DuPont Engineering, Inc.
8349 Shady Lady Court
Las Vegas, NV 89131
(702) 364-5099

Mr. Joe Yakubik
Global Equity Holdings Inc.
P.O. Box 530
Henderson, Nevada 89121

December 1, 2017

Subject: Geotechnical Investigation Report Update
Commercial Property
Lake Mead Parkway west of Van Wagenen Street
APN 178-13-717-006 and -008
Henderson, Nevada

DEI No.: 15-0473

Reference: Geotechnical Investigation Report by BBC Engineering, Inc.
Number G1676, dated July 5, 2005

Mr. Yakubik:

This letter is an update to the referenced Geotechnical Investigation Report for the subject project. We visited the site on November 27, 2017 to determine the current conditions. Since the time of the report the site remains as in the original report except that the easternmost portion of the site has been paved during the construction of the boat facility next door. At this time a commercial building of unknown construction is planned for the subject property.

The latitude and longitude of the site are 36.0345 and -115.0024, respectively. The Clark County Seismic Design Map indicates that the site classifies as Site Class C. Based upon our knowledge of the soils in the vicinity of the site, we concur with the County Map. The Seismic Design Category (International Building Code, 2012) for the site is C based on the following data:

SITE CLASS	ASSUMED SEISMIC USE GROUP	S_S	S_1	S_{DS}	S_{D1}	SEISMIC DESIGN CATEGORY
C	II	0.487	0.161	0.390	0.176	C

The Grading section of the original report is amended as follows. Structural fill should be placed in loose lifts with a maximum thickness of 6 to 8 inches assuming that conventional medium-duty compaction equipment is used. As a minimum, one compaction test should be performed for each

3,000 square feet of area per 1 foot of compacted fill thickness or as otherwise directed by the geotechnical engineer.

Based on the composition of the on-site soils, the site is classified as Special Inspection Category G-A. Therefore, periodic inspection during grading operations is acceptable.

All fill and scarified soil should be moisture conditioned and compacted in accordance with the specifications of Table 1. ASTM Test Method D 1557 should be used for determining the laboratory maximum dry density.

TABLE 1

Soil Type	Moisture Content	Relative Compaction
Coarse-grained	Over optimum	Minimum 95 percent

If imported soils are necessary to reach the site grade, they should comply with the following specifications contained in Table 2. If possible, the imported materials should be tested for compliance prior to hauling the material to the site.

TABLE 2

Sieve Screen	Percent Passing (%)
3 inch	100
¾ inch	50 - 100
No. 4	25 - 75
No. 200	5 - 25

Liquid Limit < 20	Soluble Sulfate < 0.10%
Plasticity Index < 6	Sodium Sulfate < 0.10%
Expansion Potential < 2% (oven-dried, 60 psf surcharge)	Total Solubility < 0.5 %

The Foundations section of the original report is amended as follows.

Construction Type	Min. Footing Width	Min. Footing Embedment	Allowable Bearing Pressure
1-Story Wood Frame	12	12	2000
2-Story Wood Frame	12	16	2500
CMU or Tilt Up	18	16	3000

A 1/3 increase in the allowable bearing pressure may be used for short-term loading such as wind or seismic. For retaining walls, if the backfill behind the wall is not horizontal or if surcharge loads exist, these earth pressure design parameters should be reviewed.

The slabs section is amended as follows. The thickness of the visqueen barrier should be increased from 6 mil to 10 mil. However, the sand and visqueen may be eliminated in any warehouse portion of the building used for storage that does not have floor-sensitive coverings.

The concentration of soluble sulfates in the on-site soils as determined by Silver State Analytical Laboratories was 0.03 percent. This concentration may be considered to be negligible (S0) with respect to concrete deterioration. All concrete in contact with the on-site soils should be prepared in accordance with the following table which is adapted from ACI-318.

SEVERITY	EXPOSURE CLASS	WATER-SOLUBLE SULFATE (SO_4) IN SOIL,	SULFATE (SO_4) IN WATER, ppm	CEMENT TYPE ASTM C150	$CaCl_2$ ADMIX	MAXIMUM WATER TO CEMENT RATIO	MINIMUM f'_c NORMAL WEIGHT AND LIGHTWEIGHT AGGREGATE CONCRETE, psi
Negligible	S0	0.00 - 0.10	0 - 150	NR	NR	NA	2500
Moderate	S1	0.10 - 0.20	150 - 1500	II	NR	0.50	4000
Severe	S2	0.20 - 2.00	1500 - 10000	V	NP	0.45	4500
Very severe	S3	Over 2.00	Over 10000	V+Pozz or Slag	NP	0.45	4500

These recommendations are based on the chemical properties of the on-site soils. Landscaping materials that are high in sulfates could cause deterioration of concrete made with Type II cement. If imported soils are used, an additional soluble sulfate test should be performed. The above table should be used to determine the design for concrete in contact with the imported soil.

It is our opinion that all other recommendations provided in the original report remain valid. If you have questions, please contact us.

Respectfully submitted,
DuPont Engineering, Inc.

David R. DuPont, P.E.
President

DRD
Dist: 3/Addressee

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GEOTECHNICAL INVESTIGATION REPORT
BOAT SALES AND MAINTENANCE FACILITY
APN 178-13-717-006 AND 007
LAKE MEAD DRIVE NEAR VAN WAGENEN STREET
HENDERSON, NEVADA

PREPARED FOR:
MR. ALTON DEAN JENSEN - ARCHITECT
1646 NEVADA HIGHWAY
BOULDER CITY, NEVADA 89005

PREPARED BY:
BBC ENGINEERING, INC.
4420 SOUTH ARVILLE
SUITE 33
LAS VEGAS, NEVADA 89103

BBC NO.: G1676

JULY 5, 2005

BBC Engineering, Inc.
4420 South Arville Street, Suite 33
Las Vegas, Nevada 89103
(702) 364-5099

Mr. Alton Dean Jensen - Architect
1646 Nevada Highway
Boulder City, Nevada 89005

July 5, 2005

Subject: Geotechnical Investigation Report
Boat Sales and Maintenance Facility
APN 178-13-717-006 and 007
Lake Mead Drive Near Van Wagenen Street
Henderson, Nevada

BBC No.: G1676

Sir:

We are pleased to present the results of our geotechnical investigation for the proposed boat sales and maintenance facility. Our study has indicated that the structure may be supported on a shallow spread footing system bearing on recompacted on-site soils or on structural fill.

Conclusions and recommendations have been based upon our analyses of data obtained from our field investigation and upon our previous geotechnical experience in the vicinity. Please contact us if you have questions concerning the report.

Respectfully submitted,

BBC ENGINEERING, INC.

Saady S. Farhan, Ph.D., P.E.
Principal Geotechnical Engineer

SSF/pjb
Dist: 3/Addressee

INTRODUCTION

General

This report presents the results of our geotechnical investigation for the proposed facility. The purpose of our investigation was to determine the nature and engineering properties of the subsurface materials and to provide recommendations for site grading, excavation difficulties, foundations, floor slabs, on-site pavement sections, moisture protection and surface drainage, and concrete durability requirements.

Project Description

The proposed sales and maintenance facility is planned for two adjacent lots with a total area of approximately 1.07 acre. The lots are identified as APN 178-13-717-006 and 007. The lots are located on the south side of Lake Mead Drive near Van Wagenen Street in Henderson, Nevada. A two story structure with wood-frame construction and a slab-on-grade lower floor is planned. Asphalt-paved parking is also planned. Loads typical for this type of construction have been assumed. The general site location is shown on the attached Vicinity Map. The location and configuration of the site are shown on the Site Plan.

FIELD INVESTIGATION

The subsurface conditions were explored by drilling two 15-foot deep borings at the approximate locations shown on the Site Plan. The subsurface conditions were continually recorded at the time of drilling and are summarized on the attached boring logs.

The borings were made with a truck-mounted rotary drill rig which used air to maintain circulation of the cuttings. Due to the granular nature of the subsurface soils, drive samples were not obtained. Pertinent engineering properties were determined from drilling characteristics, visual examination, and our geotechnical experience. A disturbed bulk sample was obtained for chemical testing to determine the concrete durability requirements.

SITE CONDITIONS

Surface

At the time of our exploration, the site contained a mobile office at the northern portion of the site and was covered with very sparse weeds. The property slopes downward to the north at a gradient of about 2 to 5 percent. Drainage is by sheet flow. Insignificant amounts of trash and debris were noted. The site is about 4 to 5 feet higher than Lake Mead Drive which is paved.

Subsurface

The surficial soil at the boring locations consists of 1 to 1½ feet of medium dense silty gravel and sand fill underlain by similar native material. The density increases with depth. A trace of cobbles was present. Groundwater was not encountered in either of the borings at the time of drilling.

Seismicity and Local Faulting

The site is located in a low to moderately active seismic area. The nearest fault with possible evidence of geologically recent movement is located near the western foot of Frenchman Mountain, about 5 miles north of the site. Clark County has not historically recorded any near-destructive seismic events. Significant surface displacement is not likely during an earthquake. The underlying soils are not subject to liquefaction.

The nearest mapped compaction fault is located about ¾ mile southwest of the site. This location was determined from "Subsidence in Las Vegas Valley," John W. Bell and Jonathan G. Price, Nevada Bureau of Mines and Geology, Final Project Report, 1991. The Clark County Soil Guidelines Map (August 2001) used the same reference for compaction and tectonic faults. Compaction faults are thought to be related to deep-seated differential consolidation of the underlying alluvial soils with different compressibility characteristics. It is believed that compaction fault movement has not occurred within the previous several thousand years. No signs of the compaction faults were noted on the site. In our opinion, compaction faults do not pose geotechnical problems associated with development of this site.

The Seismic Design Category (International Building Code, 2000) is D based on the following data:

SITE CLASS	ASSUMED SEISMIC USE GROUP	S_S	S_1	S_{DS}	S_{D1}	SEISMIC DESIGN CATEGORY
D	I	0.80	0.21	0.630	0.277	D

Clark County Soil Hazard Type

The Clark County Soil Guidelines Map (August 2001) mentioned in the previous section delineates four types of potential soil hazards and a non-hazard type generally consisting of mixed alluvial sand and gravel. The four hazard types are:

(i) Areas within 2000 feet of compaction or tectonic faults. These areas include 90 percent of all mapped fissure zones. Soil subsidence is the general hazard associated with this type of soil. These phenomena are discussed in the previous report section, Seismicity and Local Faulting.

(ii) Areas within 1000 feet of mapped washes. Aside from evaluating possible erosional damage to the property, the general hazards associated with these areas include recent sediment deposits and soils with a potential for solubility, clay swell, corrosion, gypsum salts, or hydrocollapse.

(iii) Areas with the same potential hazards as described in Paragraph (ii) except for the recent sediment deposits and possible erosional damage.

(iv) Areas with ground slopes in excess of 15 percent and the potential for shallow bedrock.

The general non-hazard areas usually have mixed alluvial sand and gravel. Caliche is often present in these areas. Although caliche is not a hazard, it can increase developmental costs.

The subject site is located in the non-hazard area.

CONCLUSIONS AND RECOMMENDATIONS

General

On the basis of our field investigation, our subsequent analyses, and our geotechnical experience in the vicinity, the on-site soils are not suitable for the support of the proposed structure in the present condition. After removing and recompacting a portion of these soils, a shallow spread footing system bearing on recompacted on-site materials or structural fill is appropriate. The following report sections provide our conclusions and recommendations for grading, excavation difficulties, foundations, floor slabs, on-site pavement design, moisture protection and surface drainage, and concrete durability requirements.

As required by the Southern Nevada Building Code Amendments, this report section addresses grading overexcavation, slab and footing support, and minimum footing widths and embedments.

As recommended in the Grading report section, an overexcavation of 2 feet below existing grade is required in the structure area. An overexcavation of 1½ feet below the existing grade is required in pavement areas.

As outlined in the Foundations report section, footing support may be obtained on recompacted on-site soils or structural fill compacted as recommended in the Grading report section.

As outlined in the Foundations report section, the minimum footing width is 16 inches and the minimum footing embedment depths are 18 inches below the lowest adjacent finished grade for exterior foundations and 18 inches below the top of the floor slab for interior foundations. If column footings are used the minimum footing width and embedment depths should be increased to 24 and 18 inches, respectively.

As outlined in the Slabs report section, floor slab support may be obtained with 2 inches of clean sand, a 6-mil visqueen barrier, 6 inches of Type II Aggregate Base compacted to at least 95 percent of the maximum dry density, and recompacted on-site soils or structural fill prepared in accordance with the Grading report section.

Grading

All existing vegetation and any trash or debris should be removed from the structure area prior to grading. Soils within the structure area and 5 feet beyond in plan view should be removed to a depth of 2 feet below existing grade. An overexcavation of 1½ feet below existing grade should be performed in pavement areas and 3 feet beyond in plan view. After the removal of any oversize material larger than 6 inches the removed soils may be stockpiled for later use as fill.

After the excavations have been made, the exposed surface should be scarified to a minimum depth of 12 inches and recompacted near the optimum moisture content to at least 95 percent of the maximum dry density as determined by the ASTM D 1557 Test Method. The scarification and recompaction operations should be performed after obtaining cut grade (if any) and prior to placing any new fill. After recompaction of the scarified soils, the stockpiled soils may be placed in thin horizontal lifts and compacted near the optimum moisture content to at least 95 percent of the maximum dry density.

If additional fill is required to obtain the design site grade, we recommend a clean granular imported soil with negligible salts and an oven-dry swell potential of less than 4 percent under a 60 psf surcharge. This material should be approved at the source by the geotechnical engineer prior to hauling it to the site. Structural fill consisting of approved imported fill should be placed in thin horizontal lifts and compacted near the optimum moisture content to at least 95 percent of the maximum dry density.

Structural fill should be placed in loose lifts with a maximum thickness of 6 to 8 inches assuming that conventional medium-duty compaction equipment is used. As a minimum, one compaction test should be performed for each 3,000 square feet of area per 1 foot of compacted fill thickness.

Clearing and grubbing operations will result in some loss of material. Excavation and recompaction of the on-site soils will result in shrinkage losses. We estimate a shrinkage factor of about 10 percent will be applicable for the upper 2 feet of on-site soils when excavated and recompacted. This shrinkage factor implies that it will require 1.1 cubic yards of excavated material to equal 1.0 cubic yard of properly compacted fill. Subsidence of the subgrade where soils are scarified, wetted, and recompacted will be on the order of 0.1 feet.

Excavation Difficulties

Excavation difficulties with conventional earthmoving equipment are not anticipated.

Foundations

The structure may be supported on a shallow spread footing system bearing on the recompacted on-site soils or structural fill. All footings should be at least 16 inches wide. Exterior footings should be placed at least 18 inches below the lowest adjacent finished grade. Interior footings should be placed at least 18 inches below the top of the floor slab. If column footings are used the minimum footing width and embedment depths should be increased to 24 and 18 inches, respectively. If bearing soils are disturbed during footing excavation, they should be recompacted in accordance with the recommendations contained in the Grading section of this report. Continuous wall footings or individual column footings may be designed for an allowable net bearing pressure of 2500 psf. A one-third increase may be used for wind or seismic loads. Settlement of foundations designed as recommended above should be less than 1 inch. Differential settlement should be less than one half of the total settlement.

Horizontal loads acting on foundations formed in open excavations will be resisted by friction acting at the base of foundations and by passive earth pressure. The friction acting along the base of the footings founded on the on-site soils or compacted structural fill may be computed by using a friction coefficient of 0.40 with respect to the normal dead load. Lateral passive and active earth pressures may be computed by using an equivalent fluid weighing 400 pcf and 37 pcf, respectively, for the sides of the footings formed in open footing excavations or abutting properly placed backfill. If passive earth pressure is utilized, it is important that the geotechnical engineer be present during any foundation backfill placement.

If retaining walls will be present on the project, the recommendations given above regarding subgrade preparation, allowable bearing capacity, the coefficient of friction, and the passive pressure may be used in conjunction with an active pressure equivalent to that produced by a 37-pcf fluid. These design parameters assume that water will not collect behind the retaining walls. Suitable drains or weep holes should be provided to eliminate this possibility. If the tops of the walls are restrained, then an at-rest pressure equivalent to a 60-pcf fluid should be used instead of the active pressure.

Under seismic conditions, the active and at-rest equivalent fluid unit weight should be increased to 59 and 128 pcf, respectively. The resultant of the seismic component of earth pressure (i.e. the difference between seismic and static conditions) should be applied at 0.6 of the height where lateral soil pressure is acting. If seismic lateral pressure distribution is needed, it may be taken as an inverted trapezoid (see attached Earth Pressure Distribution Figure).

If the backfill behind the wall is not horizontal or if surcharge loads exist, these earth pressure design parameters should be reviewed.

Slabs

Slab-on-grade floors may be supported on a mat of granular fill. After preparing the subgrade as recommended in the Grading Report Section, 6 inches of Type II Aggregate Base compacted to at least 95 percent of the maximum dry density should be placed. The underslab gravel should be superimposed with 2 inches of clean sand placed directly beneath the floor slab. The underslab gravel should be separated from the sand with a minimum 6-mil thick visqueen membrane. Slab reinforcement, if any, should be determined by the project structural designer. To minimize the effects of volume changes that could result in excessive cracking and curling we recommend that the concrete placement, curing, and control jointing measures be performed in accordance with the American Concrete Institute Guide for Concrete Floor and Slab Construction, ACI 302.1R-99.

On-Site Pavement

Support for the asphalt pavement and base course may be provided by the reworked on-site soils or compacted imported fill. Prior to placing the base course, the subgrade should have been prepared as recommended in the Grading Section.

Flexible pavement designs were determined from an assumed soil resistance (R-Value) of 50 for the on-site recompacted soil. Based on the typical near-surface soils encountered in our borings, the following minimum pavement structural sections are recommended:

SERVICE	THICKNESS, inches	
	ASPHALT CONCRETE	TYPE II AGGREGATE BASE
Light (Automobile Traffic & Parking) Assumed T.I. = 4.5	2½	4½
Medium (Truck Traffic) Assumed T.I. = 5.5	3	5½

The Type II Aggregate Base should conform with Sections 302 and 704 of the most recent edition of the "Uniform Standard Specifications for Public Works' Construction, Off-Site Improvements, Clark County Area, Nevada". All base materials should be compacted to at least 95 percent of the maximum dry density (ASTM D 1557). Asphalt paving materials should conform with Sections 401 and 703.

It is important that the parking area grades be set to provide positive drainage to suitable drainage structures. A desirable minimum slope for drainage in paved areas is 1½ percent.

Moisture Protection and Surface Drainage

Precautions should be taken during and after construction to eliminate saturation of the foundation soils. Positive drainage should be established away from exterior walls of the structure. A minimum slope of 5 percent should be maintained within 10 feet of exterior walls (where possible) to facilitate this drainage. If asphalt concrete or concrete slabs abut the structure, the minimum slope may be reduced to 1½ percent. All utility trenches leading into the structure and beneath the structure should be backfilled and compacted to a minimum of 90 percent relative compaction with material having a percent swell less than 4 percent at a 60 psf surcharge, at least 35 percent passing the #200 sieve, and a percent water-soluble sulfate in soil of less than 0.10. Special care should be taken during installation of subfloor sewer and water lines to reduce the possibility of future subsurface saturation. Any trees should be placed at least 10 feet away from the exterior building foundations.

Concrete Durability Requirements

The concentration of soluble sulfates in the on-site soils as determined by Silver State Analytical Laboratories was 0.03 percent. This concentration may be considered to be negligible with respect to concrete deterioration. All concrete in contact with the on-site soils should be prepared in accordance with the following table:

SULFATE EXPOSURE	WATER-SOLUBLE SULFATE (SO_4) IN SOIL, percentage by weight	SULFATE (SO_4) IN WATER, ppm	CEMENT TYPE	MAXIMUM WATER TO CEMENT RATIO	MINIMUM f'_c NORMAL WEIGHT AND LIGHTWEIGHT AGGREGATE CONCRETE, psi
Negligible	0.00 - 0.10	0 - 150	---	---	---
Moderate	0.10 - 0.20	150 - 1500	II, IP (MS), IS (MS)	0.50	4000
Severe	0.20 - 2.00	1500 - 10000	V	0.45	4500
Very severe	Over 2.00	Over 10000	V plus pozzolan	0.45	4500

These recommendations are based on the chemical properties of the on-site soils. Landscaping materials that are high in sulfates could cause deterioration of concrete made with Type II cement. If imported soils are used, an additional soluble sulfate test should be performed. The above table should be used to determine the design for concrete in contact with the imported soil.

LIMITATIONS

The conclusions and recommendations contained in this report are based on the assumption that the materials encountered in the borings represent the site conditions. We make no other warranty, either express or implied. If any unforeseen difficulties or unusual conditions are encountered, the geotechnical engineer should be contacted immediately in order to make supplemental recommendations. Any person using this report for bidding purposes should perform such independent investigations as he deems necessary to satisfy himself as to subsurface

conditions or construction procedures to be used. The evaluation of potential environmental hazards is beyond the scope of this report.

This report completes our present assignment for this project. As the design nears completion, we recommend that you consult with us on unanticipated problems or questions regarding the design and/or review of any plans or specifications. The work assignment for these services is subject to your prior approval and authorization.

CLOSURE

Our conclusions and recommendations are predicated on a geotechnical engineer's observation and testing of the excavation and foundation preparations. It would be logical for BBC Engineering, Inc. to provide these services since we are best able to determine if the conditions encountered match those used in our analyses, to determine if modifications to our recommendations are needed and to make such modifications if necessary.

If we are not retained for these services, they should be performed by a geotechnical engineer registered to practice in Nevada who will make sufficient observations, tests, and re-tests to support an opinion that the finished work conforms with our recommendations and will prepare and submit a report to that effect. Unless we are notified, and concur, we will not be responsible for any modification of our recommendations by others.

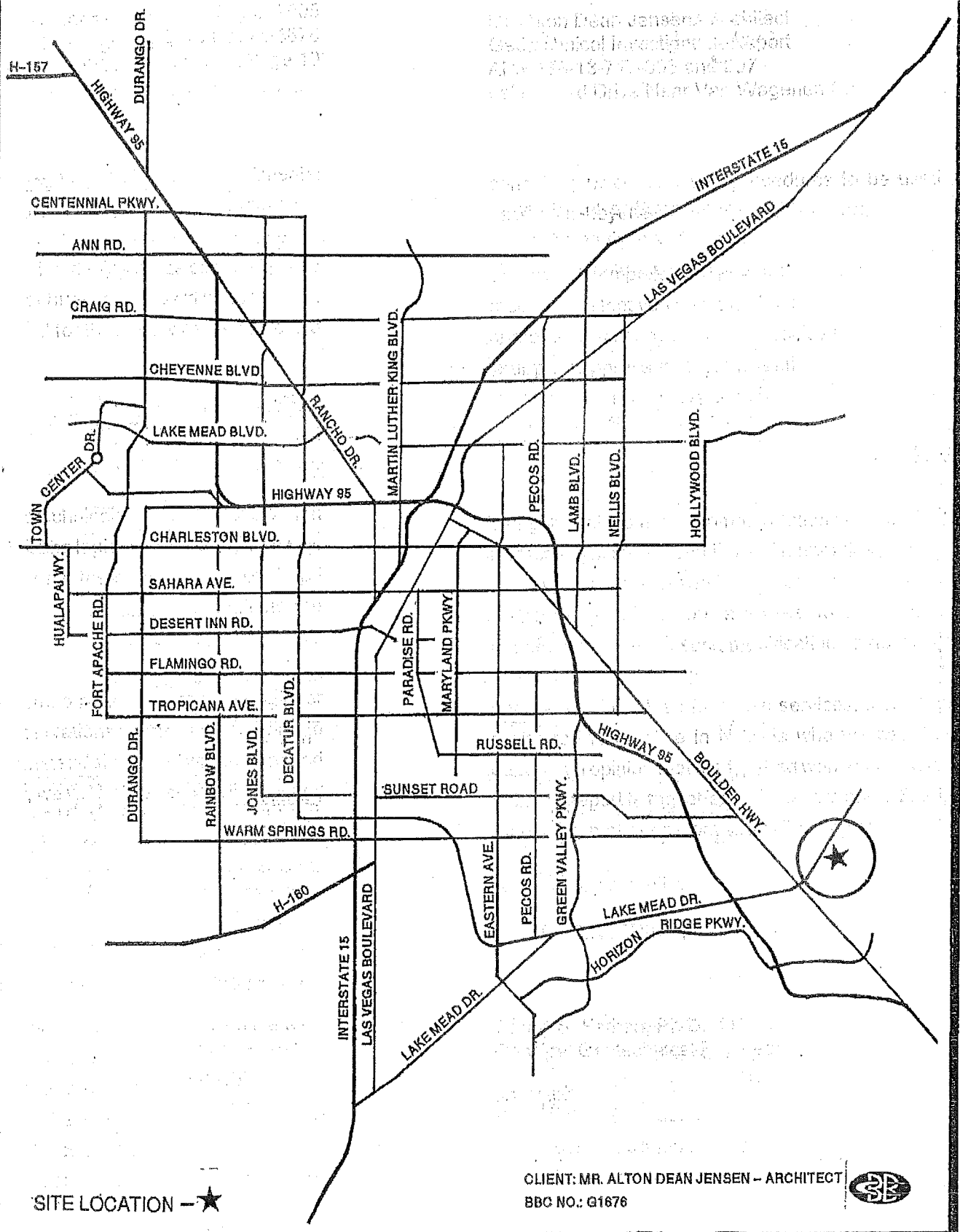
Respectfully submitted,

BBC ENGINEERING, INC.

Saady S. Farhan, Ph.D., P.E.
Principal Geotechnical Engineer

SSF/pjb

VICINITY MAP

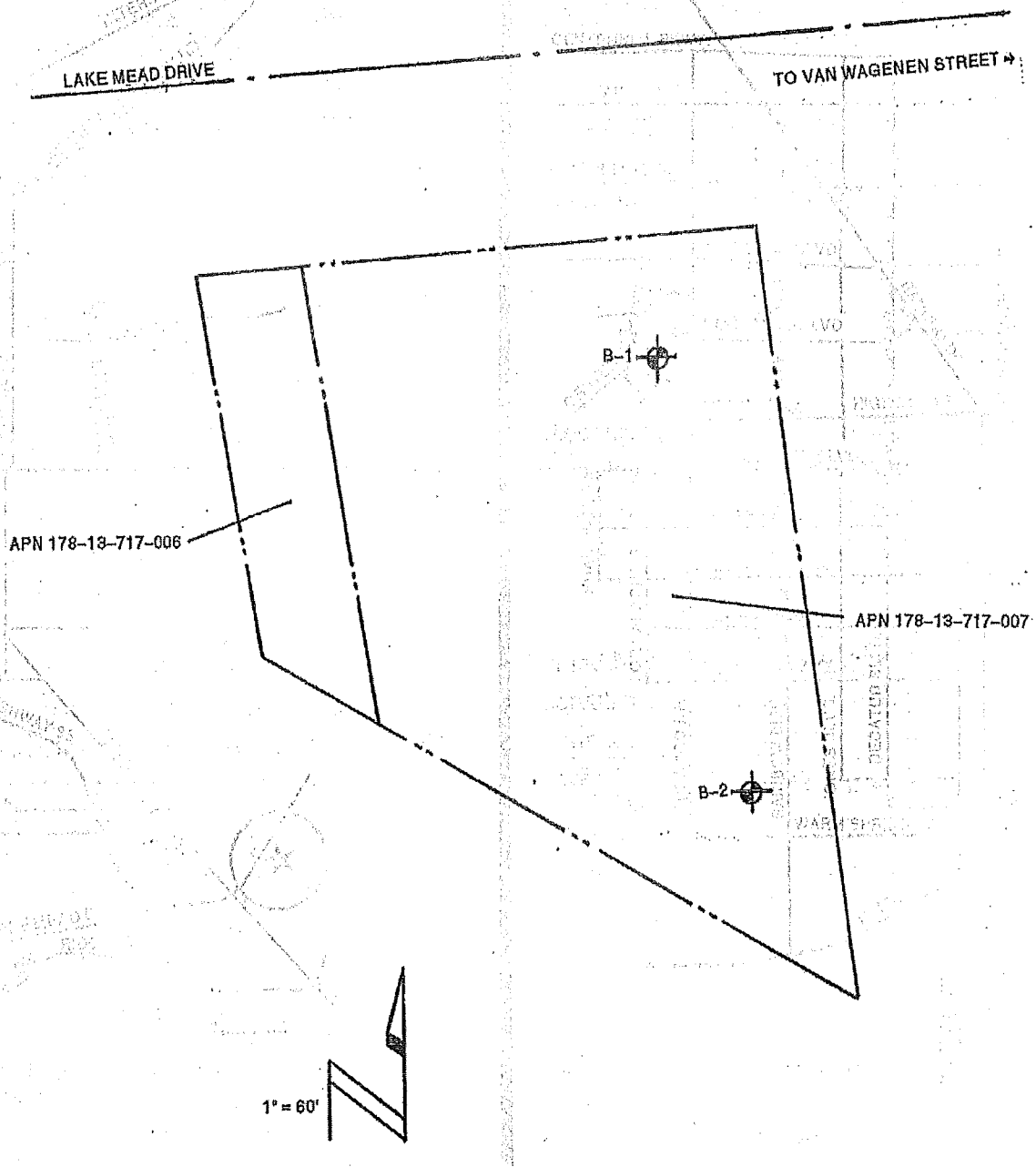


SITE LOCATION – ★

CLIENT: MR. ALTON DEAN JENSEN – ARCHITECT

BBC NO.: G1676

SITE PLAN
BOAT SALES AND MAINTENANCE FACILITY
APN 178-13-717-006 AND 007
LAKE MEAD DRIVE NEAR VAN WAGENEN STREET
HENDERSON, NEVADA



CLIENT: MR. ALTON DEAN JENSEN - ARCHITECT
BBC NO.: G1676

Client: Alton Dean Jensen - Architect
Project: Boat Sales and Maintenance Facility
Boring #: B-1

Location: APN 178-13-717-006 and 007
Henderson, Nevada

BBC No.: G1676 **Date Drilled:** 6/17/2005
Elevation: -- **Datum:** Ground Surface
Boring Type: 6" Rotary Air **Type Rig:** Mayhew

Groundwater Conditions: None ATE

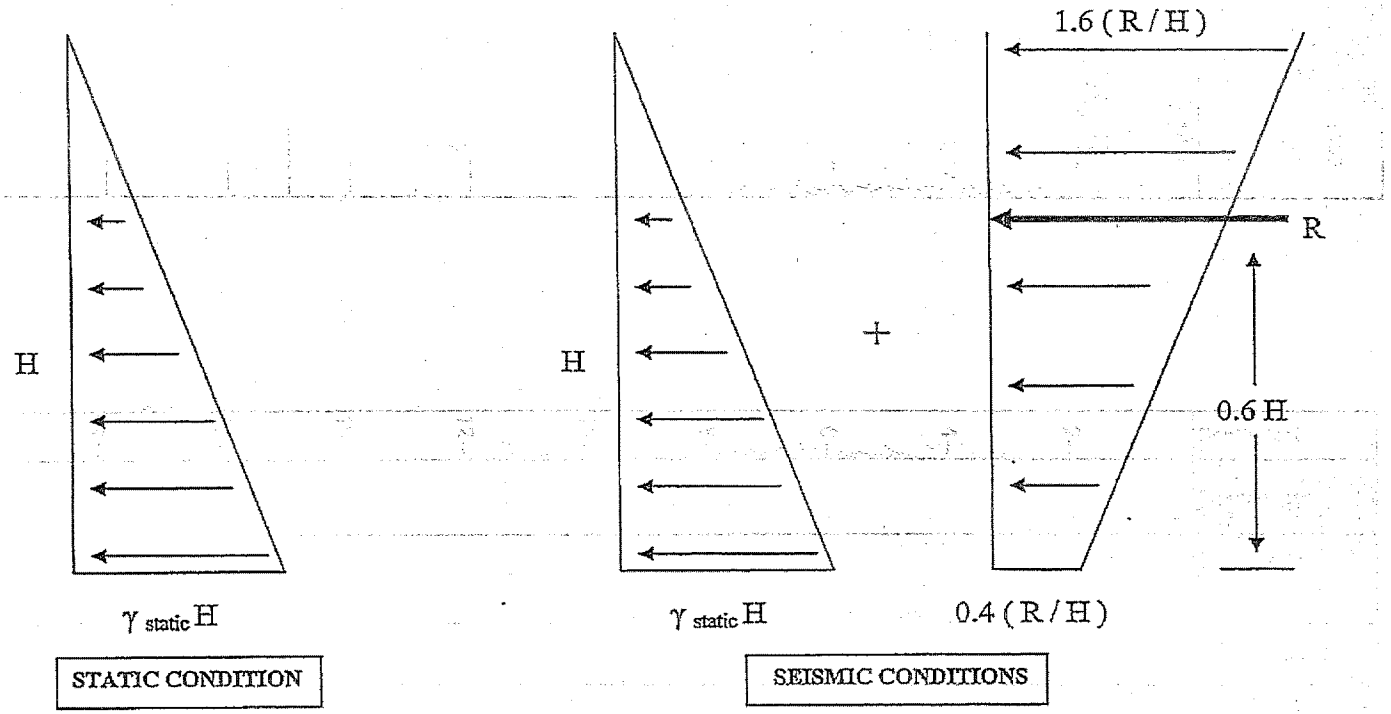
Depth, feet	Sample type	Resistance, blows/6 inches	Cohesion, ksf	Moisture Content, %	Dry Density, pcf	Unified Soil Classification	SOIL DESCRIPTION
						GM (fill)	Brown Silty GRAVEL and SAND, medium dense, dry (fill)
2	B			2.3		GM	Brown Silty GRAVEL and SAND, poorly sorted, medium dense, slightly moist
4							(medium dense to dense)
6							
8							(trace cobbles)
10							
12							trace cobbles and small boulders, dense)
14							
							BOE @ 15'
16							
18							

Client: Alton Dean Jensen - Architect
Project: Boat Sales and Maintenance Facility
Boring #: B-2

Location: APN 178-13-717-006 and 007
Henderson, Nevada

Depth, feet	Sample type	Resistance, blows/6 inches	Cohesion, ksf	Moisture Content, %	Dry Density, pcf	Unified Soil Classification	BBC No.: G1676 Date Drilled: 6/17/2005 Elevation: -- Datum: Ground Surface Boring Type: 6" Rotary Air Type Rig: Mayhew Groundwater Conditions: None ATE **SOIL DESCRIPTION**
						GM (fill)	Brown Silty GRAVEL and SAND, medium dense, dry (fill)
2						GM	Brown Silty GRAVEL and SAND, medium dense, slightly moist
4							(medium dense to dense)
6							(trace cobbles, dense)
8							(trace cobbles)
10							
12							
14							
							BOE @ 15'
16							
18							

Earth Pressure Distribution



R = Resultant of seismic component of earth pressure per unit length of the wall = ½ ($\gamma_{seismic} - \gamma_{static}$) H^2.
H = Height of the wall
γ = Equivalent fluid density, either for active or at rest conditions, as applicable.
Note: Surcharge pressure is not included here and should be added, if applicable.

DUPONT ENGINEERING, INC.

KEY TO SYMBOLS AND TERMS USED ON BORING AND TEST PIT LOGS

METHOD OF SOIL CLASSIFICATION
(ASTM D 2487)

COARSE-GRAINED SOILS
LESS THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS One half or more of coarse fraction is smaller than No. 4 sieve size
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	
SM	SILTY SANDS, SAND-SILT MIXTURES, MORE THAN 12% FINES	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	

FINE-GRAINED SOILS
MORE THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS Liquid limit less than 50
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
OL	ORGANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY	
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit 50 or more
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
PT	PEAT, MUCK, AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

Notes: Only sizes smaller than 3 inches are used to classify soils.
Dual classification used for borderline soil groups.

LOG ABBREVIATIONS

Miscellaneous:
- ATE - at time of exploration
- AE - after exploration
- BOE - bottom of exploration
- ∇ 0 - Groundwater level at time of exploration
- ∇ 72 - Groundwater level 72 hours after exploration

Sample Type:
- R - ring sample
- S - Standard Penetration Test
- D - disturbed sample
- C - core sample
- U - undisturbed sample
- B - bulk sample
- H - hand drive ring sample
- NR - no recovery
- REF - sampler refusal

Note: Ring sampler is a split-barrel sampler with 1" rings. Inside diameter is 2½" and outside diameter is about 3.1". Blow counts shown represent the number of blows for 6" penetration for a 320-pound hammer falling freely through a 30" vertical distance. Energy ratio correlations indicate a close correspondence with Standard Penetration Test values with a 140-pound hammer falling 30" with a standard split spoon sampler.