cuttings on November 02, 2015.

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.: 20162633	BORING LOG B-1	PLATE
DRAWN BY: CLW		A-2
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	
DATE: 11/18/2015		
REVISED: -		PAGE: 1 of 1

Date Begin - End:	11/03/2015	**Drilling Company:**	Eagle Drilling
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.

BORING LOG B-2

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION — Latitude: 36.32592° N; Longitude: 115.31474° W; Approximate Ground Surface Elevation (ft.): 2,798.00; Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
			Silty Clayey GRAVEL with Sand (GC-GM): fine-grained, some coarse gravel, tan, light brown to gray, slightly moist, weakly cemented											Some chatter below 1 foot
2795														Increased chatter below 3.5 feet
			Clayey SAND with Gravel (SC): fine-grained sand, fine to coarse-grained gravel, light tan to white, dry, very dense, weakly cemented											
	5				BC=50/3"	3"								
2790														
	10		- white below 10 feet		BC=50/6"	5"	SC	1.1		65	20	23	8	
2785														
	15		- decreased angular gravel, evidence of cementation		BC=50/2"									
2780			**Silty Clayey GRAVEL with Sand (GC-GM)**: fine-grained, some coarse gravel, tan, light brown to gray, slightly moist, very dense, weakly cemented											
	20		- increased gravel, evidence of moderate cementation below 20 feet		BC=50/2"									
2775														
	25		- tan and white, increased coarse-grained sand below 25 feet		BC=50/3"	3"								
2770														
	30		- interlayered zones of gravel and silty sand below 30 feet		BC=50/4"	4"								
2765														

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PROJECT NO.: 20162633	BORING LOG B-2	PLATE	
DRAWN BY: CLW			
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	A-3	
DATE: 11/18/2015			
REVISED: -		PAGE: 1 of 2	

Date Begin - End:	11/03/2015	Drilling Company:	Eagle Drilling		BORING LOG B-2
Logged By:	J. Flannery	Drill Crew:	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Diedrich D-120	Hammer Type - Drop:	140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hollow Stem Auger		
Weather:	Clear, sunny	Exploration Diameter:	8.5 in. O.D.		

FIELD EXPLORATION

Latitude: 36.32592° N
Longitude: 115.31474° W
Approximate Ground Surface Elevation (ft.): 2,798.00
Surface Condition: vegetation

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
			Clayey SAND with Gravel (SC): fine-grained sand, fine to coarse-grained gravel, light tan to white, moist, very dense, weakly cemented		BC=50/2"	2"								
2760														
	40		- increase coarse-grained sand, decreased gravel below 40 feet		BC=50/2"	1"								
2755			The boring was terminated at approximately 40 ft. below ground surface. The boring was backfilled with auger cuttings on November 03, 2015.											
	45													
2750														
	50													
2745														
	55													
2740														
	60													
2735														
	65													
2730														

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20162633	BORING LOG B-2	PLATE
	DRAWN BY: CLW		
	CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	A-4
	DATE: 11/18/2015		
	REVISED: -		PAGE: 2 of 2

BORING LOG B-3

Date Begin - End:	11/03/2015	**Drilling Company:**	Eagle Drilling
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 36.32593° N
Longitude: 115.31306° W
Approximate Ground Surface Elevation (ft.): 2,802.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2800	0	**Silty GRAVEL with Sand (GM)**: fine-grained sand, fine to coarse-grained gravel, light tan, dry, dense, no to weak cementation				GM	0.7		43	25	NP	NP	R-Value = 78 Sol = 0.19% SO_4 = <0.01% Chatter below 1 foot
2795	5	- slightly moist, dense to very dense, evidence of weak cementation, less gravel below 5 feet		BC=26 44 29	12"								Grinding below 8 feet
	10	- increased sand, decreased gravel below 10 feet		BC=50/3"									

The boring was terminated at approximately 10.5 ft. below ground surface. The boring was backfilled with auger cuttings on November 03, 2015.

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20162633 DRAWN BY: CLW CHECKED BY: DJS DATE: 11/18/2015 REVISED: -	BORING LOG B-3 Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	PLATE A-5 PAGE: 1 of 1

Date Begin - End:	11/03/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-4**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 36.32788° N
Longitude: 115.31284° W
Approximate Ground Surface Elevation (ft.): 2,795.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
			Silty SAND with Gravel (SM): fine-grained sand, fine to coarse-grained gravel, light tan, slightly moist, dense, no cementation											Chatter below 4 feet
2790	5		**Poorly graded SAND with Silt and Gravel (SP-SM)**: fine-grained sand, fine to coarse-grained gravel, light tan, slightly moist, very dense, no cementation		BC=30 41 50/2"	12"								
2785	10		- light tan to white, very dense, less gravel below 10 feet		BC=50/5"	5"								
2780	15		- white, evidence of weak cementation below 15 feet		BC=50/2"	2"								Chatter and grinding below 16.5 feet
2775	20				BC=50/4"									
2770	25													
2765	30													

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on November 03, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.: 20162633	BORING LOG B-4	PLATE
DRAWN BY: CLW		
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	A-6
DATE: 11/18/2015		
REVISED: -		PAGE: 1 of 1

Date Begin - End:	11/02/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-5**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION

Latitude: 36.32623° N
Longitude: 115.31194° W
Approximate Ground Surface Elevation (ft.): 2,793.00
Surface Condition: vegetation

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2790			**Silty SAND with Gravel (SM)**: fine-grained sand, fine to coarse-grained gravel, tan to white, moist, dense, no cementation											Mostly smooth drilling, some chatter below 1.5 feet
2785	5		**Poorly graded GRAVEL with Sand (GP-GM)**: fine-grained gravel, tan to white, moist, dense, several large gravel pieces (possible cobbles)		BC=16 43 43	10"								
2780	10		**Poorly graded SAND with Gravel (SP-SM)**: fine-grained gravel, tan to white, moist, very dense, some silty sand, reduced gravel size		BC=32 50/3"	6"								Slower drilling below 12 feet
	15		- white below 15 feet		BC=50/2"	2"								
2775			**Silty Clayey GRAVEL with Sand (GC-GM)**: fine-grained, some coarse gravel, tan, light brown to gray, slightly moist, very dense, weakly cemented											Smooth drilling below 16.5 feet
2770	20		- fine-grained gravel, coarse grained sand below 20 feet		BC=50/2"	2"								Abundant chattering below 23 feet
2765	25				BC=50/1"	1"								
2760	30		**Silty SAND with Gravel (SM)**: fine to coarse-grained sand, fine-grained gravel, white to tan, moist, very dense		BC=50/2"	2"								Grinding below 30 feet Reduced grinding below 31.5 feet

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PROJECT NO.: 20162633	BORING LOG B-5	PLATE
DRAWN BY: CLW		A-7
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	
DATE: 11/18/2015		
REVISED: -		PAGE: 1 of 2

Date Begin - End:	11/02/2015	**Drilling Company:**	Eagle Drilling			**BORING LOG B-5**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy			
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.	
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger			
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.			

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 36.32623° N
Longitude: 115.31194° W
Approximate Ground Surface Elevation (ft.): 2,793.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
			Silty SAND with Gravel (SM): fine to coarse-grained sand, fine-grained gravel, white to tan, moist, very dense - increased fine-grained gravel, increased moisture below 35 feet		BC=50/2"	2"								Chatter and grinding below 36 feet
2755														
	40				BC=50/1"	NR								
2750														
	45		- tan, increased moisture, weak cementation below 45 feet		BC=50/3"	2"								
2745														Slow drilling below 47 feet
	50				BC=50/2"	1"								Smooth drilling below 50 feet
2740			**Silty Clayey GRAVEL with Sand (GC-GM)**: fine-grained, some coarse gravel, tan, light brown to gray, slightly moist, very dense, weakly cemented											
	55		- increased gravel, evidence of weak cementation below 55 feet		BC=50/3"	1"								
2735														
	60		- increased coarse-grained sand, increased fine-grained gravel, evidence of weak cementation below 60 feet		BC=50/3"	1"								
2730			The boring was terminated at approximately 60.5 ft. below ground surface. The boring was backfilled with auger cuttings on November 02, 2015.											
	65													
2725														

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20162633	BORING LOG B-5	PLATE	
	DRAWN BY: CLW		A-8	
	CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada		
	DATE: 11/18/2015			
	REVISED: -		PAGE: 2 of 2	

Date Begin - End: 10/30/2015	**Drilling Company:** Eagle Drilling		**BORING LOG B-6**
Logged By: J. Flannery	**Drill Crew:** Tom, Timothy		
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** Diedrich D-120	**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Hollow Stem Auger		
Weather: Clear, windy	**Exploration Diameter:** 8.5 in. O.D.		

Latitude: 36.32670° N
Longitude: 115.31114° W
Approximate Ground Surface Elevation (ft.): 2,794.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description (FIELD EXPLORATION)	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol (LABORATORY RESULTS)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	0		**Silty SAND with Gravel (SM)**: fine-grained sand, fine to coarse-grained gravel, tan to white, dry, dense, weak cementation											
2790														
	5		**Poorly graded GRAVEL with Sand (GP-GM)**: fine-grained sand and gravel, white, slightly moist, dense to very dense		BC=33 39 50	13"								Mostly smooth drilling below 5 feet
2785														
	10				BC=50/3"	3"								
2780														
	15		- less gravel, evidence of weak cementation below 15 feet		BC=50/5"	4"								Grinding below 16 feet
2775														
	20		**Silty SAND with Gravel (SM)**: fine-grained sand and gravel, white, slightly moist, very dense		BC=50/2"	2"								
2770														Slow drilling and grinding below 23 feet
	25				BC=50/2"	2"								
2765														
	30		**Poorly graded GRAVEL with Clay and Sand (GP-GC)**: fine-grained sand, fine to coarse-grained gravel, white, dry, very dense, weak cementation		BC=38 50/5"	8"								
2760														

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20162633	BORING LOG B-6	PLATE
	DRAWN BY: CLW		A-9
	CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	
	DATE: 11/18/2015		
	REVISED: -		PAGE: 1 of 2

Date Begin - End:	10/30/2015	Drilling Company:	Eagle Drilling	BORING LOG B-6
Logged By:	J. Flannery	Drill Crew:	Tom, Timothy	
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Diedrich D-120	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hollow Stem Auger	
Weather:	Clear, windy	Exploration Diameter:	8.5 in. O.D.	

FIELD EXPLORATION — Latitude: 36.32670° N; Longitude: 115.31114° W; Approximate Ground Surface Elevation (ft.): 2,794.00; Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
		Poorly graded GRAVEL with Clay and Sand (GP-GC): fine-grained sand, fine to coarse-grained gravel, white, dry, very dense, weak cementation - medium to coarse-grained gravel, white to tan, slightly moist, evidence of weak cementation below 35 feet		BC=16 39 26	10"	GP-GC	1.6		49	11	22	6	
2755	40	- fine-grained gravel, increased tan, less white, moist below 40 feet		BC=50/4"	4"								Chirping/scraping, very slow drilling below 40 feet

Depth scale: 40, 45, 50, 55, 60, 65 (feet); Elevation scale: 2755, 2750, 2745, 2740, 2735, 2730, 2725 (feet)

The boring was terminated because of practical auger refusal (↑) at approximately 42 ft. below ground surface. The boring was backfilled with auger cuttings on October 30, 2015.

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.:	20162633
DRAWN BY:	CLW
CHECKED BY:	DJS
DATE:	11/18/2015
REVISED:	-

BORING LOG B-6

Kyle Canyon / US95 Interchange
Las Vegas, Clark County, Nevada

PLATE A-10

Date Begin - End:	11/06/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-7**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, windy	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 36.32623° N
Longitude: 115.31113° W
Approximate Ground Surface Elevation (ft.): 2,671.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2670			**Poorly graded GRAVEL with Silty Sand (GP-GM)**: fine-grained sand, fine to coarse-grained gravel, light tan to white, slightly moist, very dense, no cementation											Smooth drilling below 1 foot
														Chatter below 4 feet
2665	5		- very dense, less gravel, some rock pieces below 5 feet		BC=50/5"	5"								
														Decreased chatter below 7 feet
2660	10		- medium to coarse grained gravel, no rock pieces below 10 feet		BC=22 50/2"	4"								
2655	15		- evidence of weak cementation below 15 feet		BC=50/5"	4"								
														Some chatter below 16.5 feet
														Decreased chatter below 19 feet
2650	20				BC=50/2"	NR								Increased chatter below 20 feet
														Decreased chatter below 25 feet
2645	25		- increased cementation below 25 feet		BC=22 50/1"	4"								
2640	30		- fine to coarse-grained sand below 30 feet		BC=50/5"	4"								

Date Begin - End:	11/06/2015	Drilling Company:	Eagle Drilling	**BORING LOG B-7**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy	
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger	
Weather:	Clear, windy	**Exploration Diameter:**	8.5 in. O.D.	

FIELD EXPLORATION — Latitude: 36.32623° N; Longitude: 115.31113° W; Approximate Ground Surface Elevation (ft.): 2,671.00; Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2635			**Silty Clayey GRAVEL with Sand (GC-GM)**: fine-grained, some coarse gravel, tan, light brown to gray, slightly moist, very dense, weakly cemented		BC=50/2"	2"								
2630	40		- increased gravel below 40 feet		BC=50/4"	2"								
2625	45		- increased gravel, less evidence of cementation below 45 feet		BC=15 50/3"	4"								
2620	50		- some rock pieces, possible boulder below 50 feet		BC=50/5"	5"								Some chatter below 51 feet
2615	55		**Clayey SAND with Gravel (SC)**: fine-grained sand, some fine to coarse-grained gravel, light tan with white, moist, very dense, evidence of weak cementation											
2610	60		- increased evidence of weak cementation below 60 feet		BC=50/5"	4"	SC	2.7		63	24	29	14	Decreased chatter below 62 feet
2605	65													

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20162633	BORING LOG B-7	PLATE
	DRAWN BY: CLW		A-12
	CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	
	DATE: 11/18/2015		
	REVISED: -		PAGE: 2 of 3

Date Begin - End:	11/06/2015	Drilling Company:	Eagle Drilling	BORING LOG B-7
Logged By:	J. Flannery	Drill Crew:	Tom, Timothy	
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Diedrich D-120	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hollow Stem Auger	
Weather:	Clear, windy	Exploration Diameter:	8.5 in. O.D.	

FIELD EXPLORATION: Latitude: 36.32623° N; Longitude: 115.31113° W; Approximate Ground Surface Elevation (ft.): 2,671.00; Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2600		**Clayey SAND with Gravel (SC)**: fine-grained sand, some fine to coarse-grained gravel, light tan with white, moist, very dense, evidence of weak cementation - some coarse-grained sand, reduced gravel size below 70 feet	BC=50/5"									
2595	75											
2590	80	- less gravel, less coarse-grained sand below 80 feet	BC=50/3"	2"								
2585	85											
2580	90	- moist, weak cementation below 90 feet	BC=50/5"	5"								
												Slower drilling below 93 feet
2575	95											
2570	100		BC=50/5"	3"								

The boring was terminated at approximately 100.5 ft. below ground surface. The boring was backfilled with auger cuttings on November 06, 2015.

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.:	20162633	BORING LOG B-7	PLATE
DRAWN BY:	CLW		
CHECKED BY:	DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	A-13
DATE:	11/18/2015		
REVISED:	-		PAGE: 3 of 3

Date Begin - End:	11/02/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-8**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 36.32879° N
Longitude: 115.31146° W
Approximate Ground Surface Elevation (ft.): 2,774.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
	0		**Silty SAND with Gravel (SM)**: fine-grained sand, fine to coarse-grained gravel, light tan to white, dry, very dense, no cementation											
	2													Fairly smooth drilling below 2 feet
2770	5		- fine-grained gravel, less light tan, more white, slightly moist, some evidence of weak cementation below 5 feet		BC=50/2"	1"								
2765	8.5													Some grinding below 8.5 feet
	10		- some large gravel that appear to be part of a larger rock, powdery below 10 feet		BC=50/5"	2"								
	11													Louder grinding below 11 feet
2760	14													Reduced grinding below 14 feet
	15		- decreased gravel, some cementation below 15 feet		BC=50/2"	2"								
	17													Chatter below 17 feet
2755	20		- decreased gravel, no cementation below 20 feet		BC=50/1"	1"								
2750	23.5													Slower drilling below 23.5 feet
	25		- some coarse-grained sand, some evidence of weak cementation		BC=50/2"	2"								
	26													Chatter between 26 and 27 feet
2745	30				BC=50/2"	2"								Chatter below 30 feet
2740	33													Slower drilling, chatter below 33 feet

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PROJECT NO.: 20162633	BORING LOG B-8		PLATE
DRAWN BY: CLW			A-14
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada		
DATE: 11/18/2015			
REVISED: -			PAGE: 1 of 2

Date Begin - End:	11/02/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-8**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION — Latitude: 36.32879° N; Longitude: 115.31146° W; Approximate Ground Surface Elevation (ft.): 2,774.00; Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2735	40		**Poorly graded GRAVEL with Silt and Sand (GP-GM)**: fine-grained sand and gravel, white with tan, slightly moist, evidence of weak to moderate cementation		BC=50/2"	2"								Decreased chatter below 37 feet
2730	45													
2725	50													
2720	55													
2715	60													
2710	65													
2705														

The boring was terminated at approximately 40 ft. below ground surface. The boring was backfilled with auger cuttings on November 02, 2015.

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20162633	BORING LOG B-8	PLATE
	DRAWN BY: CLW		A-15
	CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	
	DATE: 11/18/2015		
	REVISED: -		PAGE: 2 of 2

Date Begin - End:	10/29/2015	Drilling Company:	Eagle Drilling		BORING LOG B-9
Logged By:	J. Flannery	Drill Crew:	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	Diedrich D-120	Hammer Type - Drop:	140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hollow Stem Auger		
Weather:	Clear, windy	Exploration Diameter:	8.5 in. O.D.		

Latitude: 36.32617° N
Longitude: 115.31071° W
Approximate Ground Surface Elevation (ft.): 2,785.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
		Poorly graded GRAVEL with Silty Sand (GP-GM): fine-grained sand, coarse-grained gravel, tan, dry, very dense, no cementation											
		- light tan to white, dense below 3 feet		BC=29 47 49	12"								
2780	5												Smooth drilling, some chatter below 5 feet
		- white, weakly cemented below 7 feet		BC=50/3"	3"								
2775	10	**Poorly graded SAND with Silt and Gravel (SP-SM)**: fine-grained sand, coarse-grained gravel, light chalky white, slightly moist, very dense		BC=50/5"	5"								
2770	15	**Poorly graded GRAVEL with Silt and Sand (GP-GM)**: fine-grained sand, coarse-grained gravel, tan, dry, very dense, no cementation		BC=50/3"	3"								
2765	20	- increased gravel below 20 feet		BC=50/2"	2"								Increased chatter below 21 feet
2760	25	- some cementation on the gravel below 25 feet		BC=50/2"	2"								Reduced chatter below 27 feet
2755	30	**Poorly graded SAND with Silt and Gravel (SP-SM)**: fine-grained sand, coarse-grained gravel, light chalky white, slightly moist, very dense, some cementation on gravel		BC=50/3"	3"								

Date Begin - End:	10/29/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-9**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, windy	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION

Latitude: 36.32617° N
Longitude: 115.31071° W
Approximate Ground Surface Elevation (ft.): 2,785.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	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
		Poorly graded GRAVEL with Silty Sand (GP-GM): fine-grained sand, coarse-grained gravel, light chalky white, slightly moist, very dense, evidence of weak cementation	BC=50/2"	2"								
2745	40		BC=50/3"	2"								
												Increased chatter below 42.5 feet
2740	45	**Silty SAND with Gravel (SM)**: fine-grained sand, coarse-grained gravel, light chalky white, slightly moist, very dense, evidence of weak cementation	BC=50/2"	2"								
												Decreased chatter below 47 feet
												Slower drilling below 49 feet
2735	50	**Silty, Clayey GRAVEL with Sand (GC-GM)**: fine-grained sand, fine to coarse-grained gravel, light tan to white, slightly moist, very dense, evidence of weak cementation	BC=42 50/4"	7"	GC-GM	1.8		56	20	20	6	
2730	55		BC=50/2"	2"								
2725	60		BC=50/3"	3"								
2720	65											

The boring was terminated at approximately 60.5 ft. below ground surface. The boring was backfilled with auger cuttings on October 29, 2015.

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

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

Date Begin - End:	11/03/2015	**Drilling Company:**	Eagle Drilling		**BORING LOG B-10**
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Clear, sunny	**Exploration Diameter:**	8.5 in. O.D.		

FIELD EXPLORATION

Latitude: 36.32549° N
Longitude: 115.31063° W
Approximate Ground Surface Elevation (ft.): 2,777.00
Surface Condition: no vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2775			**Silty SAND with Gravel (SM)**: fine-grained sand, fine to coarse-grained gravel, white, dry, dense, no cementation											Chatter below 1 foot; Decreased chatter below 4 feet
2770	5		**Poorly graded SAND with Silt and Gravel (SP-SM)**: fine to coarse-grained sand and gravel, white, slightly moist, very dense, no cementation		BC=50/3"	3"								
2765	10		**Poorly graded GRAVEL with Silt and Sand (GP-GM)**: fine to coarse-grained sand and gravel, light tan to white, slightly moist, very dense, no cementation		BC=50/4"	4"								
2760	15				BC=50/2"	2"								Chatter below 17 feet
2755	20				BC=50/3"	3"								
2750	25													
2745	30													

LABORATORY RESULTS

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on November 03, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.: 20162633	BORING LOG B-10	PLATE
DRAWN BY: CLW		A-18
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	
DATE: 11/18/2015		
REVISED: -		PAGE: 1 of 1

BORING LOG B-11

Date Begin - End:	10/29/2015	**Drilling Company:**	Eagle Drilling
Logged By:	J. Flannery	**Drill Crew:**	Tom, Timothy, Daruis
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Partly Cloudy, windy	**Exploration Diameter:**	8.5 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 36.32616° N
Longitude: 115.31073° W
Approximate Ground Surface Elevation (ft.): 2,749.00
Surface Condition: vegetation

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	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
2745	0–5		**Silty GRAVEL with Sand (GM)**: fine to coarse-grained sand and gravel, tan to white, slightly moist, very dense, weak cementation				GM	1.4		41	22	NP	NP	R-Value = 73 Sol = 0.19% SO_4 = <0.01% Chatter and grinding below 1 foot
2740	5–10		**Poorly graded GRAVEL with Silt and Sand (GP-GM)**: fine to coarse-grained sand and gravel, white to light gray, slightly moist, very dense, weakly to moderately cemented		BC=35 50/5"									Decreased noise below 5 feet Chatter and grinding below 7 feet
	10				BC=50/3"									

Elevation scale: 2745, 2740, 2735, 2730, 2725, 2720, 2715. Depth scale: 5, 10, 15, 20, 25, 30.

The boring was terminated at approximately 10.5 ft. below ground surface. The boring was backfilled with auger cuttings on October 29, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

PROJECT NO.:	20162633
DRAWN BY:	CLW
CHECKED BY:	DJS
DATE:	11/18/2015
REVISED:	-

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BORING LOG B-11

Kyle Canyon / US95 Interchange
Las Vegas, Clark County, Nevada

PLATE A-19

KLEINFELDER - 6380 S Polaris Avenue | Las Vegas, NV 89118 | PH: 702.736.2936 | FAX: 702.361.9094 | www.kleinfelder.com

APPENDIX B

Laboratory Test Results

Exploration ID	Depth (ft.)	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	
B-1	0.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM)	1.9		88	38	17	22	17	5	
B-2	10.0	CLAYEY SAND WITH GRAVEL (SC)	1.1		96	65	20	23	15	8	
B-3	0.0 - 5.0	SILTY GRAVEL WITH SAND (GM)	0.7		75	43	25	NP	NP	NP	R-Value = 78
											Sol = 0.19%
											SO_4 = <0.01%
B-6	35.0	POORLY GRADED GRAVEL WITH SILTY CLAY AND SAND (GP-GC)	1.6		91	49	11	22	16	6	
B-7	60.0	CLAYEY SAND WITH GRAVEL (SC)	2.7		96	63	24	29	15	14	
B-9	50.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM)	1.8		88	56	20	20	14	6	
B-11	0.0 - 5.0	SILTY GRAVEL WITH SAND (GM)	1.4		83	41	22	NP	NP	NP	R-Value = 73
											Sol = 0.19%
											SO_4 = <0.01%

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

KLEINFELDER
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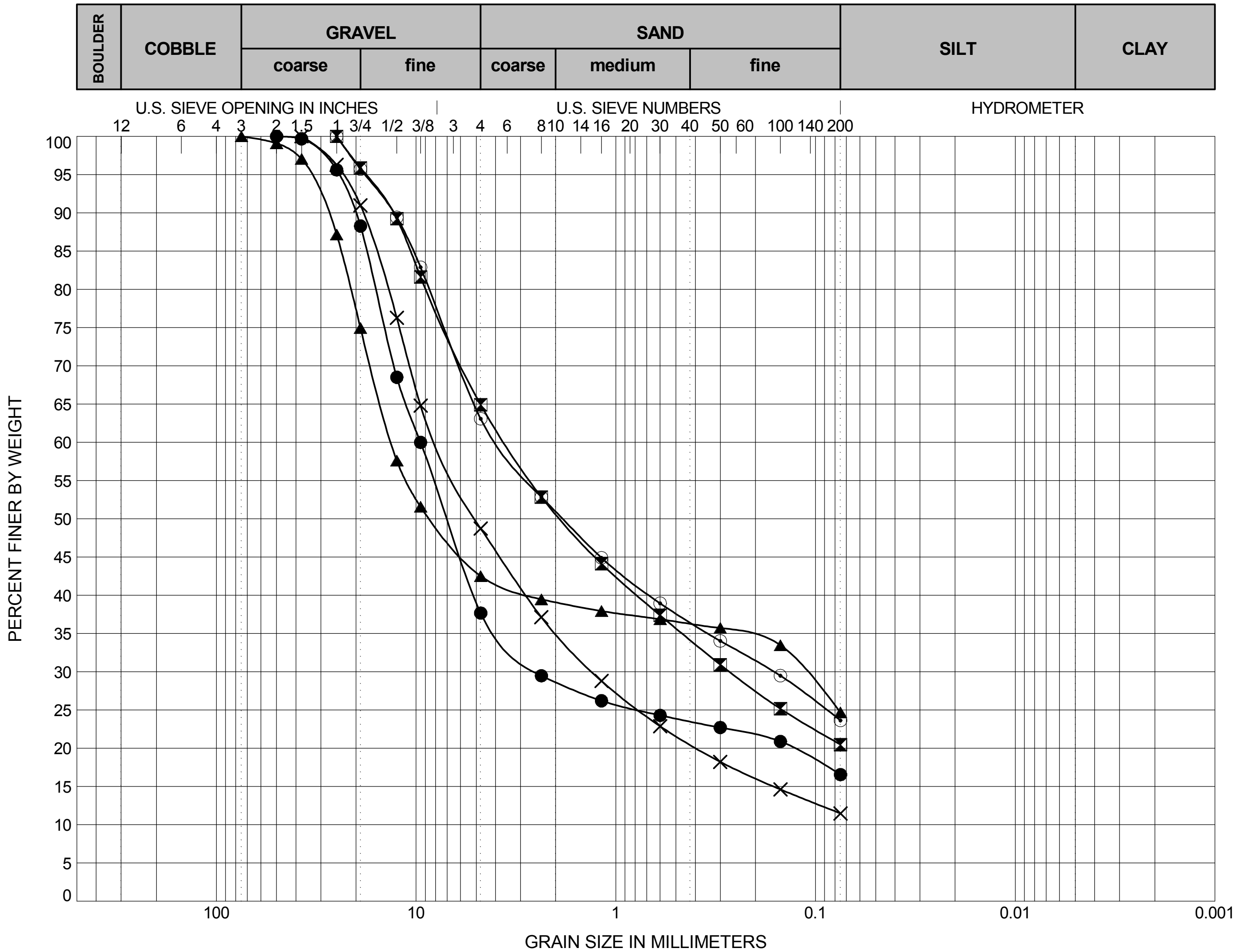
PROJECT NO.:	20162633
DRAWN BY:	CLW
CHECKED BY:	DJS
DATE:	11/18/2015
REVISED:	-

LABORATORY TEST RESULT SUMMARY

Kyle Canyon / US95 Interchange
Las Vegas, Clark County, Nevada

PLATE

B-1



	Exploration ID	Depth (ft.)	Sample Description	LL	PL	PI
●	B-1	0 - 5	SILTY, CLAYEY GRAVEL with SAND (GC-GM)	22	17	5
⧗	B-2	10	CLAYEY SAND with GRAVEL (SC)	23	15	8
▲	B-3	0 - 5	SILTY GRAVEL with SAND (GM)	NP	NP	NP
×	B-6	35	POORLY GRADED GRAVEL with SILTY CLAY and SAND (GP-GC)	22	16	6
⊙	B-7	60	CLAYEY SAND with GRAVEL (SC)	29	15	14

	Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	B-1	0 - 5	50	9.504	2.468	NM	NM	NM	88	38	17	NM	NM
⧗	B-2	10	25	3.573	0.268	NM	NM	NM	96	65	20	NM	NM
▲	B-3	0 - 5	75	13.245	0.114	NM	NM	NM	75	43	25	NM	NM
×	B-6	35	37.5	7.726	1.306	NM	4.08	142.88	91	49	11	NM	NM
⊙	B-7	60	25	3.849	0.162	NM	NM	NM	96	63	24	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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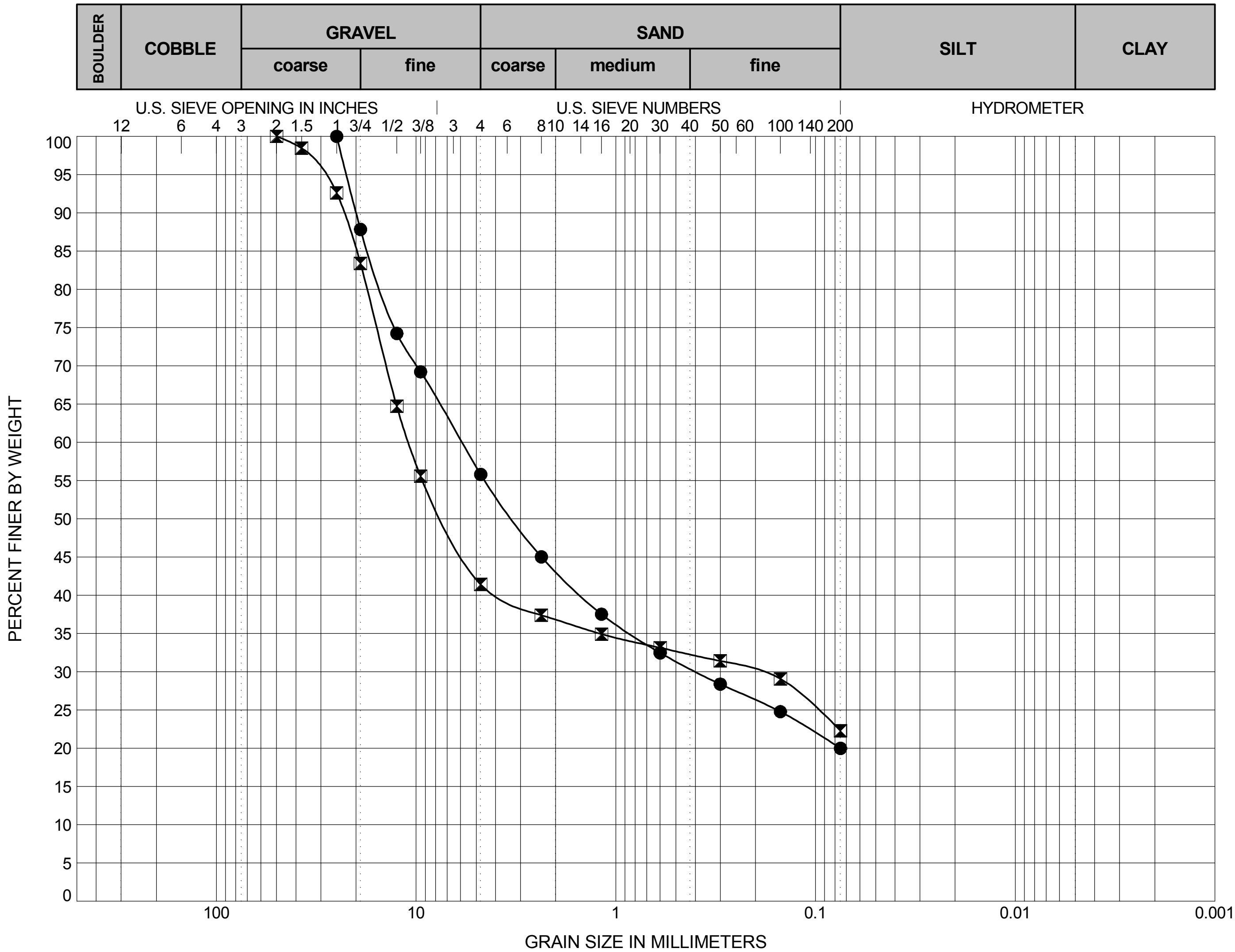
PROJECT NO.: 20162633	SIEVE ANALYSIS	PLATE
DRAWN BY: CLW		
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	B-2
DATE: 11/18/2015		
REVISED: -		



	Exploration ID	Depth (ft.)	Sample Description	LL	PL	PI
●	B-9	50	SILTY, CLAYEY GRAVEL with SAND (GC-GM)	20	14	6
⧗	B-11	0 - 5	SILTY GRAVEL with SAND (GM)	NP	NP	NP

	Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	B-9	50	25	5.902	0.395	NM	NM	NM	88	56	20	NM	NM
⧗	B-11	0 - 5	50	10.854	0.198	NM	NM	NM	83	41	22	NM	NM

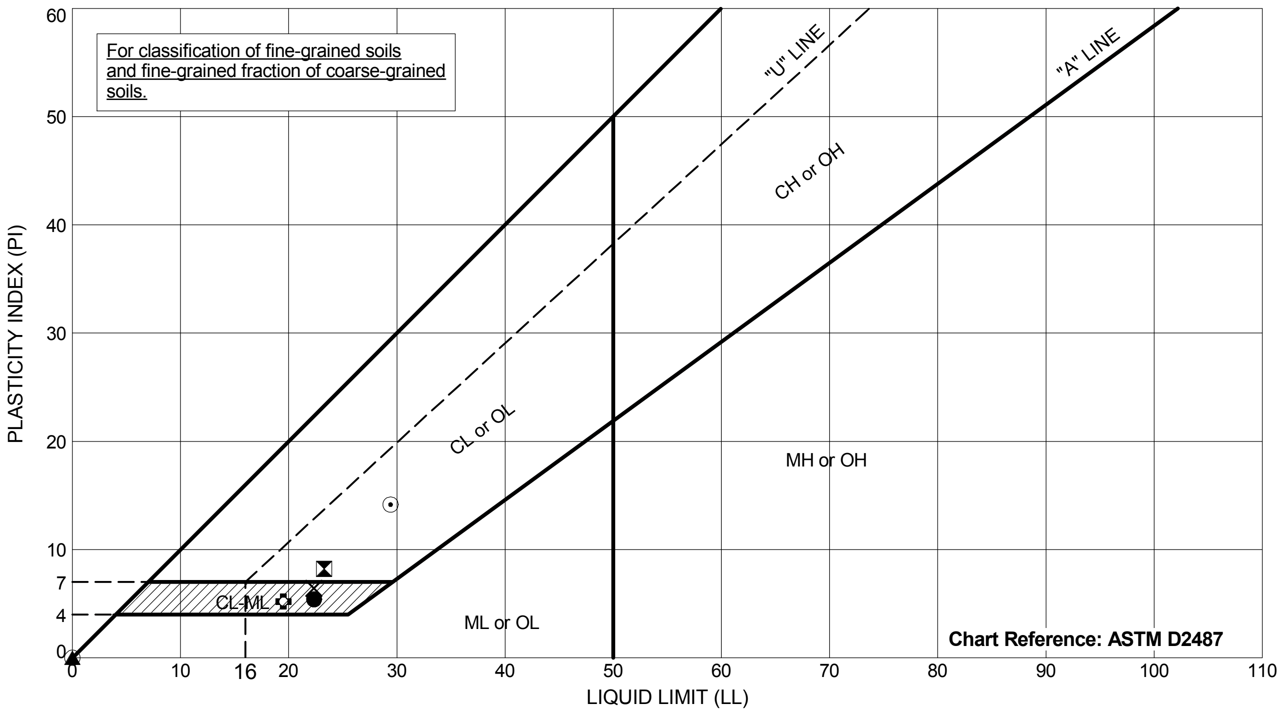
Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.
NP = Nonplastic
NM = Not Measured

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
Bright People. Right Solutions.

PROJECT NO.: 20162633	SIEVE ANALYSIS	PLATE
DRAWN BY: CLW		
CHECKED BY: DJS	Kyle Canyon / US95 Interchange Las Vegas, Clark County, Nevada	B-3
DATE: 11/18/2015		
REVISED: -		

PLOTTED: 05/17/2016 02:22 PM BY: clwilliams
gINT FILE: PROJECTWISE: 20132633_kyle Canyon Gint.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2016.GLB [KLF_SIEVE ANALYSIS]



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B-1	0 - 5	SILTY, CLAYEY GRAVEL with SAND (GC-GM)	17	22	17	5
⧗	B-2	10	CLAYEY SAND with GRAVEL (SC)	20	23	15	8
▲	B-3	0 - 5	SILTY GRAVEL with SAND (GM)	25	NP	NP	NP
✕	B-6	35	POORLY GRADED GRAVEL with SILTY CLAY and SAND (GP-GC)	11	22	16	6
⊙	B-7	60	CLAYEY SAND with GRAVEL (SC)	24	29	15	14
✿	B-9	50	SILTY, CLAYEY GRAVEL with SAND (GC-GM)	20	20	14	6
○	B-11	0 - 5	SILTY GRAVEL with SAND (GM)	22	NP	NP	NP

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

KLEINFELDER
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PROJECT NO.: 20162633
DRAWN BY: CLW
CHECKED BY: DJS
DATE: 11/18/2015
REVISED: -

ATTERBERG LIMITS

Kyle Canyon / US95 Interchange
Las Vegas, Clark County, Nevada

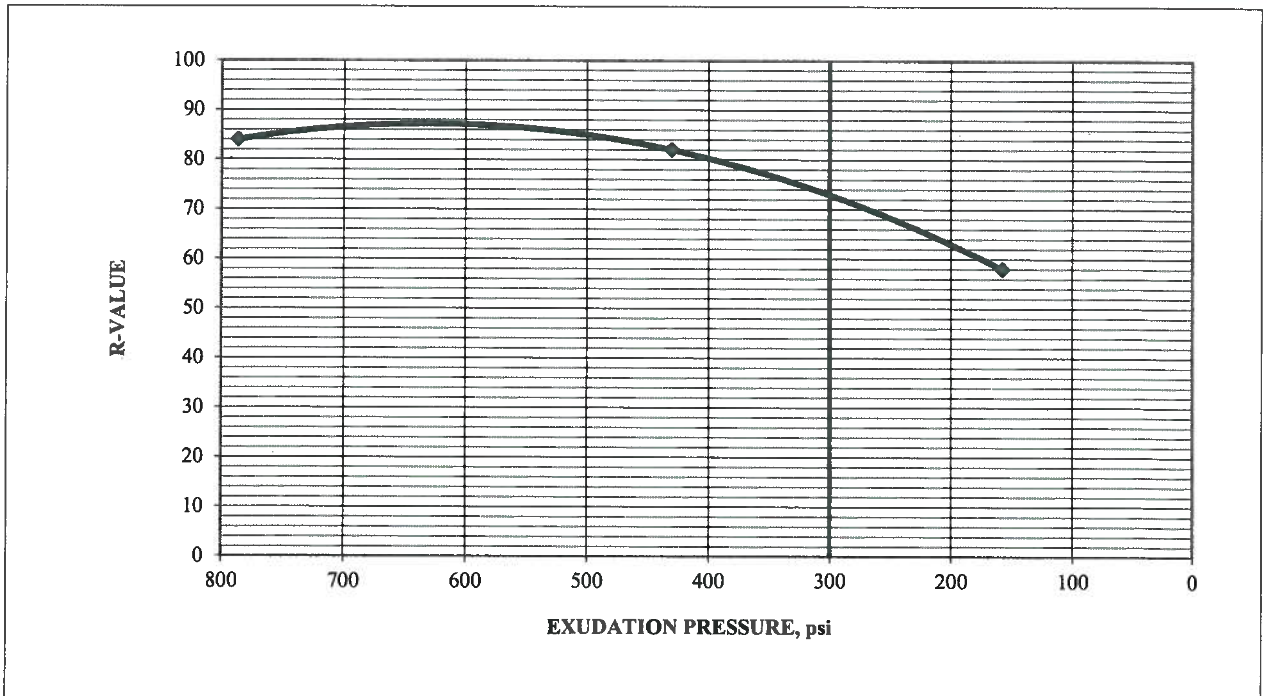
PLATE

B-4

Laboratory Test Report

Project Name: Kyle Canyon / US 95
Project No.: 20162633
Lab No.: 31243
Sample Date: November 5, 2015
Sample No.: E
Sample Location: B-11@0-5'
Material Description: Sand with silt and gravel
Report Date: November 11, 2015

Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, AASTHO T190)



Briquette No.	A	B	C
Moisture at Test, %	6.7	7.2	6.3
Dry Unit Weight at Test, pcf	136.9	134.8	138.3
Expansion Pressure, psf	17	26	13
Exudation Pressure, psi	430	158	787
Resistance Value	82	58	84
R - Value at 300 psi Exudation Pressure:			**73**

Reviewed By: David Salter

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.

6380 South Polaris Avenue, Las Vegas, NV 89118 p | 702.736.2936

APPENDIX C

Chemical Test Results

SilverState Analytical Laboratories

LABORATORY REPORT

DATE: November 12, 2015

LABORATORY NO: 15-6363-1

CLIENT: Kleinfelder
6380 South Polaris Avenue
Las Vegas, NV 89118

PAGE: 1 of 1

CLIENT PROJECT: 20162633

CLIENT PO #: 20162633

PROJECT NAME: Kyle Canyon/ IS 95 Interchange

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 11/10/15
Time Received: 1005

Analyst: SW

Sample ID: 31243 B, B-3 @ 0-5'

Analysis	Result	Unit	Method
Sodium	<0.01	%	ASTM D2791
Water Soluble Sulfate (SO_4)	<0.01	%	SM 4500 E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	<0.01	%	Calculation
Total Salts (Solubility)	0.19	%	SM2540B
Sulfide	<1.0	mg/kg	SM 4500 S^2 F
pH	8.40	S.U.	SM 9045C
Redox	276	mV	SM 2580 B
Soluble Soil Chlorides	24.4	mg/kg	SM 4500C
Resistivity (Saturated)	4691	Ω-cm	AASHTO T288

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY: [signature]
John Sloan
Laboratory Director
EPA: NV00930

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: November 12, 2015

LABORATORY NO: 15-6363-2

CLIENT: Kleinfelder
6380 South Polaris Avenue
Las Vegas, NV 89118

PAGE: 1 of 1

CLIENT PROJECT: 20162633

CLIENT PO #: 20162633

PROJECT NAME: Kyle Canyon/ IS 95 Interchange

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 11/10/15
Time Received: 1005

Analyst: SW

Sample ID: 31243 E, B-11 @ 0-5'

Analysis	Result	Unit	Method
Sodium	<0.01	%	ASTM D2791
Water Soluble Sulfate (SO_4)	<0.01	%	SM 4500 E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	<0.01	%	Calculation
Total Salts (Solubility)	0.19	%	SM2540B
Sulfide	<1.0	mg/kg	SM 4500 S^2 F
pH	8.31	S.U.	SM 9045C
Redox	269	mV	SM 2580 B
Soluble Soil Chlorides	15.9	mg/kg	SM 4500C
Resistivity (Saturated)	5698	Ω-cm	AASHTO T288

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY: DHaueltth for
John Sloan
Laboratory Director
EPA: NV00930

3626 E. Sunset Road, Suite 100, Las Vegas, NV 89120 - Tel: 702-873-4478 Fax: 702-873-7967
4587 Longley Lane, No. 2, Reno, NV 89502 - Tel: 775-825-1127 Fax: 775-825-1167
www.ssalabs.com or www.envirotechonline.com

APPENDIX D

GBA Document

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.

Geotechnical 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 civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you 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 the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- 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. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of 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.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* 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 environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of 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. Confer with you GBC-Member geotechnical engineer for more information.

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