March 16, 2010
J.N. 118-10

Mr. Tom Tomlinson
CASTLE & COOKE ALBERHILL RANCH, INC.
4113 Pearl Street
Lake Elsinore, California 92530

Subject: Geologic Constraints Study for an Environmental Impact Report (EIR) Submittal, Alberhill Villages Specific Plan, 1,374± Acres, West of Lake Street and South of Temescal Canyon Road, City of Lake Elsinore, Riverside County, California

Dear Mr. Tomlinson:

In accordance with your request, Petra Geotechnical, Inc. (Petra) has prepared this geologic constraints study for an approximately 1,374-acre property, identified as the Pacific Clay Products, Inc. and Pacific Aggregates, Inc. (herein referred to as Pacific Clay), located west of Lake Street and south of Temescal Canyon Road in the City of Lake Elsinore, California (Figure 1). The purposes of our study were to obtain available geotechnical and geologic information on the nature of the previous land usage and current surface-soil conditions, to evaluate the potential geologic constraints that may affect development of the property, and to provide geologic and geotechnical mitigation recommendations for planning purposes for submittal with an Environmental Impact Report (EIR) for the Alberhill Villages Specific Plan (AVSP).

This report presents the findings and opinions regarding the feasibility of the proposed project with respect to the geologic and geotechnical factors that may impact site development. This report is based on review of information provided by you, KWC Engineers and The Planning Associates, available geologic and geotechnical reports and data, research and review of available historical documents and aerial photographs, pertinent interviews, site reconnaissance and surficial geologic mapping.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Grayson R. Walker, GE
Vice President

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PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to research and obtain available surface information and background data within the site and surrounding areas in order to characterize the geologic constraints with regards to an EIR submittal for the AVSP and future proposed development of the property and to provide recommendations for additional geotechnical studies. The scope of services for this level of study was as follows.

- Research and review of available reports prepared by Petra and other geotechnical consultants for the site and general vicinity.
- Research available published and unpublished geologic maps and government publications.
- Research and review historical texts and documents with regards to the Alberhill area's history.
- Research and review historic stereoscopicaerial photographs of the property vicinity to evaluate site geomorphology and previous land usage.
- Conduct interviews with Pacific Clay's geologist to determine the site's previous usage.
- Review archived records and maps at the Pacific Clay facility to determine the property's previous mining history.
- Conduct a site reconnaissance and surficial geologic mapping of exposed geologic units.
- Identify the relevant geologic, seismic and geotechnical constraints that would affect development of the property.
- Prepare a generalized geologic map showing the approximate extent of surficial geologic units.
- Preparation of this report presenting the results of our evaluation and provide recommendations for mitigating geologic impacts with regards to the AVSP and future development.

Location and Site Description

The subject site is an irregular shaped parcel encompassing approximately 1,374 acres and is located immediately west of Lake Street and south of Temescal Canyon Road in the City of Lake Elsinore, California, approximately ¼ mile south of Interstate 15. The site is located in an area defined as the Pacific Clay and Pacific Aggregates facility, formerly know as the LA Brick Company. The approximate location of the site boundary is shown on Figure 1. A newly developed residential tract is located adjacent to the northwest western property boundary and the Alberhill Ranch residential development is located directly across from Lake Street adjacent

to the southeastern boundary. The future Alberhill Ridge property is located across from Lake Street along the northeastern boundary. The Pacific Clay brick plant is located just south of Temescal Canyon Road at the northern end of the project and the existing Pacific Aggregates offices are located in several temporary trailers near the Lake Street entrance in the southeastern section of the site.

A large portion of the property is characterized by undocumented-fill stockpiles and mine tailings of unknown depths, deep open-pit mining excavations and in-filled pits, surface ponds, and mining support structures and improvements. These features have greatly disturbed the natural surface of the majority of the site. The various undisturbed areas located adjacent to the actively mined/disturbed areas, are generally characterized by gently to steeply sloping hills comprised of older alluvium or bedrock, trending northeast to northwest and incised by drainage channels. Vegetation within the site consists of moderate to dense chaparral brush on the flanks of the natural slopes with occasional isolated trees. A larger stand of eucalyptus and cottonweed trees are located within the alluvial drainage along Temescal Canyon Road at the northern property boundary. Large portions of the site were void of vegetation growth due to the former and current mining operations.

Numerous power lines, haul roads, outbuildings, maintenance shops, aggregate plant machinery, water tanks, well houses, concrete pads and various other man-made improvements associated with the former and current mining and trucking operations are located throughout various areas of the site. A former residential community and school house are located in the northeastern corner of the property. Various abandoned structures and possible mine shafts are also located within the property.

GEOTECHNICAL EVALUATION

Background Information

Coal and clay have been mined in the general area since the 1880's and in 1886 C.H. Albers and J.H. Hill founded the community of Alberhill. Historically, both coal and clay were mined by underground methods with coal mining terminated around 1900. Since 1940, clay has been mined almost entirely by open-pit methods. The majority of the property to be developed has been extensively mined with the remnants of the mining operation present throughout the site. These remnants include excavated pits, quarry faces, tailings stockpiles and infilling, desilting basins, and possibly portions of the subsurface mine horizontal adits and laterals. Significant quantities of mine tailings and/or stripped overburden materials have been used to backfill clay mining pits, sedimentation basins and temporary reservoirs which were no longer in use.

The following synopsis highlights the some of the major land use activities and history related to the mining and development of the site and is based on our research of available documents, interviews and aerial photo analysis for the Pacific Clay property.

- The existing historical school house was built in 1912 and operated until 1960. Several residences were observed in aerial photo's surrounding the school house from at least 1949 to 1958. The area surrounding the school site was graded in 1962.
- In 1927, the Los Angeles Brick and Clay Company opened the existing clay products plant located at the northern end of the property.
- Pacific Clay Products Company moved operations from Terra Cotta City to the Alberhill area in 1940. Since then mining has been by open pit methods.
- The current clay pipe storage area (former brick plant) adjacent to Lake Street began operations sometime between 1927 and 1938.
- Portions of the High Power Pit, 25 Fire Clay Pit and the three smaller unnamed pits immediately north were excavated prior to 1938. The vast majority of the site was in an undisturbed state in 1938. The 25 Fire Clay Pit excavation expansion and other operations continued to nearly present day. It is possible that some mines were excavated into the south side of the 25 Fire Clay Pit.
- The 25 Fire Clay Pit operations expanded south into the area of the future Sun Glow Pit between 1950 and 1953.
- Between 1950 and 1953 the ERM pit was excavated to the northwest of the future Sloan Pit.

- Open-pit mining operations began in 1955 at Sloan Pit. Sloan Pit excavation, expansion and other operations have continued to nearly present day.
- Two existing 100-foot deep wells located immediately north of the existing clay brick plant were installed during the 1950's.
- Pacific Clay Products Company purchased the subject property from the Los Angeles Brick Company in 1963.
- David H. Murdock purchased Pacific Clay Products in 1973.
- Pacific Clay Products submitted an application to the State Mining and Geology Board for a reclamation plan approval in August 1978 (Converse Ward Davis Dixon, 1978).
- Mining/excavations for the reservoir/pit between the current Pacific Aggregates offices and Lake Street began between 1987 and 1988.
- A 300-foot deep well was installed between the ERM and Sloan Pits in the late 1990's.
- The Yellow Shale Pit was mined in 2005 for additional clay materials.
- The WYROC Pit was excavated intermittently for construction aggregate between 2001 and 2008.
- Numerous sedimentation ponds for disposal of washed aggregate waste products were excavated at the southern end of the site between 2006 and 2008.
- Ongoing mining of sand and gravel within the southeastern portion of the site near Lake Street for construction aggregate continue to the present day. Pacific Aggregates reportedly plans to continue expanding this operation into the near future. The deep open mine pits in this general area are not accurately depicted on the current topographic maps by KWC Engineers (KWC, 2010).

Previous Geotechnical Studies and Literature Review

Feasibility-level studies were performed by G. A. Nicoll and Associates (Nicoll, 1988a, 1988b) for a small portion of the subject property and Petra Geotechnical (Petra, 1991) provided geologic input for the subject property for a previous EIR approximately 20 years ago. The G.A. Nicoll studies included geologic mapping, subsurface exploration, and laboratory testing for small sections of the project site adjacent to Lake Street. The Petra report was primarily a reconnaissance-level engineering geologic study that was mainly a desktop review of available documents and aerial photos and included a site reconnaissance, however no detailed mapping was conducted. We also reviewed our engineering and engineering geologic investigation for the adjacent Alberhill Ranch development (Petra, 1990) which included subsurface investigation, testing and recommendations for the residential development.

Ninyo & Moore conducted a geotechnical evaluation of the feasibility for mining of construction quality aggregate within the undisturbed natural hillsides in the southwest portion of the site and the hill immediately northwest of the existing clay plant building (Ninyo, 2003). Their evaluation included exploratory borings and test pits, as well as seismic refraction lines.

Petra conducted a fault investigation within the Rice Canyon wash, immediately south of the southern property line for a proposed tentative tract (Petra, 2004). Fault trenching was conducted across the entire width of the State of California delineated Alquist-Priolo Earthquake Fault Zone (EFHZ) as well as trenching in areas of suspected lineaments outside of the fault zone near Pacific Clay's property boundary. Active faulting was not encountered within the EFHZ, however an active fault was encountered in trenches that project towards the Pacific Clay property. Petra also performed a preliminary geotechnical investigation for the proposed 30-acre commercial site and a foundation report for a proposed pedestrian bridge over Lake Street within the subject property (Petra, 2007a and 2007b). Petra conducted a feasibility study for the proposed Phase I area of development (223 acres) within the subject property (Petra, unpublished report 2008). The geotechnical investigations included subsurface investigation, laboratory testing and recommendations for future development. The unpublished Phase I feasibility study included research of the Pacific Clay site and limited geologic mapping.

We have also reviewed various published and unpublished geologic maps, reports, data and government publications which pertain to the geology of both the specific site and the general region.

Aerial Photo Analysis

Sequential black and white stereo, color oblique, and individual-frame, aerial photographs (1938 to 2007) covering portions of or all of the site area were obtained and reviewed by Petra. These photographs, obtained from Continental Aerial Photo, Whittier College (Fairchild Collection), Pacific Clay Products Archives, University of California Riverside, University of California

Santa Barbara, and Petra's in-house aerial photographic library, were at scales ranging from 1 inch equals 500 feet to 1 inch equals 4,150 feet.

Additional sources of aerial photos for review included Geo-Tech Imagery Intl., Riverside County Flood Control, USDA Soil Conservation Service, UCLA (Spence Collection), Lake Elsinore Historical Society, and the Lake Elsinore Public Library.

Interviews

Petra geologists met with Mr. Chad Warren, current Manager of Geology and Mining for Pacific Aggregates, Inc. and Dr. Karl Kottman, former mining manager at their office facilities in February 2010 to discuss and review available documents, photographs, and maps pertaining to the site history and recent mining operations. A limited search of Pacific Clay's archived files was also conducted. Pertinent information is included in our study.

Geologic Mapping

Surficial geologic mapping of the site was accomplished utilizing 100-scale topographic maps provided by KWC. The topographic information was flown on May 5, 2008 by Inland Aerial Surveys, Inc. The reconnaissance-level mapping was subsequently performed by Petra geologists between January 28 and February 2, 2010. The results of our previous geologic mapping conducted in July 2008 for the Phase I study (223 acres) is also included with this study. This information has been plotted on the enclosed Figures 2 and 3.

FINDINGS

Topography and Drainage

The site descends generally to the north-northeast towards Lake Street and Temescal Canyon Road. Elevations varied from a high of approximately 1,820 feet above mean sea level (msl) in the peaks of the natural hills within the southwestern portion of the site to a low of

approximately 1,210 feet msl at the northeastern extremity of the site along Temescal Canyon Road. Natural slope gradients on the site ranged from nearly level along ridge tops to as steep as 1:1 (horizontal: vertical [h:v]) (h:v) along the sides of the incised drainage channels. Numerous man-made cut slopes varied from 2:1 (h:v)to basically vertical up to heights of approximately 80 feet. Natural drainage is generally toward the north to northeast towards the westward flowing Temescal Creek; however, many of the natural drainage channels within the property have been re-directed or dammed entirely by haul roads and/or undocumented fills/stockpiles associated with the previous and ongoing mining operations. In addition numerous deep open pits have created localized topographic lows compared with the surrounding areas that collect surface water or are utilized as sedimentation ponds and/or reservoirs for the Pacific Clay operations. Three main north-northeast trending natural drainages formerly dissected the site and include the Rice Canyon Wash in the central portion of the site and two unnamed canyon washes, one that enters the site near the Sun Glow pit and another that crosses the northwestern corner of the site. The extreme northern portion of the site is located within the Temescal Creek floodplain.

It should be noted that the topography of the site, as shown on the topographic maps provided by KWC (KWC, 2010) and used as a base map for our geologic maps (Figures 2 and 3) may not be indicative of the most current topography due to ongoing fill stockpiling and mining operations throughout the site.

Subsurface Mines

No evidence for subsurface mines or mine shafts was observed within this property during our literature research, aerial photo analysis, or field geologic mapping. However, based on conversations with current Pacific Clay geologists it is possible that some mine shafts may have been excavated within the hillside south of the 25 Fire Clay Pit.

Regional Geologic Setting

Regionally, the site is located in the northern portion of the Peninsular Ranges Geomorphic Province of California. The Peninsular Range Province is characterized by northwest-trending mountain ranges formed and separated by a series of sub-parallel fault zones associated with the San Andreas Fault System. From west to east, these faults include primarily the Rose Canyon-Newport Inglewood, Elsinore-Whittier, San Jacinto and San Andreas Fault zones. These faults separate the continental crust into three major blocks identified as the Santa Ana, Perris and San Jacinto blocks. The subject site is located along the eastern flanks of the Santa Ana Mountains at the northern end of the northwest-trending Lake Elsinore Valley which forms the boundary between the Santa Ana and Perris blocks. Formed by extension of the en echelon Elsinore fault zone, the Elsinore Valley is a structural trough separating the Santa Ana Mountains to the west and the Perris Structural Block to the east. Lake Elsinore fills the majority of the northern part of this extensional structural basin.

The Santa Ana mountain range consists of basement rocks that include Jurassic-aged, slightly metamorphosed sedimentary and metasedimentary bedrock of the Bedford Canyon Formation, intruded by both Middle to Late Cretaceous igneous rock of the Southern California Batholith and early Cretaceous Santiago Peak volcanic rock. The Jurassic Bedford Canyon formation forms the oldest rocks within the site area, generally placed between 145 to 200 million years ago (Ma). The intrusive granitic pluton of the Southern California Batholith in the Santa Ana Mountains area has an approximate emplacement age of 110-126 Ma. The intrusive Santiago Peak volcanic rocks have an approximate emplacement age of 123 to 134 Ma making it similar in age with the older part of the Southern California Batholith.

Marine sedimentary rock of the Paleocene Silverado Formation (55 to 65 Ma) is also exposed unconformably overlying the basements rocks within portions of the site area and is further overlain by Pleistocene-aged consolidated older alluvium. Older alluvium also overlies the Bedford Canyon formation, Santiago Peak volcanics and granitic bedrock in numerous areas.

Many local valleys contain recent terrestrial sedimentary units that typically consist of Holocene topsoil, colluvium and/or alluvium (channel sands, flood plain, alluvial fans etc.).

Generally the site consists of north-to northeast-trending ridges descending from the flanks of the Santa Ana Mountains, separated by shallow to deep incised canyon drainages. Deformation resulting from broad folding, thrust and strike-slip faulting, and regional uplift has exposed the bedrock formations at or near the surface within portions of the site where they have been subsequently modified by weathering and erosion. As noted, the bedrock is often mantled by Pleistocene-age, consolidated older alluvium and more recent, unconsolidated, porous alluvium of variable depths. The more recent alluvium is primarily limited to canyon drainages. Large portions of the site are covered with recent man-made stockpiles and fill, as well as deep open mine pits related to the mining activities that have occurred on the site over the past 90 to 100 years.

Local Geology and Surface Conditions

Earth units exposed at the surface during our reconnaissance level mapping consisted of recent and historical artificial fill (stockpiles, haul roads, mine tailings, pit infill, sedimentation ponds etc), recent alluvium, colluvium and alluvial wash, Pleistocene-aged older alluvium, an intermediate clay unit Pacific Clay denotes as the Olive Formation, landslide deposits, Paleocene sedimentary bedrock of the Silverado Formation, Cretaceous granitic bedrock, Cretaceous Santiago Peak volcanics and Jurassic metamorphosed bedrock of the Bedford Canyon Formation. The units are discussed in detail below.

- Artificial Fill (no map symbol) – Undocumented fill, mine tailings, open-pit infill, and soil and aggregate stockpiles were encountered across large portions of the site. The depths of many of these areas are unknown at this time but may be as deep as 50 feet or greater below existing grades in some areas.

- Alluvium (no map symbol) – Alluvium and colluvium of Holocene-age was present along the natural and diverted drainages and within the floodplain area at the northern end of the

site. Alluvial deposits are considered to be unconsolidated and subject to varying degrees of settlement.

- Older Alluvium (map symbol Qoal) – Pleistocene-age older alluvium was observed at various locations across the site and is generally comprised of consolidated to locally cemented, silty sand to sands which include gravel-to cobble-sized sedimentary and granitic clasts. This unit caps many of the older bedrock units at variable depths.

- Olive Formation (map symbol Qofm) – A stratigraphicaly thin intermediate clay unit underlying the older alluvium and overlying the Silverado Formation is exposed in various areas through the site. This clay unit does not appear to be part of the Silverado Formation and have been named the Olive Formation by Pacific Clay geologists. It is estimated to be of early Pleistocene age but is not definitively age dated. This material is discontinuous across the site and where exposed is observed to consist of olive green plastic clays that are susceptible to landsliding in slope areas.

- Landslide Deposits (map symbol Qls) – Several landslide and surficial failures/slumps were encountered within portions of the site generally attributed to areas of Silverado Formation bedrock and the Olive Formation. Some of the failures were observed in man-made oversteeepened cut slopes within open-pit mine excavations such as the 25 Fire Clay pit and the Sun Glow Pit. Exposures of the Olive Formation within many slope areas also showed signs of surficial failures and are know by Pacific Clay geologists to be problematic during excavating.

- Tertiary Silverado Formation Bedrock (map symbol Tsi) – Exposures of the Paleocene-aged Silverado Formation were observed in many of the mined open-pit cut slopes within the central portion of the site. Silverado Formation was also encountered beneath the older alluvium during our previous investigations at the eastern end of the site. This unit is juxtaposed with the Bedford Canyon Formation by faulting at the 25 Fire Clay pit. This bedrock typically consists of marine and non-marine thin to thickly interbedded sandstones, siltstones and claystones that are tilted to varying degrees.

- Cretaceous Granitic Bedrock (map symbol Kgr) – Undifferentiated intrusive granitic bedrock (granite, granodiorite, tonalite, diorite etc.) is exposed within the hillsides at the southern extremity of the site on either side of the Rice Canyon wash. The unit is typically highly weathered at the surface by chemical and mechanical processes and was found to be moderately hard to hard, fractured and locally faulted.

- Cretaceous Santiago Peak Volcanic Bedrock (map symbol KJsp) – Intrusive volcanic rocks were exposed in the hillsides in the southwestern portion of the site and the hill immediately west of the existing clay brick plant. These materials consisted primarily of latite and dacite

porphyries that were grey, brown-grey or yellow brown, hard to very hard, massive, slightly to moderately weathered in the near surface and closely fractured/jointed.

- Jurassic Bedford Canyon Bedrock (map symbol Jbc) – Bedrock of the Bedford Canyon Formation was exposed at the surface north and northwest of the ERM and Sloan Pits as well as south of the 25 Fire Clay Pit and several hills in the south central portion of the site. The Bedford Canyon Formation typically forms resistant ridges and consists of massive, hard to very hard metasedimenatry rock that is jointed and highly fractured.

Groundwater

Groundwater was encountered during our previous geotechnical investigation in the 30-acre commercial site near Lake Street and groundwater is reported by Pacific Clay to be at very shallow depths at the north end of the site near Temescal Creek. (Petra, 2007a, 2007b). Surface water has collected in many of the ponds and topographic low points at various locations throughout the site. In addition perched groundwater has been routinely encountered within differing bedrock units during the course of mining operations by Pacific Clay geologists.

Faulting

Numerous active faults exist in southern California most of which exist to accommodate right-lateral shear deformation associated with the relative motion between the Pacific and North American tectonic plates. Thus, southern California is along a tectonic plate boundary, with most of the motion between the plates accommodated by the San Andreas Fault System. Within this system, most of the active faults in southern California strike toward the northwest and include (east to west) the San Andreas fault (proper), the San Jacinto fault, the Elsinore fault, the Rose Canyon-Newport Inglewood fault and various offshore faults.

Although the site exists just outside of the limits of a *Fault Hazard Zone* for the Elsinore fault zone, as defined by the state of California in the Alquist-Priolo Earthquake Fault Zoning Act, portions of the southern end of the site are located within a Riverside County Fault Zone. The faults located within the southern boundary of the site are thought by Riverside County and in our professional opinion, to be potentially active. In the State of California, an *active* fault is

considered to have had surface displacement within Holocene time or approximately during the past 11,000 years. The property is located in an area of relatively complex faulting within the Elsinore fault zone that exhibits numerous faults across a 3,000- to 4,000-foot wide zone. This complexity is partly associated with a large *releasing step over* within the Elsinore fault zone that consists of the Glen Ivy North fault on the north side of Lake Elsinore and the Wildomar fault on the south side of Lake Elsinore. The southern end of the site resides essentially at the northern end of the *releasing step over*.

The Elsinore fault zone consists of en-echelon, northwest to west-northwest-trending faults. Many of these faults are accompanied by geomorphic and geologic features that indicate they have been active during late Pleistocene and Holocene time. Displacement of Holocene-age sediments and evidence for ground-surface rupture associated with the May 15, 1910 earthquake have been documented in a trench in Temescal Valley along the Glen Ivy segment of the Elsinore fault zone (Millman and Rockwell, 1986). The Glen Ivy segment is capable of producing an earthquake with a maximum moment magnitude of 6.8 with a moderately constrained slip rate of 5±2 millimeters per year (CGS, 2002).

The northern fault strand within the 3,000- to 4,000-foot wide fault zone in the area of the site is called the Glen Ivy North fault, which, in our professional opinion, is likely the main trace of the Elsinore fault zone in the area. However, this portion of the fault is not within the California State EFHZ. The Glen Ivy North fault is currently mapped within the southern boundary of the property. These potentially active faults are shown on the attached Figure 2 in the south and southwestern corners of the property. Based on our fault investigation south of the site in the Rice Canyon Wash, an active splay of the Glen Ivy North fault projects towards the property (Petra, 2004).

Based on review of Pacific Clay's files, numerous other bedrock faults are delineated on Pacific Clay geologist's cross sections throughout the property. These bedrock faults are buried under

older alluvium at variable depths and do not have a surface expression, thus indicating they are considered to be inactive faults.

Landslides

Although not mapped on regional geologic maps, landslides and/or surficial failures were observed and mapped within the site boundaries. Several of these failures have occurred due to man-made cut slopes in the Silverado Formation bedrock such as within the Sun Glow pit area and the 25 Fire Clay pit area. In addition, evidence of surfical slope failures was commonly observed in the weak plastic clay of the Olive Formation.

CONCLUSIONS

Development Feasibility

Based on our research and review of pertinent geotechnical literature and on the surficial geologic mapping, development of the Alberhill Villages Specific Plan is considered feasible from a geotechnical standpoint. However, there are a number of geologic and geotechnical constraints inherent to the property that should be considered during the design process. These constraints and other preliminary design considerations should be more thoroughly investigated at the Tentative Map-level of planning for the Alberhill Villages Specific Plan and are presented in the following paragraphs.

GEOLOGIC AND GEOTECHNICAL CONSTRAINTS

Active Faulting

Several splays of the Glen Ivy North fault, a segment of the Elsinore Fault Zone, are mapped as crossing portions of the southern end of the property and are shown on Figures 2 and 3. Although the site is not located within a State-determined Alquist-Priolo Earthquake Fault Zone these splays are within a Riverside County fault zone and are considered potentially active.

Additionally, previous work by Petra immediately south of the site in the Rice Canyon wash has indicated that at least one of these splays is active. If structures for human occupancy are planned to be developed within these areas then a subsurface fault study would be necessary to locate the faults and determine whether they are active or inactive. If development of structures for human occupancy or structures sensitive to ground rupture are not planned in these areas then a fault investigation would not be required.

Hard Rock

Outcropping of hard to very hard Bedford Canyon Formation, Santiago Peak Volcanics and granitic bedrock exposed at the surface and on hillsides was observed in various areas of the property. These geologic units are depicted on Figures 2 and 3. Difficulty in excavating these materials is anticipated due to the hard nature of the bedrock. Significant costs associated with excavation and/or blasting of the bedrock hillsides should be expected. In addition substantial amounts of oversize rock may be generated that may not be suitable for use in engineered fills. Seismic tomographic line survey or an evaluation with an air-trac drill rig would help constrain the depths of hardness of the bedrock to help determine the amount of blasting, if any, that may be necessary.

Landsliding and Potential Slope Instability

Evidence of slope failures was observed during our field mapping and discussions with the Pacific Clay geologists. In addition, there is a potential to create additional unstable slopes during future site development. As discussed, portions of the site have large stockpiles of uncompacted, undocumented fill that might be subject to slope failures in their current condition. Additionally, if cut slopes are proposed in Silverado Formation, Olive Formation or Bedford Canyon Formation and Santiago Peak bedrock, they may encounter an out-of-slope component depending on the dip of the Silverado Formation bedding, and/or the fracturing/jointing/faulted pattern of the Bedford Canyon Formation and Santiago Peak volcanic bedrock. Further evaluation within specific areas, including subsurface exploration with a bucket auger and

computer models for slope stability analysis may be necessary depending of the proposed grading concept with regards to potential cut slopes areas.

Compressible Soils

The most extensive geotechnical constraint, with regards to the subject property, are the areas of compressible soils which are generally comprised of undocumented fill, mine tailings, soil and aggregate stockpiles, open-pit mine infill, saturated open-pit excavations and recent alluvium/colluvium. The horizontal extent of the compressible soil areas are shown as the uncolored areas on Figures 2 and 3; however the depths to competent soils and/or bedrock are unknown at this time. Depending on the development scheme, the project could be impacted by significant costs with regards to remedial grading. Subsurface geotechnical drilling, sampling and laboratory testing would help constrain the depths of compressive soils in areas that would require remedial grading.

Expansive Soils

Although not specifically tested as part of this study, expansive soil may be encountered throughout portions of the site. In addition, highly expansive soils were encountered within the Silverado Formation bedrock during the subsurface investigation for the 30-acre commercial site by Petra at the eastern end of the site (Petra, 2007a). Based on the fact that the site was previously mined for clay products, we also anticipate encountering some clayey, expansive soil materials within areas of mined stockpiles and/or tailings. Although the extent of these materials is currently unknown, Petra assumes that expansive soil materials will be encountered during site development and specialized grading recommendations may be needed.

Liquefaction Potential

Portions of the site are delineated as having a moderate potential for liquefaction based on Riverside County Land Information System, and groundwater is anticipated to be within 50 feet for portions of the site. Based on these facts, there is the potential for dynamic settlement within areas of the site underlain by undocumented fill and/or recent alluvium during a seismic event. The liquefaction potential will need to be evaluated during the geotechnical investigation phases within specific areas of the site that are to be developed with building structures in accordance with the State of California's guidelines presented within Special Publication 117. This would include subsurface drilling and sampling to at least 50 feet below ground surface, laboratory testing of samples obtained at or below the water table, computer modeling and engineering analysis.

Strong Ground Motions

The subject site is located within a seismically active area of southern California that is likely to be subjected to moderate to strong ground shaking during the life of the project. Structures should be designed to resist the effects of seismic ground motions as provided in the applicable building code requirements when the site is developed in the future. Seismic design parameters and peak ground accelerations will be provided during the future site specific geotechnical investigations. The anticipated seismic-induced ground motions are anticipated to be accommodated by design parameters of the 2007 CBC.

Suitability of On-Site Materials for Use as Engineered Fill

Based on our surficial observations at the subject site, the vast majority of soil materials would be suitable for use as engineered fill. As previously discussed expansive soils may be encountered during site development that may require special recommendations and/or oversize rock may be generated during excavation/blasting of Bedford Canyon Formation, Santiago Peak and/or granitic bedrock. Saturated soils, if encountered, would be suitable provided they are air-dried back to near optimum moisture content. As with most remedial grading, the majority of

soils exposed at or near the surface would require moisture conditioning to near optimum moisture for use as engineered fill.

Shallow Groundwater

Although shallow groundwater is not anticipated to impede the majority of the proposed development, numerous surface ponds/reservoirs are located within the property. Depending of the proposed development scheme, these areas may need to be drained of the surface water followed by remedial grading to prepare these areas for future engineered fill placement. Additionally, the extreme northern portion of the site near Temescal Creek is anticipated to encounter groundwater at shallow depths. If deep excavations are proposed, perched groundwater or seepage may also be encountered.

RECOMMENDATIONS

Mitigation of Geologic /Geotechnical Constraints

Active Faulting

Subsurface fault trenching should be performed during the Tentative Map phase of planning in all areas where structures for human occupancy, as well as structures sensitive to ground rupture, are proposed and active faults are mapped or are suspected. The areas of known potentially active faulting are currently limited to the south central extremity and the southwestern corner of the site as shown on Figures 1 and 2. If these faults are located but proven to be inactive, or if there is no evidence of faulting, then the proposed development will not be constrained by a fault surface rupture hazard. If active fault strands are discovered, then appropriate fault setbacks will be required for structures for human occupancy. Evidence of active faults do not preclude other forms of development such as roadways, park sites, graded slopes etc.

Hard Bedrock

Geotechnical studies should be performed at the time definitive grading plans have been prepared for each site to evaluate the excavation and rippability characteristics of the Silverado Formation (Tsi), Bedford Canyon Formation (Jbc), Santiago Peak (KJsp) and Granitic (Kgr) bedrock materials. These studies may indicate the possible need for blasting. A combination of several techniques are available to evaluate bedrock excavation and rippability characteristics that include seismic tomographic (refraction) line surveys, air-trac borings and excavation of test trenches utilizing a large excavator.

To facilitate future excavation of building footings and utility trenches with backhoes and wheel trenchers, hard bedrock exposed at finish grade in building pad and street areas should be overexcavated and replaced with compacted fill. The depths of overexcavation in building areas, in general, should extend to a depth of about 2 to 3 feet below the bottoms of the footings or to the depth of the deepest utility, whichever is greater. The depths of overexcavation in street areas should extend to at least 1 foot below the depth of the deepest utility.

Landslides and Potential Slope Instability

Areas that have been mapped as landslides or areas that have suspect soils and bedrock materials know to be susceptible to slope failure should be fully investigated utilizing down-hole geologic logging of bucket auger borings to evaluate the geologic structure and analyze the potential for future failures and to provide engineering recommendations for stabilizing these areas. Areas of known landslide will require (remedial) grading to remove the slide mass to competent materials (bedrock) and replacing with a compacted buttress fill.

Depending on their orientation, proposed cut slopes excavated in the Silverado Formation bedrock or Olive Formation may expose bedding components that dip out-of-slope and create an unstable slope condition. In addition, proposed cut slopes excavated in the Bedford Canyon or Santiago Peak bedrock may expose unfavorable out-of-slope fracturing/jointing patterns that

may also create an unstable slope condition. Therefore, additional mapping of bedrock discontinuities and large-diameter bucket auger borings are recommended in proposed cut slope areas to evaluate bedrock structure. Analysis of the geologic structure of the bedrock and the shear strength of the soil and bedrock materials will determine the gross (global) and surficial stability of the proposed slopes. Where instability is anticipated, the cut slope may be reconstructed as either a buttress fill or stabilization fill slope depending on the nature of the instability. Proposed cut slopes excavated in existing undocumented artificial fill materials or low density alluvial soils will be grossly unstable and should be reconstructed as engineered fill slopes.

In addition, all existing large and/or overstepped cut slopes created by the previous mining operations will need to be analyzed for existing gross stability and how these slopes will impact the future development.

Compressible Soils

Compressible soils identified throughout the property are generally comprised of undocumented fill, mine tailings, soil and aggregate stockpiles, open-pit mine infill, saturated open-pit excavations and recent alluvium/colluvium. Any compressible soils that exist within proposed structural fill areas, or any that remain in-place at finish grade in proposed cut areas, should be removed to underlying competent bedrock or older alluvium and then replaced as compacted fill. Subsurface exploration combined with sampling and laboratory testing of the onsite soils should be performed to determine the horizontal limits and the depths of remedial grading that will likely be required.

Expansive Soils

Expansive soils are present throughout much of the property. Without proper mitigation measures, expansive soils can have an adverse effect on building foundations, street improvements (i.e., pavement sections) as well as a variety of other site improvements (i.e.,

walkways, driveways, masonry walls, etc.). Subsurface exploration combined with sampling and laboratory testing of the onsite soils should be performed to determine their expansion potential characteristics in order to develop specific geotechnical design parameters for building foundations and site improvements to mitigate the effects of expansive soils.

Such mitigation measures typically entail removal of the expansive soils from beneath the affected areas, replacing them with non-expansive soils. Other mitigative measures include compensation in the building or improvement design to accommodate expansive soils, or treatment of expansive soils with lime or cement to enhance soil characteristics.

Liquefaction Potential

The potential for earthquake-induced liquefaction should be evaluated in areas of the property underlain with recent alluvial deposits that have been delineated by the Riverside County Land Information System as having a moderate potential for liquefaction. A series of hollow-stem auger borings, rotary wash borings and/or cone penetration tests (CPT) extending to a depth of least 50 feet or to bedrock, whichever occurs first, should be conducted in selected areas to determine the depths to groundwater and the in-situ physical characteristics of the subsurface soils. The potential secondary effects of liquefaction should also be evaluated, such as ground subsidence, dynamic settlement, lateral spreading and manifestation of liquefaction at the surface (i.e., sand boils, foundation bearing failure). If the liquefaction analyses indicate a potential for earthquake-induced liquefaction is present within any portions of the property, mitigation recommendations will be provided. The recommendations may include ground modification measures and/or the use of special foundation types such as deep foundations, post-tensioned slabs or mat foundations.

Strong Ground Motions

Since the subject property is located within a seismically active area of southern California, moderate to strong ground shaking can be expected within the site during the life of the project.

Therefore, structures should be designed the resist the effects of seismic ground motions as provided in the applicable building codes at the time the site is developed. Seismic design parameters and peak ground accelerations will be provided as part of future site specific geotechnical investigations.

Suitability of On-Site Materials for Use as Engineered Fill

On-site soil and bedrock materials that are free of hard rock greater than 12 inches in maximum dimension, and any trash, organics or similar deleterious materials will be suitable for use as engineered fill. Rock greater than 12 inches in maximum dimension may be buried in deep fill areas utilizing special grading techniques such as placing the rock in windrows or as rock blankets. Specific recommendations and grading techniques for burying oversize rock would be provided as part of future site specific geotechnical investigations.

Surface Water and Shallow Groundwater

Temporary dewatering may be required during remedial grading operation such as removal and recompaction of low-density alluvial materials, as well as removal of compressible soils that exist in ponded areas. In addition, materials subject to removal may be very moist to saturated and will be unsuitable for placement as engineered fill until the moisture content has been reduced to a satisfactory level. This will require large areas to spread the wet materials and allow drying. Additional equipment would also be required to periodically turn the materials to facilitate the drying process and promote uniformity of the material moisture content. Specific recommendations and grading techniques would be provided as part of future site specific geotechnical investigations.

RECOMMENDATIONS FOR ADDITIONAL STUDY

The findings and conclusions presented in this geologic constraints evaluation are based on the research and preliminary field mapping performed by Petra for the Pacific Clay Specific Plan. When Tentative Tract and Final maps for each of the subsequent project sites have been

developed, additional studies, including preliminary subsurface investigations, detailed geologic mapping and geotechnical testing and analysis, will be necessary to provide detailed recommendations that are appropriate for the proposed construction. The following is a synopsis of the typical types of studies that may be performed during the subsequent development phases.

Tentative Tract Map Phase

- Subsurface fault investigations in areas of known or suspected active faulting.
- Clearing areas of potential ground surface rupture hazards and/or establishing fault setback zones.
- Detailed geologic mapping within areas of proposed development.
- Geophysical and/or air-trac subsurface investigations to evaluate the ripability of hard bedrock units and/or possibility of blasting.
- Drilling of geotechnical hollow-stem auger borings and or excavating test pits in areas of compressible soils (fill and natural alluvium) to determine the depths to competent materials.
- Excavating large-diameter bucket auger borings for down-hole geologic logging and subsequent slope stability analysis in slope areas of know or suspected landslides and failures as well as proposed cut slopes to be excavated within suspect geologic units.
- Evaluate the potential for liquefaction in areas with suspected shallow groundwater and soil materials prone to liquefy under seismic shaking. A combination of CPT soundings or geotechnical hollow-stem auger borings may be utilized
- Evaluation of groundwater, if encountered within our borings, with respect to the grading design concept.

Final Tract Map Phase

- Comparison review with the previous Tentative Tract map for design changes.
- Site specific 40 grading plan reviews.
- Grading specific recommendations, including but not limited to areas for disposal of oversize rock, slope buttressing or stabilization, specialized grading for highly expansive soil materials etc.
- Site specific supplemental geotechnical investigations which may include additional subsurface borings, test pits, CPT's and/or geophysical methods depending on the location of the proposed structures and/or changes to the grading concept.
- Preliminary foundation design recommendations.

EVALUATION LIMITATIONS

This report is based on the project site as shown on the 100-scale topographic maps (KWC, 2010) provided for our review and our geologic and geotechnical research as described herein. The surface materials encountered during our evaluation are believed representative of the project area and the conclusions and recommendations contained in this report are presented on that basis.

This report has been prepared in a manner consistent with the level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and, as such, are not to be considered a guarantee or warranty.

We hope this information meets your needs at this time. Should you have questions, please contact this office.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Douglass L. Johnston, CEG	Grayson R. Walker, GE
Project Geologist	Principal Engineer
CEG 2477	GE 871

Attachments: References
Figure 1 – Site Location Map
Figures 2 and 3 – Geologic Maps

Distribution: (2) Addressee
(2) KWC Engineers, Attn: Mr. Ken Crawford
(4) The Planning Associates, Attn: Mr. Hardy Strozier
DJ/GW/jg/kms

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CASTLE & COOKE ALBERHILL RANCH INC. March 16, 2010
Pacific Clay Property/Lake Elsinore J.N. 118-10

Aerial-Photographs Reviewed

Agency	Date	Flight - Photo Number	Scale 1 inch = --- feet
Davidson Library, UCSB	7/28/1938	AXM-73 – 28, 29	1,500
Fairchild Collection	1947	C-11730 F – 20-3, 20-4	1,500
Continental Aerial Photo	5/6/1949	AXM-3F – 128, 129	1,500
Petra In-House Library	5/6/1949	AXM-3F – 127, 128	1,500
Fairchild Collection	6/10/1954	C-20546 – 1:8, 1:9	2,000
Fairchild Collection	10/24/1955	C-22280 – 5:131, 5:132, 5:133, 5:134, 5:135, 5:136, 5:142, 5:143, 5:144, 5:145, 5:146,	600
Fairchild Collection	10/28/1955	C-22280 – 6:5, 6:6, 6:7, 6:8, 6:9, 6:10, 6:49, 6:50, 6:51, 6:52, 6:53	600
Fairchild Collection	1958	C-23023 – ORA:99, ORA:99, RIV:5:95, RIV:5:96	3,000
Pacific Clay Archives	May 1958	23023 – 5-99	3,000
Fairchild Collection	August 1961	C-24153 – 50, 51, 52, 53	1,000
Petra In-House Library	1/2//1962	24244 – 184, 185, 186, 449	1,800
Continental Aerial Photo	5/15/1967	AXM-3HH – 246, 247	1,800
Petra In-House Library	11/22/1969	43, 44	1,000
Petra In-House Library	6/20/1974	578, 579	2,000
Petra In-House Library	6/20/1974	578, 579, 580	3,000
Continental Aerial Photo	2/15/1977	RIV – 6-01, 6-02	4,150
Petra In-House Library	1/20/1984	929	1,600
Pacific Clay Archives	9/15/1987	W.O. 236-87 – 1-1, 1-2, 1-3, 1-4, 1-5	500
Continental Aerial Photo	2/11/1988	C-80 – 61-26, 61-27	
Continental Aerial Photo	9/23/1988	C-80 – 63A-1	2,125
Petra In-House Library	Sept. 1989	9899 –Hunsaker (7 unmarked oblique color photos)	Various

CASTLE & COOKE ALBERHILL RANCH INC. March 16, 2010
Pacific Clay Property/Lake Elsinore J.N. 118-10

Aerial-Photographs Reviewed

Agency	Date	Flight - Photo Number	Scale 1 inch = --- feet
Petra In-House Library	9/9/1989	9899 – 3-1, 3-2, 3-3, 3-4, 4-1, 4-2, 4-3, 4-4	500
Continental Aerial Photo	6/24/1993	C-94-11 – 84, 85	2,000
Continental Aerial Photo	9/11/1997	C-116-38 – 102, 103	2,000
Continental Aerial Photo	3/2/1999	C-135-38 – 66, 67	2,000
Petra In-House Library	3/2/1999	C-135-38 – 97, 98	2,000
Petra In-House Library	7/27/2005	12-10, 12-11	1,800
KWC Engineers	1/5/2006	N/A	500
KWC Engineers	1/3/2007	N/A	500

Riverside County

38655 Sky Canyon Drive, Suite A
Murrieta, California 92563
951-600-9271

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Engineers, Geologis
Environmental Scientis

COPY

February 28, 2007
J.N. 137-07 & 140-07

Mr. Scott Thayer
CASTLE & COOKE COMMERCIAL – CA, INC.
2470 Tuscany Road, Suite 104
Corona, California 92881

Subject: Preliminary Geotechnical Investigation, Proposed 30-Acre Commercial Site and Nichols Road Extension, Pac Clay Lake/Nichols South and North, City of Lake Elsinore, Riverside County, California

Dear Mr. Thayer:

In accordance with your request, Petra Geotechnical, Inc. (Petra) has prepared this preliminary geotechnical investigation report for an approximately 30-acre property located west of Lake Street, identified as the Pac Clay Lake/Nichols South and North sites, in the City of Lake Elsinore, California. This report presents the findings and opinions with regard to the feasibility of the proposed commercial project with respect to the geotechnical factors that may have an impact on site development. This report is based on review of information provided by you, available geologic information, review of aerial photographs, site reconnaissance, limited subsurface investigation and laboratory testing of collected soil samples.

EXECUTIVE SUMMARY

The soils encountered in the exploratory borings during this investigation included undocumented fill (0 to 58 feet thick), alluvium (0 to 16 feet thick), older alluvium (0 to 53 feet thick) overlying Silverado Formation bedrock. The surficial materials (undocumented fill, topsoil and alluvium) were generally loose to poorly consolidated and porous while the older alluvial sediments were generally medium dense to dense and consisted of silty sands and clayey sands with gravel and cobbles. The underlying Silverado Formation bedrock were generally

hard to very hard and consisted of claystone, siltstone and sandstone. Based on Petra's review of available geotechnical and geologic reports, site reconnaissance, limited subsurface exploration and laboratory testing, the following key geotechnical issues are presented.

- Remedial Grading – Remedial grading will consist of removal and recompaction of the upper 0 to 10 feet of the majority of the site with local, deeper removals from 10 to 15 feet in swale and canyon drainages. Overexcavation of highly expansive material, including claystone found in the upper units of the Silverado Formation, is recommended below and adjacent to proposed structures.

- Groundwater – Groundwater was encountered in several exploratory borings across the site. Groundwater was encountered in our exploratory borings as shallow as 5 feet below existing ground surface. Groundwater is anticipated during the grading of the site. Mitigation for shallow groundwater conditions should be anticipated with future designs of the proposed commercial development.

- Faulting –The site does not lie within a fault hazard zone. Active faulting, requiring structural setbacks, is not anticipated on the site.

- Strong Ground Shaking – Due to the site's close proximity to the active Elsinore fault, site improvements should be designed to resist strong ground shaking.

- Liquefaction – Subsequent to removal of undocumented artificial fill and alluvium and, due to the density of the older alluvium and Silverado Formation bedrock, liquefaction is not anticipated to impact the site.

- Hard Rock – Surficial soils and bedrock underlying the site should be readily excavated utilizing conventional earthmoving equipment. Excavation in the older alluvium will generate some gravel and cobbles.

- Blasting – No blasting is anticipated.

- Expansion Potential – Based on laboratory testing, onsite soils and bedrock materials we found to have from **VERY LOW** to **VERY HIGH** expansion potential.

- Foundations –Conventional slab-on-ground foundations will likely be satisfactory for commercial structures. However, for some foundations, post-tensioned slabs or piers may be required to mitigate uplift from potentially expansive material.

INTRODUCTION

This report presents the results of Petra's preliminary geotechnical investigation for the proposed commercial site located west of Lake Street within the Alberhill Ranch area of the City of Lake Elsinore, California. The purposes of our preliminary geotechnical investigation were to obtain geotechnical and geologic information on the nature of the surface- and subsurface-soil conditions, evaluate their in-place characteristics and provide geotechnical recommendations for planning purposes in the development of site plans. This evaluation also included a review of published and unpublished geotechnical literature, aerial photograph review, as well as review of geologic maps pertaining to active faults that lie in proximity to the site and which may have an impact on the proposed construction. This report presents the result of our preliminary geotechnical investigation, as well as our conclusions and recommendations for the proposed development.

Site Location and Site Description

The subject site encompasses approximately 30.7 acres and is located immediately west of existing Lake Street at the future Lake Street intersection with Nichols Road, currently under construction, in the northwestern portion of the Alberhill Ranch area in the City of Lake Elsinore, California. The site is located in an area defined as the Murdock Ranch Mine on the Pacific Clay Products, Inc. property and is bordered on the east by the recently mass-graded Lake Street realignment and to the north, west and south by undeveloped property. A man-made pond is located approximately 150 feet southwest of the proposed southern property line created during Pacific Clay Product, Inc.'s ongoing mining operations. The approximate location of the site is shown on Figure 1.

The western one-third of the property is characterized by gently sloping, native, undisturbed slopes incised by two alluvial-drainage channels descending to the north-northeast. The central and eastern portions of the site is comprised of several undocumented-fill stockpiles

(approximately up to 70 feet in height) and mining excavations that have greatly disturbed the natural surface of the site.

The eastern edge of the property, along the proposed commercial site property line, has also undergone recent mass-grading to facilitate construction of the Lake Street realignment from approximate Stations 53+40 to 75+60. Currently, a storm-drain line is being installed within the Lake Street realignment.

Proposed Development and Grading

It is our understanding that development of the site will consist of several small- to large-sized, commercial-type structures with associated parking and drive areas and retaining walls. At the time of this investigation, conceptual-grading plans were not developed; however, the preliminary-site plan provided by KWC Engineers (KWC, 2006) indicated the grades and alignment of the Nichols Road extension and the proposed property lines. Using the proposed grades along Nichols Road extension (elevations 1,351 to 1,361 feet mean sea level [msl]), we assumed the majority of the southern parcel (approximately 17.4 acres) will be cut to create level building pads to within 5 to 10 feet of Nichols Road extension. The northern parcel (approximately 13.3 acres) is generally lower than the proposed Nichols Road; therefore, Petra is assuming this portion of the site will require engineered fills of variable depths to create level building pads with some minor cut areas. Extensive amounts of earthmoving would be required to achieve the configuration assumed, requiring deep cuts and fills from existing grades.

Possible cut slopes are anticipated along the southern and western property lines descending to the north and east with assumed heights up to approximately 50 feet at a ratio of 2:1 (horizontal:vertical [h:v]). Assumed fill-slope heights located in the northern parcel may be up to approximately 25 feet at a ratio of 2:1 (h:v). Possible retaining-wall heights were not available at the time of our report. We understand that the majority of materials (i.e. fill stockpiles, topographic highs, etc.) may be exported from the site by Pacific Clay Products, Inc.

One- to two-story commercial and retail structures are anticipated. Details of the proposed building locations and related foundation configuration and loads were not available at the time of this investigation.

Existing Improvements and Vegetation

Vegetation within the site consisted of moderate to dense brush on the flanks of the natural slopes on the western one-third of the site with a few large trees observed at the central portion of the site and within the drainage channel at the northwest corner of the site. The eastern portion of the site was void of vegetation growth due to current mining and stockpiling operations.

Two existing overhead power/telephone lines also traversed the site. One line parallel to the east-west trending main haul road and crossing Lake Street at approximately Station 67+00 and the other line trended northwest-southeast at the northern end of the site and crosses Lake Street at approximately Station 69+00. Petra observed ongoing mining and export operations in the northern and eastern portions of the site between the existing power lines during our current investigation

Topography and Drainage

Elevations in the natural undisturbed land varied from approximately 1,410 feet above msl within the southwest portion of the site to approximately 1,310 feet msl at the northern extremity of the site. Natural-slope ratios on the site ranged from nearly level along ridge tops to as steep as 3:1 (h:v) along the incised drainage channels. Natural drainage was generally toward the north-northeast; however; the natural-drainage channels on the southwestern side of the property have been dammed by undocumented fills at the central portion of the site due to the east-west-trending main-haul road.

Elevations varied significantly in the stockpile/mining areas within the central and eastern portions of the site from approximate highs of 1,425 to 1,435 feet msl within the largest two

stockpile areas in the central portion of the site, to approximate lows of 1,327 feet msl adjacent to Lake Street near Station 70+00. It should be noted that the topography of the eastern part of the site, shown on the preliminary site plan provided by KWC (KWC, 2006) and used as a base map for our geotechnical investigation (Plates 1 and 2), is not indicative of the actual current topography due to recent fill stockpiling and mining operations.

Purpose and Scope of Services

The purpose of this study was to obtain subsurface information and background data within the site in order to provide geotechnical recommendations with regard to proposed development of the property and to characterize underlying subsurface conditions. The scope of services was as follows.

- Review of available reports prepared by Petra and other geotechnical consultants for the site and general vicinity.
- Review historic stereoscopic-aerial photographs of the property vicinity to evaluate site geomorphology and previous land usage.
- Coordinate with the local underground utilities locating service (Underground Service Alert) and Castle & Cooke Commercial – CA, Inc. representatives to obtain an underground utilities clearance prior to commencement of the subsurface investigation.
- Drill 13 hollow-stem auger borings and four bucket-auger borings.
- Log and visually classify soil materials encountered in our borings in accordance with the Unified Soils Classification System.
- Collect representative bulk and undisturbed soil samples at various depths for laboratory testing.
- Perform laboratory tests on soil and formational samples.
- Prepare a geotechnical map showing the locations of our borings and geologic units.
- Perform geologic and geotechnical engineering analyses on data collected.

- Prepare a geotechnical report presenting the results of our evaluation and provide recommendations for the proposed development in general conformance with the requirements of the 2001 California Building Code (CBC) as well as in accordance with applicable State and local jurisdictional requirements.

INVESTIGATION AND LABORATORY TESTING

Aerial-Photo Analysis

Sequential stereo-aerial photographs (1949 to 2002) covering the site area were reviewed by Petra. These photographs, obtained from Riverside County Flood Control, Continental Air Photo and Petra's in-house aerial photo library, were at scales ranging from 1 inch equals 500 feet to 1 inch equals 3,000 feet.

Previous Geotechnical Studies

Previous geotechnical investigations adjacent to the site along Lake Street were conducted by Petra (Petra, 2006a; 2006b). The investigation included drilling six exploratory hollow-stem auger borings adjacent to the property. Approximate locations of these borings are shown on the enclosed Plates 1 and 2. Geotechnical logs of our previous borings are included in Appendix A (Petra, 2006a).

Geologic Mapping

Surficial geologic mapping of the site was accomplished utilizing a preliminary site plan provided by KWC (KWC, 2006). The mapping was subsequently performed by a Petra geologist during field exploration operations from September 29 through October 12, 2006. This information has been plotted on the enclosed Plates 1 and 2.

Field Exploration

Subsurface exploration was conducted under the observation of a Petra geologist from October 3 through October 11, 2006, and consisted of drilling 13 exploratory borings utilizing a CME-75, 8-inch diameter hollow-stem auger drill rig to a maximum explored depth of approximately 81

feet below the existing ground surface. Additionally four 30-inch diameter, bucket-auger drill rig borings were also excavated to a maximum depth of approximately 60 feet below existing ground surface and downhole-logged by a Petra geologist. The hollow-stem auger borings were excavated in order to collect representative data of the subsurface soils. The bucket-auger borings were excavated in order to evaluate subsurface geologic contacts in areas where cut slopes may be proposed. Earth materials encountered within the borings, as well as observed during geologic mapping, were classified and logged in accordance with the visual-manual procedures of the Unified Soil Classification System. The approximate locations of the exploratory borings are shown on Plates 1 and 2 and geologic cross-sections depicting site geology are shown on Plates 3 and 4. Descriptive logs of the subsurface-soil conditions at each boring location are presented in Appendix A.

Associated with the subsurface exploration was the collection of bulk samples and relatively undisturbed samples of soil materials for classification, laboratory testing and engineering analysis. Bulk samples were collected from the bucket-auger cuttings. Selected soil samples were obtained at various depth intervals and sealed in plastic bags for transport to our laboratory. Undisturbed soil samples were collected from each of the exploratory hollow-stem and bucket-auger borings using a 3-inch, outside diameter, modified California split-spoon soil sampler lined with 1-inch high brass rings. With the hollow-stem auger drill rig, the modified California split-spoon soil sampler was driven with successive 30-inch drops of a 140-pound automatic-trip hammer. The central brass rings from the sampler were placed in sealed containers and transported to our laboratory for testing. The number of blows required to drive the split-spoon sampler 18 inches was recorded in 6-inch increments. However, the number of blows required to drive the split-barrel sampler for the last 12 of the 18 inches was identified as the blows per foot. The bucket-auger boring soil sampler was driven with successive 30-inch drops of the 4,500-pound drill rig Kelly bar.

Standard penetration tests were also performed on the hollow-stem auger borings in accordance with the American Society for Testing and Materials Standard Procedure (ASTM) D1586. This

method consisted of driving an unlined standard split-barrel sampler 18 inches into the soil with successive 30-inch drops of a 140-pound automatic-trip hammer. Blow counts were recorded for each 6-inch driving increment; however, the number of blows required to drive the standard split-barrel sampler for the last 12 of the 18 inches was identified as the standard penetration resistance, or N-count. Disturbed soil samples from the unlined standard split-barrel sampler were also placed in plastic bags and transported to our laboratory for testing.

Laboratory Testing

Laboratory testing was performed on selected samples for classification purposes and to evaluate the soil's physical properties and engineering characteristics. The following testing was performed.

- In-situ moisture and dry density
- Expansion index and
- Maximum dry density and optimum moisture content
- Liquid and plastic limits
- Direct shear
- Collapse potential and consolidation

The testing was performed in general accordance with applicable ASTM and California Test Methods (CTM). A description of laboratory test methods and results of the laboratory testing are presented in Appendix B. The results of in-situ moisture content and dry density tests are summarized in the boring logs in Appendix A

FINDINGS

Aerial-Photo Interpretation

Based on our aerial-photograph review and previous reports, the site was vacant along Lake Street through 2003 (Petra, 2003). Mining and stockpiling operations had not yet commenced and the site was mainly in its natural state through that time. Various dirt-haul roads traverse the

site for heavy equipment operations. The main east-west-trending haul road in the central portion of the site (in the vicinity of the proposed Nichols Road) was observed in aerial photographs since 1989.

Regional Geologic Setting

Regionally the subject site is located within the Peninsular Ranges Geomorphic Province of southern California, which is generally characterized by alluviated basins, elevated erosion surfaces and northwest-trending faults. The subject site is situated at the northern end of the northwest-trending Elsinore Valley. Formed by the Elsinore fault zone, the Elsinore Valley is a structural trough separating the Santa Ana Mountains to the west and the Perris Structural Block to the east.

Bedrock within the vicinity of the site consists of Paleocene- through Pleistocene-age sedimentary sandstone, claystone and siltstone of the Silverado Formation. Deformation resulting from broad, gently folding faulting and regional uplift has exposed the bedrock at or near the surface where they have been subsequently modified by erosion. Generally the site consists of northeast-trending ridges separated by shallow canyon drainages. The bedrock is mantled by Pleistocene-age, consolidated older alluvium, which included gravel to cobble-sized sedimentary to granitic clasts, while the drainages are filled with minor amounts of more recent, unconsolidated, porous alluvium.

Local Geology and Subsurface Conditions

Earth units underlying the proposed approximately 30-acre commercial site consisted of undocumented artificial fill, alluvium, older alluvium and Paleocene sedimentary bedrock of the Silverado Formation. The units are discussed in detail below.

- Artificial Fill (map symbol Afu) – Undocumented-fill stockpiles were encountered across the central and eastern portions of the site. These materials were comprised of locally derived materials of clayey sand and silty sand with minor amounts of gravel, which were yellow brown to dark brown, generally loose to medium dense and low in optimum moisture. The

fills observed ranged from approximately 5 to 58 feet in thickness; however, deeper fills may be encountered in the central portion of the site where former alluvial drainages may have been filled in during stockpiling.

- Alluvium (map symbol Qal) – Alluvium of upper Holocene-age was present along the natural drainages and beneath undocumented fill stockpiles and consisted of dark yellowish brown to grayish brown to dark brown, fine to medium sand with silt to silty fine sand. These materials were generally loose to medium dense, dry, poorly consolidated and porous.

- Older Alluvium (map symbol Qoal) – Pleistocene-age older alluvium was observed across the majority of the site underlying undocumented fills and/or alluvium and overlying bedrock. These materials were typically clayey to silty fine to coarse sand and gravely sand with cobble which were generally reddish brown to yellow brown to yellowish red in color and were generally moist and dense to very dense in nature. The gravel to cobble and trace amounts of boulders encountered were subangular to subrounded and consisted of both sedimentary and granitic clasts. Thickness of this unit ranged from as little as 4 feet to as much as 51 feet.

- Silverado Formation (map symbol Tsi)—Bedrock exposed on the site consisted of non-marine sandstone, siltstone and claystone of the Silverado Formation. These units consisted of pale yellow, yellow to olive yellow, silty to clayey sandstone/siltstone with interbeds of bluish grey to grey to olive claystone. Bedding varied from laminated to massive, dipping generally to the west and locally to the east. Bedrock was mapped at the surface at the northeastern edge of the property where recent grading of Lake Street realignment has been cut to approximate street grade (approximate Lake Street Stations 71+00 to 74+50).

Groundwater

Groundwater was encountered in several of our borings across the site at the time of our investigation. Groundwater levels, less than 15 feet from existing grade, were generally encountered within the existing drainage channels north of the proposed Nichols Road and west of the active mining area (Borings B-10, B-11 and B-12). Groundwater was observed at Boring B-8 less than 5 feet below grade immediately west of the recently graded Lake Street realignment near Station 70+00. Groundwater was also encountered during the Lake Street exploration activities (Petra, 2006b) at Borings B-4, B-7 and B-8 at 15, 9 and 9 feet below grade, respectively. Groundwater levels, approximately 18 to 51.5 feet below grade, were observed at several locations on the southern portion of the site (Borings B-2, B-4, B-7, BA-1, BA-2 and BA-3). Based on survey data, groundwater elevations vary in the northern area from

approximately 1,322 to 1,340.5 feet msl or about 10 to 30 feet below future assumed grades. In the southern area, groundwater elevations vary from about 1,348 to 1,368 feet msl or about 7 feet msl to 12 feet below the future assumed grades. The initial depth to groundwater and corresponding elevations for each boring are shown on Plates 1 and 2.

Faulting

The subject site is not located within the boundaries of a designated Earthquake Fault Hazard Zone, as defined by the State of California pursuant to the Alquist-Priolo Earthquake Fault Zoning Act. The closest active fault is the Elsinore – Glen Ivy fault located approximately 1 mile southwest of the site. The Glen Ivy fault has been placed within an Alquist-Priolo Special Studies Zone by the State of California; however, the site's southern boundary lies approximately 4,500 feet away from a special studies zone that would require a site-specific fault investigation. (State of California, 1980). Furthermore, review of aerial photographs and site geologic mapping did not disclose evidence of recent faulting across the site (i.e., vegetation lineaments, offset drainages, fissures, pressure ridges or mounds, depressions, fault scarps, etc.).

The Elsinore fault zone consists of en-echelon, northwest to west-northwest-trending faults. Many of these faults are accompanied by geomorphic and geologic features that indicate they have been active during late Pleistocene and Holocene time. Displacement of Holocene-age sediments and evidence for ground-surface rupture associated with the 1910 earthquake have been documented in a trench along the Glen Ivy segment of the Elsinore fault zone. A northwest-trending splay of the Elsinore fault zone is mapped closer to the southern site boundary, approximately 800 feet to the south; however, it is not considered active according to the State of California (Greenwood, 1992).

Seismicity

The site is located in a seismically active area of southern California and is likely to be subjected to moderate to severe ground shaking during the life of the project. Published earthquake fault zone maps pertaining to the area of the subject site indicate that the property is located

approximately 1.6 kilometers (1 mile) north of the Glen Ivy segment and 9 kilometers (5.6 miles) north of the Temecula segment of the Elsinore fault zone and are officially classified by the State of California as active faults (meaning that surface rupture has occurred along these faults within about the last 11,000 years). The maximum magnitude earthquake expected to be produced by these faults are magnitude 6.8. Other principal regional active faults that may affect the property during the life of the proposed structures include the Chino-Central Avenue segment of the Elsinore fault located approximately 21.6 kilometers (13.4 miles) northwest, the Whittier segment of the Elsinore fault zone located approximately 28 kilometers (17.4 miles) northwest, the San Jacinto fault located approximately 34 kilometers (21.1 miles) northeast, the Newport-Inglewood located approximately 43.5 kilometers (27 miles) northwest and the San Andreas fault zone located approximately 52.2 kilometers (32.4 miles) to the east-northeast.

Several sources were consulted for information pertaining site seismicity. The majority of the data were originally obtained from Campbell and Bozorgnia and have been incorporated into digital programs by Thomas F. Blake (Blake, 1998/1999; 2000a; 2000b) which provide an estimation of peak horizontal acceleration using a data file of approximately 150 digitized California faults. The program compiles various information, including the dominant-type of faulting within a particular region, the maximum credible earthquake magnitude each fault or fault segment is capable of generating, the estimated slip rate for each fault and the approximate location of the fault trace. These data are then used for the "probabilistic" analysis of the site.

The probabilistic analysis incorporates uncertainties in time, recurrence intervals and size and location (along faults) of hypothetical earthquakes. This method accounts for the likelihood (rather than the certainty) of occurrence and provides levels of ground acceleration that might be more reasonably hypothesized for a finite-exposure period. Moreover, the State of California has adopted the standard of using peak-ground acceleration exceeded at a 10 percent probability in 50 years, also know as Design-Basis Earthquake Ground Motion, in seismic analysis for liquefaction calculations per requirement of the 2001 CBC Sections 1627, 1629.1 and 1631.2.

Our probabilistic analysis was performed by utilizing computer program "FRISKSP" (Blake, 2000b) and adopting the attenuation relationship for Pleistocene Soil - uncorrected, published by Bozorgnia, et al (Blake, 2000b). The results indicate that the design-basis earthquake ground motion would result in a mean peak horizontal ground acceleration for the site of 0.54g for peak-ground acceleration has a 10 percent probability of being exceeded within a 50-year period. The results of our probabilistic analysis are included in Appendix C.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our review of pertinent geotechnical literature and on the results of our limited subsurface investigation, development of the site as currently planned is considered feasible from a geotechnical standpoint. However, there are a number of geotechnical constraints inherent to the property that should be considered by the Client and other members of the design team during the design process. These constraints and other preliminary design considerations are presented in the following paragraphs.

Geologic Considerations

Landslides

Landslides or surficial failures were not observed within or immediately adjacent to the site boundaries. As a result, the probability of the site being affected by landsliding is not anticipated.

Subsidence

In consideration of the anticipated grading, recommended overexcavations and subsurface material types and their conditions, unfavorable ground subsidence is not anticipated.

Faulting

Geologic hazards due to fault rupture are not known to be present at the subject site.

Ground Rupture

Ground rupture due to fault displacement is not anticipated.

Groundwater

Adverse effects on the proposed development resulting from groundwater may likely be anticipated. Shallow groundwater may be encountered at various areas of the site depending upon future building-pad grades or may impact the installation of some utilities.

Liquefaction Potential

Liquefaction is the transformation of a cohesionless soil from a solid to a liquid state caused by an increase in pore pressure and a reduction in effective stress. Liquefaction can occur when loose saturated cohesionless (sandy) soils are subjected to strong ground motion during an earthquake. Typically, liquefaction occurs in areas where groundwater lies in the upper 50 feet of the ground surface.

Based on review of the Riverside County Land Information System (Riverside County, 2007), the site lies within a moderate liquefaction potential zone. Groundwater was encountered in the borings. However, based on the density of the older alluvium and bedrock, the potential for liquefaction is considered low. However, loose cohesionless sands in alluvium may be encountered depending upon final design grades. The potential for liquefaction should be evaluated with future investigation once site plans are made available.

Flooding

Based on review of the Riverside County Land Information System (Riverside County, 2007), the site does not lie within an area designated as a potential flood area.

Tsunamis, Inundation, Seiches and Flooding

The site is approximately 24 miles from the Pacific Ocean at an elevation of approximately 1,300 feet msl. Therefore, tsunamis (seismic sea waves) are not considered a significant hazard at the site. The site is not located downslope of a large body of water that could adversely affect the site in the event of earthquake-induced failures or seiches (wave oscillations in an enclosed or semi-enclosed body of water).

Seismic-Design Considerations

Structures within the site should be designed and constructed to resist the effects of seismic ground motions as provided in 2001 CBC. The method of design is dependent on the seismic zoning, site characteristics, occupancy category, building configuration, type of structural system and on the building height.

For structural design in accordance with the 2001 CBC, a computer program developed by Thomas F. Blake (UBCSEIS, 1998/1999) was utilized which compiles fault information for a particular site using a modified version of a data file of approximately 150 California faults that were digitized by the California Division of Mines and Geology and the U.S. Geological Survey. This program computes various information for a particular site including the distance of the site from each of the faults in the data file, the estimated slip-rate for each fault and the "maximum moment magnitude" of each fault. The program then selects the closest Type A, Type B and Type C faults from the site and computes the seismic design coefficients for each of the fault types. The program then selects the largest of the computed seismic design coefficients and designates these as the design coefficients for the subject site. The property will probably experience ground shaking from moderate- to large-size earthquakes during the life of the proposed development. Furthermore, it should be recognized that the southern California region is an area of high-seismic risk and that it is not considered feasible to make structures totally resistant to seismic-related hazards.

Based on our evaluation and computer analysis, an earthquake along the Elsinore-Glen Ivy fault, located approximately 1.6 kilometers (1 mile) southwest from the site, would probably generate severe site ground motions based on an anticipated maximum moment magnitude of 6.8. These criteria are based on the soil profile type as determined by existing subsurface geologic conditions, on the proximity of the Elsinore-Glen Ivy fault and on the maximum moment magnitude and slip rate of this fault. The following 2001 CBC seismic design coefficients should be used for the proposed structures.

2001 CBC		FACTOR
Figure 16-2	Seismic Zone	4
Table 16-I	Seismic Zone Factor, Z	0.4
Table 16-U	Seismic Source Type	A
Table 16-J	Soil Profile Type	S_D
Table 16-S	Near-Source Factor, N_a	1.5
Table 16-T	Near-Source Factor, N_v	2.0
Table 16-Q	Seismic Coefficient, C_a	0.77
Table 16-R	Seismic Coefficient, C_v	1.28

Earthwork

Excavation Characteristics

Based on the results of the exploratory borings, residual soil materials and other surficial deposits (existing fill, alluvium and older alluvium) and bedrock of the Silverado Formation should be excavatable with conventional earthmoving equipment. Most bedrock materials will be excavatable with moderate ripping. The need for blasting is not anticipated.

Ground Preparation

Existing low-density, weathered and potentially collapsible-surficial materials, such as all existing fill stockpiles, recent alluvium and approximately the upper 1 to 2 feet of older alluvium and highly weathered bedrock should be overexcavated to underlying competent alluvium, older alluvium or bedrock.

Overexcavation depths of existing undocumented fill stockpiles could locally be as deep as 70 feet below the existing ground surface. However, actual depths and horizontal limits of overexcavation should be evaluated during grading on the basis of in-grading observations and testing performed by the project geotechnical consultant.

Groundwater

Groundwater will likely be encountered on the southern portion of the site at depths varying from approximately 18 to 51 feet below existing grade or approximately 7 feet above to 12 feet below assumed proposed grades. Groundwater levels were observed at shallower depths on the northern portion of the site, 5 to 15 feet below existing grade or approximately 10 to 30 feet below assumed proposed grades. Groundwater mitigation may be required once more detailed grading plans are available.

Canyon Subdrains

Following overexcavation of unsuitable surficial materials to competent material, subdrains should be installed within tributary areas located primarily on the northern portions of the tract where the depth of anticipated fill may exceed approximately 10 to 25 feet. Canyon subdrains will reduce potential build-up of hydrostatic pressures below compacted fills due to infiltration of surface waters. Proposed subdrain locations are shown on Plates 1 and 2 and are based on these areas of the site being filled to create level building pads at or near proposed Nichols Road grades. Actual subdrain locations should be determined during rough grading as conditions are exposed.

Disposal of Oversize Rock

Minor quantities of oversized material (boulders or rock fragments greater than 12 inches) were observed during downhole logging of the bucket-auger borings. These materials will be generated from the older alluvial deposits and Silverado Formation bedrock and will likely breakdown using conventional grading equipment. Areas of proposed deep fill (i.e., fills greater than 10 feet in thickness) within the tract would be suitable for disposal of oversized material provided that they are placed in an approved fashion.

Expansive Material

Laboratory test results indicate that undocumented-fill materials have a **LOW** expansion potential. Laboratory testing indicate that claystone bedrock that may be encountered during grading have a **VERY HIGH** expansion potential. While the claystone of the Silverado Formation bedrock is limited in extent, some of the bedrock material that will be used as fill or exposed in cut surfaces may potentially be very highly expansive. As such, some selective grading will likely be required to help mitigate the adverse effects of the expansive soils. Selective grading would entail removing the expansive material and overexcavation of building pads to remove such materials, replacing them with granular fill. Pavement areas could be similarly overexcavated of expansive soils, typically to depths of 2 to 4 feet, replacing them with granular fill to reduce not only the pavement section but the potential for damage to curbs, sidewalks and other shallow structures.

Processing of Cut Areas

Where unsuitable surficial deposits of artificial fill, recent alluvium, unsuitable portions of older alluvium and/or highly weathered bedrock are not removed in cut areas below proposed structures and/or improvements, these materials should be overexcavated and replaced as properly compacted fill. Excavated expansive materials should be restricted from the building pads and the upper 2 feet of pavement areas.

Horizontal limits of overexcavation should extend beyond perimeter-building lines a distance equal to the depth of overexcavation or 5 feet, whichever is greater.

Shallow Fill-To-Deep Fill Lots

To reduce the potential adverse effects of differential settlement on fill pads underlain with substantial differences in compacted fill depths, the shallow fill portions should be overexcavated to maintain the fill depths recommended. The overexcavation typically extends to one-half the maximum fill depth in the building pad.

Slope-Stability Analysis and Construction

Cut Slopes

Based on conversations with representatives of KWC, cut slopes may be planned to heights of approximately 40 to 45 feet or less at a slope ratio of about 2:1 (h:v) or flatter. Provided these slopes expose favorable geologic conditions, they should be grossly stable to the planned height and inclination. Due to the variability of bedding in the underlying bedrock, potential cut slopes along the southern property line would likely require reconstruction as stabilization fill slopes.

In-grading observation and mapping of other individual proposed cut slopes by the project-engineering geologist is recommended. Where undocumented fill, highly weathered bedrock, out-of-slope bedding, seepage or cohesionless sandy materials are observed, the cut slopes in question may require stabilization by means of a stabilization fill or buttress.

Fill Slopes

Based on conversations with KWC, fill slopes may be planned to heights of approximately 25 feet or less in the northern portion of the site. Fill slopes should be surficially and grossly stable provided they are constructed with the recommendations contained herein. A fill key with a minimum depth of 2 feet or more into competent bedrock or undisturbed native soil is

recommended at the base of fill slopes. The width of the fill key should equal one-half the slope height or 15 feet, whichever is greater.

Slope-stability recommendations for the existing temporary fill stockpiles were addressed by Petra in our referenced revised slope-mitigation letter (Petra, 2006c) as part of the Lake Street widening and relocation project. Please refer to the letter for mitigation measures recommended for the existing temporary fill stockpiles located onsite.

Geotechnical Observations

Observation of clearing operations, removal of unsuitable surficial materials, cut- and fill-slope construction and general grading procedures should be performed by the project geotechnical consultant. Fills should not be placed without prior review from the geotechnical consultant.

The project geotechnical consultant or his representative should be present onsite during grading operations to observe and document proper placement and compaction of fill, as well as to observe and document compliance with the other recommendations presented herein.

RECOMMENDATIONS FOR ADDITIONAL STUDY

The findings and conclusions presented in this preliminary geotechnical evaluation report are based on the field investigation, sampling and laboratory testing performed by Petra. When actual grading plans for the sites have been developed, additional studies, possibly including supplemental subsurface investigation and geotechnical analysis, will likely be necessary to provide detailed recommendations that are appropriate for the grading and construction proposed.

REPORT LIMITATIONS

This report is based on the proposed project as shown on the 60-scale maps (KWC, 2006) provided for our review and geotechnical data as described herein. The materials encountered

during our limited subsurface investigation and described in the reference reports are believed representative of the project area and the conclusions and recommendations contained in this report are presented on that basis.

This report has been prepared in a manner consistent with the level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and, as such, are not to be considered a guarantee or warranty.

We hope this information meets your needs at this time. Should you have questions, please contact this office.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Douglas Johnston, RG
Project Geologist

PROFESSIONAL GEOLOGIST
JAMES A. LARWOOD
NO. 1897
CERTIFIED
ENGINEERING
GEOLOGIST
exp. 8/31/08
STATE OF CALIFORNIA

James A. Larwood, CEG
Senior Associate Geologist

REGISTERED PROFESSIONAL ENGINEER
GRAYSON R. WALKER
No. 871
EXP. 3/31/07
GEOTECHNICAL
STATE OF CALIFORNIA

Grayson R. Walker, GE
Principal Engineer

DJ/JMS/JAL/GRW/kec

Attachments: References
Figure 1 – Site Location Map
Plates 1 and 2 – Geotechnical Maps (in pocket)
Plates 3 and 4 – Geologic Cross-Sections
Appendix A – Logs of Borings (current; Petra, 2006a)
Appendix B – Laboratory Test Criteria/Laboratory Test data
Appendix C – Seismic Analysis

Distribution: (5) Addressee

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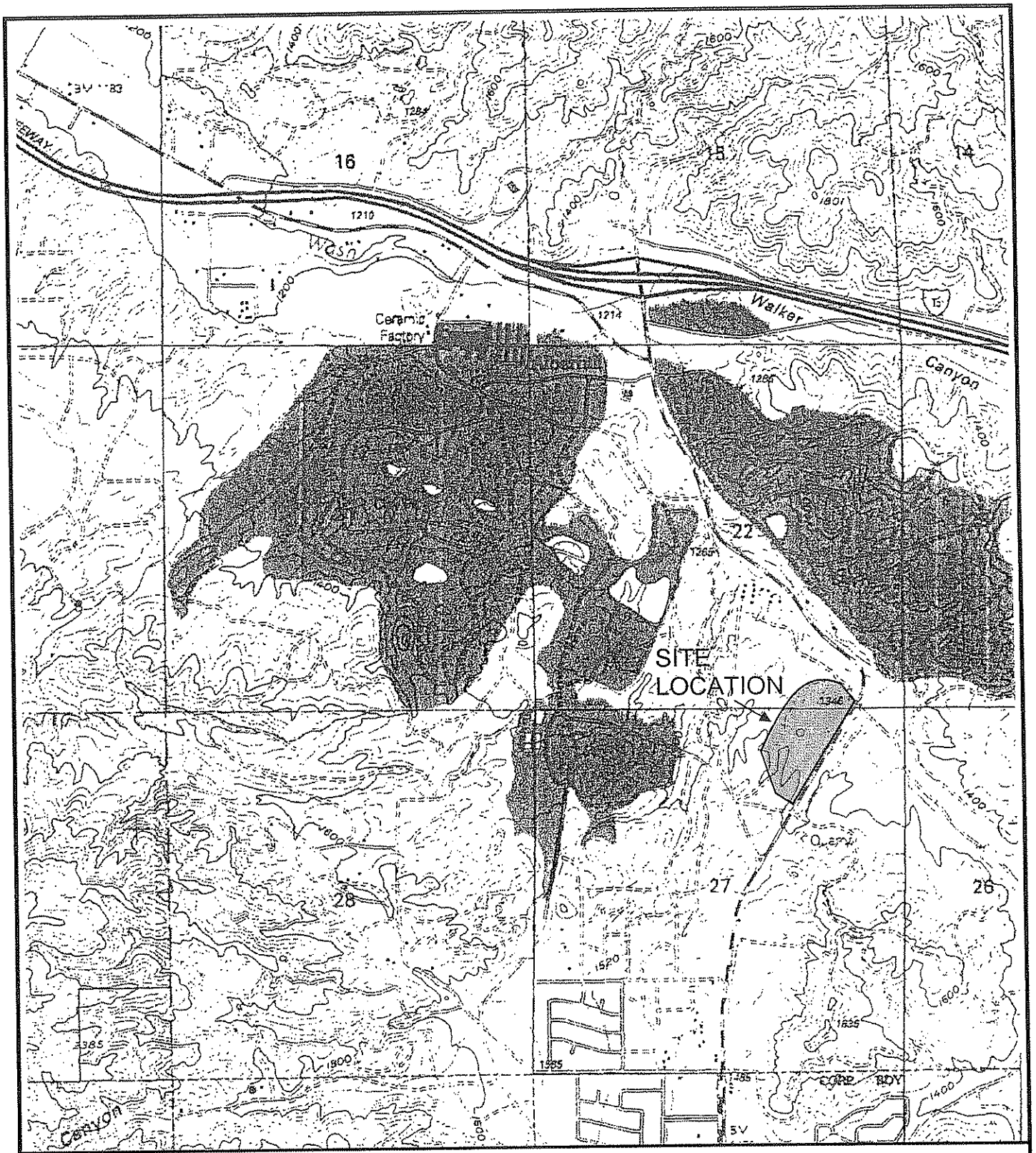
Aerial-Photographs Reviewed

Agency	Date	Photo Number	Scale 1 inch = --- feet
Continental	05/6/49	AXM-3F – 127,128	2,000
Riverside County Flood Control	01/28/62	184, 185, 186	1,800
Continental	05/15/67	AXM-3HH – 246,247	1,600
Riverside County Flood Control	11/22/69	43,44	1,000
In-House	06/20/74	578,579,580	3,000
Continental	02/15/77	RIV 6 – 01,02	4,150
In-House	01/20/84	929	1,600
Hunsaker	09/9/89	9899 – 3-1,3-2,3-3,4-1,4-2,4-3	500
Hunsaker	1989	9899	600
Continental	05/14/93	C91-10 – 81,82	2,000
Continental	01/30/95	C104-38 – 46,47	2,000
Continental	09/11/97	101-102	2,000
Continental	03/02/99	C-135-138 – 96,97	2,000
Terraserver	2002	--	--



SITE LOCATION MAP

NORTH

0 2000 FEET

SCALE

Reference:
USGS topographic map, 7.5 minutes series, Alberhill Quadrangle, dated 1997.

PETRA GEOTECHNICAL, INC.

JN 137-07/140-07 FEB., 2007

FIGURE 1

SITEMAP

APPENDIX A

LOGS OF BORINGS

PETRA

Key to Soil and Bedrock Symbols and Terms

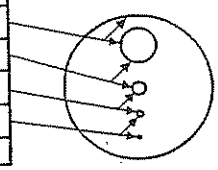
PETRA

Unified Soil Classification System

Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye	GRAVELS more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
			Gravels with fines	GM	Silty Gravels, poorly-graded gravel-sand-silt mixtures
				GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
		SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
			Sands with fines	SM	Silty Sands, poorly-graded sand-gravel-silt mixtures
				SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve		SILTS & CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts & clays of low plasticity
		SILTS & 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 silts and clays of medium-to-high plasticity
Highly Organic Soils				PT	Peat, humus swamp soils with high organic content

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller



Laboratory Test Abbreviations

MAX	Maximum Dry Density	MA	Mechanical (Partical Size) Analysis
EXP	Expansion Potential	AT	Atterberg Limits
SO4	Soluble Sulfate Content	#200	#200 Screen Wash
RES	Resistivity	DSU	Direct Shear (Undisturbed Sample)
pH	Acidity	DSR	Direct Shear (Remolded Sample)
CON	Consolidation	HYD	Hydrometer Analysis
SW	Swell	SE	Sand Equivalent

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

Sampler and Symbol Descriptions

- Approximate Depth of Seepage
- Approximate Depth of Standing Groundwater
- Modified California Split Spoon Sample
- Standard Penetration Test
- Bulk Sample
- No Recovery in Sampler

Bedrock Hardness

Soft	Can be crushed and granulated by hand; "soil like" and structureless
Moderately Hard	Can be grooved with fingernails; gouged easily with butter knife; crumbles under light hammer blows
Hard	Cannot break by hand; can be grooved with a sharp knife; breaks with a moderate hammer blow
Very Hard	Sharp knife leaves scratch; chips with repeated hammer blows

Notes:
Blows Per Foot: Number of blows required to advance sampler 1 foot (unless a lesser distance is specified). Samplers in general were driven into the soil or bedrock at the bottom of the hole with a standard (140 lb.) hammer dropping a standard 30 inches. Drive samples collected in bucket auger borings may be obtained by dropping non-standard weight from variable heights. When a SPT sampler is used the blow count conforms to ASTM D-1586

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-1**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,428± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (afu) Clayey SAND (SC): yellow brown, moist, medium dense; fine to medium.							
5									
		Silty SAND (SM): very light yellow brown, moist, loose; fine to medium, trace coarse sand.							
10		Clayey SAND (SC): dark yellow brown, moist, loose; fine to medium, trace coarse sand.		9			19.1		
15									
20		Silty SAND (SM): dark yellow to yellow brown, moist, medium dense; fine to medium.		11			10.4		

PLATE A-1

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-1**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,428± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
30		Silty SAND (SM): brown to yellow brown, moist, medium dense; fine to medium, trace coarse sand.		24			8.0		
35									
40		Silty SAND (SM): yellow, moist, medium dense; fine, trace medium.		26			9.3		
45									

PLATE A-2

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-1**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,428± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty SAND (SM): very dark brown, moist, medium dense; fine to medium, with coarse sand.		21			7.4		
55		Silty SAND (SM): very dark brown, moist, medium dense; fine to coarse.		26			7.3	125.9	
		ALLUVIUM (Qal) Silty SAND (SM): dark yellowish brown, moist, loose; fine to coarse, trace clay and fine gravel.		10			9.5		
65		Silty SAND (SM): dark brown, moist, medium dense; fine to coarse.		11			8.1		
		BEDROCK: SILVERADO FORMATION (Tsi) CLAYSTONE: pale yellow to olive, moist, hard.							
70		Silty SANDSTONE: olive yellow, moist, very hard; fine-grained, slightly weathered, minor iron staining.		16 50/6"			17.1	109.0	

PLATE A-3

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-1**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,428± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty SANDSTONE: pale yellow to yellow, moist, very hard; fine-grained, micaceous, with clay.		28 50/ 5"	■		16.0	116.3	
80		Silty SANDSTONE: light olive brown to olive yellow, moist, very hard; fine-grained, micaceous, with clay.		28 50/ 4"	■		19.1	112.0	
		TOTAL DEPTH = 81.0' NO GROUNDWATER ENCOUNTERED BORING BACKFILLED.							

PLATE A-4

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-2**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,406± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (afu) Clayey SAND (SC): dark yellow brown, moist, loose; fine to medium, with fine gravel.							
5									
10		Clayey SAND (SC): yellow brown, moist, loose; fine to medium.		8			14.4		
		@ 13.0 feet: gravel lense.							
		ALLUVIUM (Qal) Silty SAND (SM): medium brown, moist, medium dense; fine to coarse, with fine gravel.							
15				18			5.4		

PLATE A-5

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-2**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,406± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty SAND (SM): dark reddish brown, moist, medium dense; fine to medium, with fine gravel and clay, trace coarse.		15	■		8.0	119.6	cnsol
25		Silty SAND (SM): strong brown, moist, medium dense; fine to medium, with coarse, trace fine gravel.		16	■		8.5	126.6	
30		**OLDER ALLUVIUM (Qoal)** Silty SAND (SM): dark yellow brown, moist, very dense; fine to coarse, with clay and gravel.		91	■		7.6	122.2	
35		Silty SAND (SM): yellowish red, moist, very dense; medium to coarse, with fine gravel, trace clay.		85	■		9.0	123.7	cnsol
		@ 37.5 feet: groundwater.	▽						
		@ 39.0 feet: cobbles.							

PLATE A-6

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-2**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,406± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		SAND (SP-SC): yellow red, wet, very dense; medium to coarse, with clay, trace gravel.		37 50/4"	■		9.9	127.9	
45		**BEDROCK: SILVERADO FORMATION (Tsi)** CLAYSTONE/Silty SANDSTONE: pale yellow to white, wet, hard; fine-grained.		21 50/5"	■		16.5	116.1	
50		CLAYSTONE: blue grey, wet, very hard; with fine sand and iron staining.		80	■		20.0	110.0	
		TOTAL DEPTH = 51.5' GROUNDWATER ENCOUNTERED @ 37.5' BORING BACKFILLED.							

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

PLATE A-7

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-3**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,425± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED FILL (afu) Silty SAND (SM): brownish yellow, moist, loose; fine to medium, trace fine gravel.							
5									
10		Silty SAND/Clayey SAND (SM/SC): dark yellow brown, moist, loose; fine to medium, trace fine gravel.		13			12.6		
15									
20		Clayey SAND (SC): dark yellow brown, moist, loose; fine to medium, trace coarse sand.		12			11.8		

PLATE A-8

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-3**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,425± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
30		Silty SAND (SM): light olive brown, moist, medium dense; fine to medium, trace fine gravel.		19			12.1		
35		@ 38.0 feet: organics.							
40		**ALLUVIUM (Qal)** Silty SAND (SM): yellowish brown, moist, medium dense; fine to coarse, with gravel.		28			4.9		
45		@ 44.0 to 47.0 feet: cobbles.							
		OLDER ALLUVIUM (Qoal) SAND (SP): reddish brown, moist, medium dense.							

PLATE A-9

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-3**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,425± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/3/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		SAND (SP): reddish grey, slightly moist, medium dense; fine to medium, trace silt.		23			4.0		
55		Silty SAND (SM): yellowish brown, moist, dense; fine to coarse, trace fine gravel. @ 57.0 to 59.0 feet: abundant subangular to subrounded gravel.		48			10.5	119.1	collapse
60		SAND (SP): pale yellow brown to light yellow, moist, very dense; medium to coarse, trace silt.		38 50/5"			10.4	123.3	
65		SAND (SP): yellow red, moist, very dense; coarse, with medium sand, trace clay.		94			9.5	116.4	
70		SAND (SP): yellow red, moist, very dense; fine to coarse, with gravel, trace clay.		37 50/5"			6.8	114.6	
		TOTAL DEPTH = 71.0' NO GROUNDWATER ENCOUNTERED BORING BACKFILLED.							

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

PLATE A-10

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-4**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,378± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		TOPSOIL Silty SAND (SM): light brown, dry, loose; fine, with organics.							
		ALLUVIUM (Qal) Silty SAND (SM): light yellowish brown, dry, medium dense; fine, trace medium to coarse, porous.		34	■		2.0	115.0	
5		**OLDER ALLUVIUM (Qoal)** Silty SAND (SM): yellow brown, dry, medium dense; fine to coarse, with fine to coarse gravel. @ 6.0 to 9.0 feet: abundant gravel.		33	■		4.0	115.0	shear
10		Clayey SAND (SC): yellow red, moist, very dense; fine to medium, trace coarse.		28 50/5"	■		9.2	122.4	
15		Silty SAND (SM): dark yellow brown, moist, very dense; fine to medium, trace coarse to fine gravel, trace clay. @ 18.0 feet: groundwater in pipe after drilling.	▼	85	■		9.5	127.9	

PLATE A-11

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-4**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,378± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		SAND (SP): brownish yellow, moist, very dense; medium to coarse, trace silt.		50/5"	■		3.8	121.1	
		@ 24.0 feet: groundwater.	▽						
25		Gravelly SAND (SW): brownish yellow, wet, very dense; medium to coarse, with fine to coarse gravel.		30 50/4"	■		13.7	119.3	
		BEDROCK: SILVERADO FORMATION (Tsi) CLAYSTONE: olive brown to greenish grey, moist, very hard; laminated, with iron staining.							
30				34 50/5"	■		23.6	106.0	shear
		TOTAL DEPTH = 31.5' GROUNDWATER ENCOUNTERED @ 24.0' PERFORATED PIPE INSTALLED.							

PLATE A-12

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	B-5
Location:	Nichols Road/Lake Street, Lake Elsinore, CA	Elevation:	1,365± ft msl
Job No.: 137-07 & 140-07	Client: Castle & Cooke AHR	Date:	10/4/06
Drill Method: 8-inch hollow-stem	Driving Weight: 140 lbs / 30 in	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (afu) Silty SAND (SM): light brown, dry, loose; fine, with gravel.							
		Clayey SAND (SC): light olive brown, moist, medium dense; fine to medium, trace coarse.		34					
5		**ALLUVIUM (Qal)** CLAY (CH): dark brown, moist, stiff; fat clay.		26			14.1	113.5	cnsol
10		**OLDER ALLUVIUM (Qoal)** Clayey SAND (SC): reddish brown, moist, dense; fine to coarse, trace fine gravel.		55			11.8	123.4	
15		Silty SAND (SM): yellow red, moist, very dense; fine to medium, trace coarse sand and clay.		23 50/4"			9.7	119.7	
20		Silty SAND (SM): brownish yellow to orange, moist, very dense; fine to coarse, trace clay.		22 50/4"			8.2	118.7	
		TOTAL DEPTH = 21.0' NO GROUNDWATER ENCOUNTERED BORING BACKFILLED.							

PLATE A-13

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-6**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,366± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal) Silty SAND (SM): brown, dry, dense; fine to medium, porous. @ 4.0 feet: cobbles.		47	■		1.6	117.4	
5		**OLDER ALLUVIUM (Qoal)** Clayey SAND (SC): dark yellow brown, moist, very dense; fine to medium, with coarse sand, trace fine gravel.		41 50/5"	■		7.9	127.1	
10		Silty SAND (SM): reddish brown, moist, very dense; fine to coarse, trace gravel.		37 50/4"	■		7.1	128.7	
15		SAND (SP): yellow brown, moist, very dense; medium to coarse, trace silt.		29 50/4"	■		2.7	129.2	
20		Silty SAND (SM): strong brown , moist to slightly wet, very dense; fine to coarse, with gravel.		79	■		11.8	124.2	
		TOTAL DEPTH = 21.5' NO GROUNDWATER ENCOUNTERED BORING BACKFILLED.							

PLATE A-14

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-7**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,379± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (afu) Silty SAND (SM): yellow brown to brown, dry to moist, loose; fine to medium, with coarse to fine gravel.							
5		Silty SAND (SM): red brown, moist, loose; fine to medium, trace clay, with coarse to fine gravel.							
		OLDER ALLUVIUM (Qoal) Silty SAND (SM): red brown, moist, loose to medium dense; fine to medium, friable, trace coarse.							
10				17			6.5		
15									
20		SAND (SP): light yellow, moist, medium dense; fine to coarse, friable, trace silt.		21			3.3		

PLATE A-15

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-7**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,379± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		SAND (SP): light olive yellow, moist, dense; fine to coarse, friable, trace silt.		38	■		6.8	117.5	collapse
30		SAND (SP): pale yellow to light grey, moist, dense; fine, friable, trace medium to coarse.		46	■		4.2	111.3	
35		SAND (SP): olive yellow, moist, dense; fine to medium, friable, trace coarse and silt.		36	■		5.2	112.0	
		BEDROCK: SILVERADO FORMATION (Tsi)							
40		Silty SANDSTONE: pale yellow to light olive grey, moist to slightly wet, hard; fine to medium, slightly weathered, micaceous, trace gravel.		75	■		14.1	119.2	
		@ 44.0 feet: groundwater.	▽						
45		Silty SANDSTONE: pale yellow to yellow, wet, hard.		32 50/4"	■		13.8	118.3	
		TOTAL DEPTH = 46.0' GROUNDWATER ENCOUNTERED @ 44.0' BORING BACKFILLED.							

EXPLORATION LOG - VZ 137-07 140-07.GPJ PETRA.GDT 2/27/07

PLATE A-16

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-8**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,327± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal) SAND (SP-SM): grey brown, moist to slightly wet; fine to medium, trace coarse, with silt.		12	■		9.2	124.0	
5		SAND (SP-SM): grey brown, wet, medium dense; fine to coarse, with silt, groundwater.	▽	26	■		10.3	126.2	
10		**OLDER ALLUVIUM (Qoal)** Sandy CLAY (CL): light olive brown to light brown grey, moist, very stiff.		40	■		16.1	116.7	cnsol
15		Sandy CLAY (CL): yellow olive, moist, very stiff.		47	■		24.4	107.4	
20		**BEDROCK: SILVERADO FORMATION (Tsi)** CLAYSTONE: olive to olive grey, moist, hard; laminated, some iron staining.		38	■		27.4	99.6	

TOTAL DEPTH = 20.5'
GROUNDWATER ENCOUNTERED @ 4.0'
PERFORATED PIPE INSTALLED.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

PLATE A-17

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-9**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,338.5± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (afu) Silty SAND (SM): light yellow brown, moist, loose; fine to coarse, trace gravel.							
		OLDER ALLUVIUM (Qoal) Sandy CLAY (CL): olive, moist, stiff.							
5				10			20.9		
		BEDROCK: SILVERADO FORMATION (Tsi) Sandy SILTSTONE: olive yellow, yellow and bluish grey, moist, moderately hard; weathered, micaceous.							
10				22			19.9		
15		Clayey SANDSTONE: light olive grey to yellow, moist, very hard; highly micaceous.		72			20.3	110.6	

PLATE A-18

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-9**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,338.5± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/4/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		CLAYSTONE: olive yellow to pale olive, moist, very hard.		79	■		22.9	103.7	
25		CLAYSTONE: olive brown to olive, moist, very hard; with iron staining.		80	■		21.8	106.1	
		TOTAL DEPTH = 26.5' NO GROUNDWATER ENCOUNTERED BORING BACKFILLED.							

PLATE A-19

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-10**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,346± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/5/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal) SAND (SP): olive yellow, loose, dense; fine to coarse.							
		OLDER ALLUVIUM (Qoal) Clayey SAND (SC): dark brown, moist, dense; fine to medium, trace coarse.		53	■		10.1	126.6	
5		Clayey SAND (SC): dark red brown, moist, very dense; fine to medium, with coarse to fine gravel.		72	■		10.1	125.8	
		@ 7.0 feet: groundwater in pipe after drilling.	▼						
10		Silty SAND (SM): yellow brown, moist to slightly wet, very dense; fine to coarse, trace clay.		96	■		8.1	130.8	
		@ 12.0 feet: groundwater.	▽						
15		SAND (SP): brownish yellow, wet, very dense; fine to coarse, trace silt.		50/4"	■		10.7	123.9	

PLATE A-20

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **B-10**	
Location: **Nichols Road/Lake Street, Lake Elsinore, CA**		Elevation: **1,346± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Castle & Cooke AHR**	Date: **10/5/06**	
Drill Method: **8-inch hollow-stem**	Driving Weight: **140 lbs / 30 in**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty SAND (SM): pale yellow to yellow, wet, very dense; fine to coarse, micaceous, trace clay.		50/5"	■		18.0	111.1	
		BEDROCK: SILVERADO FORMATION (Tsi) Silty SANDSTONE: olive yellow, moist, very hard; with clay.							
25				30 50/3"	■		24.4	102.6	
30		@ 30.0 feet: no recovery.		50/2"					

TOTAL DEPTH = 30.1'
GROUNDWATER ENCOUNTERED @ 12.0'
PERFORATED PIPE INSTALLED.

PLATE A-21

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	B-11
Location:	Nichols Road/Lake Street, Lake Elsinore, CA	Elevation:	1,356± ft msl
Job No.: 137-07 & 140-07	Client: Castle & Cooke AHR	Date:	10/5/06
Drill Method: 8-inch hollow-stem	Driving Weight: 140 lbs / 30 in	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal) Silty SAND (SM): brown, dry, very loose; fine.							
		SAND (SP-SM): dark brown, moist, medium dense; fine to coarse, porous, with silt.		22	■		4.6	114.1	
		@ 3.0 to 5.0 feet: cobbles.							
5		@ 5.0 feet: no recovery.		29	⊗				
		OLDER ALLUVIUM (Qoal) Clayey SAND (SC): grey to orange, moist, dense; fine to coarse, with gravel.							
10				41	■		12.9	120.6	shear
15		Clayey SAND (SC): brownish orange, moist, very dense; fine to coarse, with gravel. @ 15.5 feet: groundwater in pipe after drilling. @ 17.0 feet: groundwater.	▽	74	■		12.0	124.3	
20		SAND (SP): olive yellow, wet, very dense; medium to coarse, trace silt.		36 50/3"	■		12.2	124.6	

TOTAL DEPTH = 21.0'
GROUNDWATER ENCOUNTERED @ 17.0'
PERFORATED PIPE INSTALLED.

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	B-12
Location:	Nichols Road/Lake Street, Lake Elsinore, CA	Elevation:	1,336± ft msl
Job No.: 137-07 & 140-07	Client: Castle & Cooke AHR	Date:	10/5/06
Drill Method: 8-inch hollow-stem	Driving Weight: 140 lbs / 30 in	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Other Lab Tests
		ALLUVIUM (Qal) Silty SAND (SM): dark brown, moist, loose; fine to medium, trace clayey sand.							
		Silty SAND (SM): greyish brown, moist, loose to medium dense; fine to medium, with coarse sand.		19	■		4.5	132.0	
		OLDER ALLUVIUM (Qoal)							
5		Clayey SAND (SC): olive grey, moist, medium dense; fine to medium.							
		Clayey SAND (SC): orange to grey, moist, very dense; fine to medium, trace coarse to fine gravel.		21 50/5"	■		12.2	122.4	
10		Clayey SAND (SC): orange to grey, moist to slightly wet; fine to coarse, trace fine gravel.		86	■		10.4	124.7	
		@ 14.0 feet: groundwater.	▽						
15		Clayey SAND (SC): brownish orange, wet, dense; fine to medium, trace coarse.		44	■		15.2	116.2	
20		Silty SAND (SM): pale yellow, wet, very dense; fine to coarse, with gravel.		42 5/5"	■		10.4	129.2	
		TOTAL DEPTH = 21.5' GROUNDWATER ENCOUNTERED @ 14.0' BORING BACKFILLED.							

PLATE A-23

EXPLORATION LOG - V2 137-07 140-07.GPJ PETRA.GDT 2/27/07

Petra Geotechnical, Inc.

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	B-13
Location:	Nichols Road/Lake Street, Lake Elsinore, CA	Elevation:	1,312± ft msl
Job No.: 137-07 & 140-07	Client: Castle & Cooke AHR	Date:	10/5/06
Drill Method: 8-inch hollow-stem	Driving Weight: 140 lbs / 30 in	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		OLDER ALLUVIUM (Qoal) Silty SAND (SM): olive yellow, moist, medium dense; fine to medium.							
5		Sandy CLAY (CL): olive grey, moist, very stiff; fine, with heavy iron staining.		35			14.3	120.6	
		@ 8.0 to 10.0 feet: cobbles.							
10		Clayey SAND (SC): dark reddish brown, moist, dense; fine to coarse, with gravel.		52			10.3	126.8	
		@ 12.0 to 13.0 feet: very heavy cobble.		17			29.0		
		BEDROCK: SILVERADO FORMATION (Tsi) Sandy CLAYSTONE: light green to olive yellow, moist, moderately hard. @ 13.5 feet: refusal.							

TOTAL DEPTH = 13.5'
NO GROUNDWATER ENCOUNTERED
BORING BACKFILLED.

PLATE A-24

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	BA-1
Location:	Lake St/Nichols Rd, Lake Elsinore, CA	Elevation:	1,407± ft msl
Job No.: 137-07 & 140-07	Client: Caslte & Cooke AHR	Date:	10/10/06
Drill Method: 30-inch bucket-auger	Driving Weight: 4,500 lbs	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED FILL (afu) Clayey SAND (SC): orange brown to strong brown, dry to moist, loose; fine to medium, trace coarse sand to fine gravel.							
									El A Limit
5		@ 5.0 feet: Clayey SAND to Sandy CLAY.							
		Silty SAND (SM): medium brown, dry, medium dense; fine to coarse.							
10				3			2.7	123.3	
		TOPSOIL SAND (SP): light orange brown, dry, loose; fine to medium, trace silt, abundant organics.							
15		**ALLUVIUM (Qal)** Silty SAND (SM): medium brown, dry, loose; fine to medium, porous, trace rootlets, fine gravel.							
		OLDER ALLUVIUM (Qoal) Silty SAND (SM): dark brown to orange brown, moist, medium dense; fine to coarse, with clay, trace fine gravel.							

PLATE A-2

EXPLORATION LOG - V2 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

Petra Geotechnical, Inc.

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	BA-1
Location:	Lake St/Nichols Rd, Lake Elsinore, CA	Elevation:	1,407± ft msl
Job No.: 137-07 & 140-07	Client: Caslte & Cooke AHR	Date:	10/10/06
Drill Method: 30-inch bucket-auger	Driving Weight: 4,500 lbs	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				2	■		7.5	117.3	
		Clayey SAND (SC): brownish grey, moist, dense; fine to medium, with coarse sand.							
		@ 22.5 feet: yellowish reddish.							
		BEDROCK: SILVERADO FORMATION (Tsi) Silty SANDSTONE: yellow to pale yellow, moist, hard; fine- to medium-grained, weathered, massive.							
25									
		@ 27.0 feet: highly micaceous, highly cemented.							
		CLAYSTONE: dark grey, moist, stiff; sheared fat clay, with iron staining							
		Bedding Attitude: N10°W/30° W.							
30				2	■	■	26.9	99.8	shear cnsol
		Silty SANDSTONE: purple; with iron staining, sheared clay and silty sandstone							
		Bedding Attitude: N10°W/60°W.							
		CLAYSTONE: dark grey, moist, hard; weathered, blocky fractures, lean clay, with iron staining.							
35									
		@ 36.0 feet: clay becomes more fat.							
		@ 38.1 feet: Contact: red to grey.							
		Silty SANDSTONE-Clayey SANDSTONE: grey to yellow, moist to slightly wet.	▼						
		@ 39.0 feet: Bedding Attitude: N15°W/35°SW.							

PLATE A-25

Petra Geotechnical, Inc.

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **BA-1**	
Location: **Lake St/Nichols Rd, Lake Elsinore, CA**		Elevation: **1,407± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date: **10/10/06**	
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		@ 39.5 feet: heavy groundwater seepage (east sidewall).							
		@ 41.0 feet: minor groundwater seepage (west sidewall).							
		CLAYSTONE: grey to brownish grey, moist, hard to very hard Bedding Attitude: N80°W/20°S.		10	■		15.9	118.1	
45									
		CLAYSTONE-SILTSTONE.							
50		TOTAL DEPTH = 50.0' GROUNDWATER SEEPAGE @ 39.5' BORING BACKFILLED.							

PLATE A-2

EXPLORATION LOG - V2 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **BA-2**	
Location: **Lake St/Nichols Rd, Lake Elsinore, CA**		Elevation: **1,409± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date: **10/11/06**	
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		TOPSOIL Clayey SAND (SC): reddish brown, dry, medium dense; with organics.							max
		OLDER ALLUVIUM (Qoal) Silty SAND (SM): yellowish brown, moist, dense; fine to medium, with coarse sand to fine gravel.							
		SAND (SP-SM): yellowish brown, moist, dense; fine to medium, friable, with silt, trace gravel.							
5		Silty SAND (SM): yellowish brown, moist, dense; fine to medium. @ 6.0 to 7.5 feet: abundant fine to coarse, subangular to subrounded gravel, sedimentary to granitic clasts.							
10		SAND (SW): yellowish brown, moist, dense; medium to coarse, friable, with gravel to small cobbles, subangular to subrounded sedimentary to granitic clasts, trace silt.		9			6.4	118.4	
		@ 12.0 feet: abundant gravel to cobble.							
15		@ 17.0 feet: decrease in cobble content.							
		Clayey SAND (SC): yellowish brown, moist, dense; fine to coarse, with fine gravel to small cobble, sedimentary to granitic clasts.							
20				3			7.3	118.5	
		Silty SAND (SM): yellowish brown, moist, dense; friable, trace coarse sand to fine gravel.							

PLATE A-28

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	BA-2
Location:	Lake St/Nichols Rd, Lake Elsinore, CA	Elevation:	1,409± ft msl
Job No.: 137-07 & 140-07	Client: Caslte & Cooke AHR	Date:	10/11/06
Drill Method: 30-inch bucket-auger	Driving Weight: 4,500 lbs	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		@ 25.0 feet: heavy subangular to subrounded gravel to cobble, sedimentary to granitic clasts.							
		SAND (SP): yellowish brown, moist, dense; fine to coarse, friable, with gravel to cobble, trace silt. @ 27.0 feet: less gravel, no cobble.							
30		Sandy SILT- Silty SAND (ML-SM): olive yellow, moist, dense; micaceous, with small cobble.		10	■		6.4	121.2	shear
		Gravelly SAND (SW): brownish yellow , moist, dense; friable, with abundant gravel to small cobble, trace silt. @ 33.0 to 34.0 feet: heavy cobbles, sedimentary to granitic clasts.							
35		@ 37.0 feet: metamorphic boulder.							
		SAND (SP-SM): brownish yellow, moist, dense; with silt, trace cobble.							
40		Silty SAND (SM): yellowish brown, moist, dense; fine.		6	■		12.1	115.0	
		SAND (SP-SM): yellowish brown, moist, dense; with gravel and silt.							
		Sandy SILT-Silty SAND (ML-SM): grey, moist, dense; fine, micaceous.	▼						
		SAND (SP-SM): yellowish brown, saturated, dense; friable, with silt.							
		BEDROCK: SILVERADO FORMATION (Tsi) CLAYSTONE: olive grey, wet, hard; weathered, with iron staining.							
45		Silty SANDSTONE: grey, wet, hard; fine- to medium-grained with yellowish brown staining.							
		@ 45.0 feet: Sandstone bedding Bedding Attitude: N10 °E/10°W.	▽						
		@ 47.0 feet: very heavy groundwater seepage Attitude: N20°E/10°W.							

EXPLORATION LOG - V2 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

PLATE A-29

Petra Geotechnical, Inc.

EXPLORATION LOG

Project:	**Pac Clay Lake/Nichols South and North**	Boring No.:	**BA-2**
Location:	**Lake St/Nichols Rd, Lake Elsinore, CA**	Elevation:	**1,409± ft msl**
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date:	**10/11/06**
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By:	**D Johnston**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		@ 52.0 feet: Attitude: N10°W/10°W.							
		@ 52.1 feet: CLAYSTONE: purplish grey, wet, hard; with iron staining.							
55		SANDSTONE: wet, hard; fine- to medium-grained.							
60		TOTAL DEPTH = 60.0' MINOR GROUNDWATER SEEPAGE @ 42.5' HEAVY GROUNDWATER @ 47.0' BORING BACKFILLED.							

PLATE A-30

Petra Geotechnical, Inc.

EXPLORATION LOG - V2 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project:	**Pac Clay Lake/Nichols South and North**	Boring No.:	**BA-3**
Location:	**Lake St/Nichols Rd, Lake Elsinore, CA**	Elevation:	**1,404± ft msl**
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date:	**10/11/06**
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By:	**D Johnston**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		TOPSOIL Silty SAND (SM): light brown, dry, loose; fine to medium, porous, with organics.							
		OLDER ALLUVIUM (Qoal) Clayey SAND (SC): reddish brown, moist, dense; fine to coarse, trace fine gravel.							
5									
		Silty SAND (SM): brownish yellow, moist, dense; fine to coarse, friable, trace gravel, sandstone clasts.							
10									
		Clayey SAND (SC): grey, moist, dense; fine to medium.							
		Gravelly SAND (SW): brownish yellow, moist, dense; friable, with coarse gravel to small cobble, subangular to subrounded granitic to sedimentary clasts, trace silt.							
15									
20		@ 20.5 feet: dense cobble.							
		Clayey SAND (SC): brownish yellow, moist, dense; fine to medium, trace fine gravel.							

PLATE A-31

Petra Geotechnical, Inc.

EXPLORATION LOG

Project:	**Pac Clay Lake/Nichols South and North**	Boring No.:	**BA-3**
Location:	**Lake St/Nichols Rd, Lake Elsinore, CA**	Elevation:	**1,404± ft msl**
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date:	**10/11/06**
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By:	**D Johnston**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		@ 26.0 feet: becomes more yellowish brown.							
		Silty SAND (SM): greyish brown, moist, dense; fine, trace gravel.							
30		SAND (SP-SM): yellowish brown, moist, dense; friable, with silt, trace gravel.							
		Gravelly SAND (SW): brownish yellow, moist, dense; friable, with coarse gravel to cobble, trace boulder to 12-inch diameter.							
35		@ 35.0 feet: decrease in cobble, fine to coarse gravel.							
		@ 37.0 to 39.0 feet: trace gravel.							
40		@ 40.0 to 47.0 feet: trace boulders, abundant gravel to cobble.		12	■		1.4	137.0	
45		@ 47.0 feet: brownish yellow, increased moisture; decrease in cobble size and frequency, no boulders.							
		49.0 feet: slightly wet.							

PLATE A-32

Petra Geotechnical, Inc.

EXPLORATION LOG

Project:	**Pac Clay Lake/Nichols South and North**	Boring No.:	**BA-3**
Location:	**Lake St/Nichols Rd, Lake Elsinore, CA**	Elevation:	**1,404± ft msl**
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date:	**10/11/06**
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By:	**D Johnston**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		SAND (SP): brownish yellow, wet; medium to coarse, with gravel.		2	■		13.2	119.1	shear
		@ 51.5 feet: groundwater.	▽						
		BEDROCK: SILVERADO FORMATION (Tsi)							
		CLAYSTONE: bluish grey; with iron staining, 4 inches thick							
55		Bedding Attitude: N10°E/45E.							
		Silty SANDSTONE: yellow, wet, hard; fine- to medium-grained.							
60		TOTAL DEPTH = 60.0' GROUNDWATER ENCOUNTERED @ 51.5' BORING BACKFILLED.							

EXPLORATION LOG - V2 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

EXPLORATION LOG

Project: **Pac Clay Lake/Nichols South and North**		Boring No.: **BA-4**	
Location: **Lake St/Nichols Rd, Lake Elsinore, CA**		Elevation: **1,366± ft msl**	
Job No.: **137-07 & 140-07**	Client: **Caslte & Cooke AHR**	Date: **10/11/06**	
Drill Method: **30-inch bucket-auger**	Driving Weight: **4,500 lbs**	Logged By: **D Johnston**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		OLDER ALLUVIUM (Qoal) Clayey SAND (SC): light reddish brown, moist, dense; fine to coarse.							
5		Silty SAND (SM): brownish yellow, moist, dense; fine to medium, with fine to coarse gravels, granitic to sedimentary clasts.		4	■		4.9	116.0	
		SAND (SW): olive yellow, moist, dense; fine to medium, friable, with fine to coarse gravels, subangular to subrounded, granitic to sedimentary clasts.							
10		@ 10.0 feet: yellow; trace gravel.		4	■		2.2	118.1	
		Clayey SAND (SC): brownish yellow, moist, dense; fine.							
15				4	■		7.2	123.1	
		Silty SAND (SM): brownish yellow, moist, dense; fine to medium, trace gravel.							
20		SAND (SP-SM): olive brown, moist, dense; fine to medium, friable, with silt, trace gravel.							

EXPLORATION LOG - V2 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

PLATE A-34

EXPLORATION LOG

Project:	Pac Clay Lake/Nichols South and North	Boring No.:	BA-4
Location:	Lake St/Nichols Rd, Lake Elsinore, CA	Elevation:	1,366± ft msl
Job No.: 137-07 & 140-07	Client: Caslte & Cooke AHR	Date:	10/11/06
Drill Method: 30-inch bucket-auger	Driving Weight: 4,500 lbs	Logged By:	D Johnston

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty SAND (SM): olive brown, moist, dense; fine to medium, trace coarse sand to small cobble.							
30		SAND (SP-SM): brownish yellow, moist, dense; fine to coarse, friable, with silt, trace fine gravel.							
		@ 33.0 feet: wet.							
		@ 34.0 feet: increased coarse gravel small cobble.							
35									
40		TOTAL DEPTH = 40.0' NO GROUNDWATER ENCOUNTERED BORING BACKFILLED.							

PLATE A-35

Petra Geotechnical, Inc.

LOGS OF BORINGS

(PETRA, 2007a)

PETRA

EXPLORATION LOG

Project: **Future Lake Street**		Boring No.: **B-1**	
Location: **Lake Elsinore**		Elevation: **1346**	
Job No.: **160-04**	Client: **Castle and Cooke**	Date: **2/14/06**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AR**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		OLDER ALLUVIUM (Qoal) Silty Sand and Sandy Clay (SM/CL): Dark brown to yellow-gray; moist; medium dense/ stiff; fine-grained sand, some coarse-grained sand; organic odor.							MAX RV
				7 9 13			15.7	111.8	MAX RV
5		**BEDROCK - Silverado Formation (Tsi)** Siltstone: Light gray, with orange iron oxide staining; moist; hard.		7 20 26			21.8	103.3	
		Sandstone: tan to yellowish-brown; slightly moist; hard; massive; moderately weathered; slightly oxidized.							
10				28 37 50/ 3"			13.2	119.4	
15				19 30 50/ 3"			15.5	118.2	
		Notes Total Depth = 16.5 Feet No Groundwater No Caving.							

PLATE A-1

EXPLORATION LOG - V3 160-040.GPJ PETRA.GDT 5/4/06

Petra Geotechnical

EXPLORATION LOG

Project: **Future Lake Street**		Boring No.: **B-2**	
Location: **Lake Elsinore**		Elevation: **1341**	
Job No.: **160-04**	Client: **Castle and Cooke**	Date: **2/14/06**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AR**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Other Lab Tests
		BEDROCK - Silverado Formation (Tsi)							
		Siltstone: Reddish-brown to yellowish-brown; moist; hard; massive; slightly fractured; highly weathered.							
				14	■		20.3	103.1	
				15	■				
				25					
5				14	■		21.6	98.9	
				18	■				
				22					
		Siltstone: Mottled yellowish-brown and tan; moist; moderately hard to hard; massive; slightly fractured; slightly weathered; increased plasticity with depth.							
10				24	■		21.7	104.8	
				35	■				
				50					
15				11	■		23.6	101.5	
				14	■				
				30					
		Siltstone: Brown to tan; slightly moist; hard; massive; slightly fractured; slightly weathered.							
20				23	■		19.2	104.5	
				48	■				
				47	■				
		Notes Total Depth = 21.5 Feet No Groundwater No Caving.							

PLATE A-2

EXPLORATION LOG

Project: Future Lake Street		Boring No.: B-3	
Location: Lake Elsinore		Elevation: 1321	
Job No.: 160-04	Client: Castle and Cooke	Date: 2/14/06	
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: AR	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		OLDER ALLUVIUM (Qoal) Sandy Clay (CL): Olive-gray with iron oxide stains; moist; stiff; medium- to coarse-grained sand; becomes sandier with depth.		5 8 11			18.7	107.7	CON
5		**BEDROCK - Silverado Formation (Tsi)** Siltstone: Olive-gray with iron oxide stains; moist; moderately hard; massive; moderately fractured; moderately weathered.		8 14 25			20.4	104.8	
10		Siltstone: Light gray to dark gray; moist; hard; massive; moderately fractured; slightly weathered; grades into a siltstone with sand with depth.		19 50/ 6"			18.2	110.4	
15				25 30 50			23.0	91.3	

Notes
Total Depth = 16.5 Feet
No Groundwater
No Caving.

PLATE A-

EXPLORATION LOG - V3 160-04D.GPJ PETRA.GDT 5/4/06

Petra Geotechnical

EXPLORATION LOG

Project: **Future Lake Street**		Boring No.: **B-4**	
Location: **Lake Elsinore**		Elevation: **1313**	
Job No.: **160-04**	Client: **Castle and Cooke**	Date: **2/14/06**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AR**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		OLDER ALLUVIUM (Qoal) Sandy Silt (ML): Reddish-brown; moist; very dense; fine-grained sand; becomes sandier with depth.		19 40 50			9.1	124.4	
5		Silty Sand (SM): Reddish-brown; slightly moist to moist; medium dense to dense; fine- to coarse-grained sand, with fine gravel.		18 20 24			9.9	117.6	
10				9 11 14			12.9	112.9	CON
		Silty Sand (SM): Reddish-brown; saturated; medium dense; fine-grained sand to coarse-grained gravel.							
15			▽	7 11 14			16.6	117.8	
		BEDROCK - Silverado Formation (Tsi) Sandstone: Olive gray; saturated; hard; massive; slightly weathered.							
20				17 21 32			19.7	111.1	

Notes
Total Depth = 21.5 Feet
Groundwater @ +/-15 Feet
No Caving.

PLATE A-4

EXPLORATION LOG

Project: Future Lake Street		Boring No.: B-6	
Location: Lake Elsinore		Elevation: 1305	
Job No.: 160-04	Client: Castle and Cooke	Date: 2/14/06	
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: AR	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Other Lab Tests
		OLDER ALLUVIUM (Qoal) Silty Sand (SM): Reddish-brown; slightly moist; dense; fine- to coarse-grained sand; up to 5% pinhole voids.							
				15 26	■		3.2	106.5	
5				19 36	■		2.7	103.6	
10				17 24	■		9.4	116.7	
		Silty Sand (SM): Reddish-brown; slightly moist; dense; fine-grained sand. becomes coarser with depth; friable; some pinhole voids (2%); abundant clasts of gravel up to 1/2" diameter.							
15				18 20	■		9.7	116.3	
20				19 31	■		5.4	109.0	
		Notes Total Depth = 21.5 Feet No Groundwater No Caving.							

PLATE A-

ORATION LOG - V3 160-04D.GPJ PETRA.GDT 5/4/06

EXPLORATION LOG

Project: Future Lake Street		Boring No.: B-7	
Location: Lake Elsinore		Elevation: 1372	
Job No.: 160-04	Client: Castle and Cooke	Date: 2/14/06	
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: AR	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (Afu) Silty Sand (SM): Dark brown; slightly moist; loose; fine- to coarse-grained sand; abundant rootlets; some fine-grained gravel.							
		YOUNGER ALLUVIUM (Qal) Silty Sand (SM): Dark brown; slightly moist to moist; loose; fine- to coarse-grained sand; fine-grained gravel up to 1/4" diameter; some clay; some rootlets.		1 2	■		12.2	111.4	
5				2 4	■		13.1	111.1	CON
		Silty Sand (SM): Reddish-brown; saturated; medium dense; fine- to coarse-grained sand; <5% clay content.	▽						
10				2 12	■		21.3	104.5	
		OLDER ALLUVIUM (Qoal) Silty Sand (SM): Dark brown; saturated; medium dense; fine- to medium-grained sand, some fine gravel; possible clay content; becomes less saturated with depth.							
15				7 13	■		15.6	114.8	
20				14 21	■		13.1	120.3	
		Notes Total Depth = 21.5 Feet Groundwater @ +/- 9 Feet No Caving.							

PLATE A-7

XPLORATION LOG - V3 160-04D.GPJ PETRA.GDT 5/4/06

EXPLORATION LOG

Project: **Future Lake Street**		Boring No.: **B-8**	
Location: **Lake Elsinore**		Elevation: **1357**	
Job No.: **160-04**	Client: **Castle and Cooke**	Date: **2/14/06**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AR**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		UNDOCUMENTED ARTIFICIAL FILL (Afu) Silty Sand (SM): Reddish-brown; dry to slightly moist; loose to medium dense; fine- to coarse-grained sand; occasional fine gravel; few shards of glass in sampler.		8 13	■		2.9	105.2	
5		**YOUNGER ALLUVIUM (Qal)** Silty Sand (SM): Reddish-brown; slightly moist, becomes saturated by 10 feet; loose to medium dense; fine- to coarse-grained sand; few rootlets.		8 10	■		8.2	111.1	CON
			▽						
10				2 1	■		20.5	105.9	CON
		OLDER ALLUVIUM (Qoal) Sandy Clay (CL): Dark brown; very moist to wet; firm; fine- to coarse-grained sand.							
15				7 9	■		15.5	115.8	CON
20				8 12	■		17.3	113.1	
		Silty Sand (SM): Reddish-brown; saturated; medium dense; fine- to coarse-grained sand.							

PLATE A-8

EXPLORATION LOG

Project: **Future Lake Street**		Boring No.: **B-8**	
Location: **Lake Elsinore**		Elevation: **1357**	
Job No.: **160-04**	Client: **Castle and Cooke**	Date: **2/14/06**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AR**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				9 13	■		15.8	116.1	
		BEDROCK - Silverado Formation (Tsi) Sandstone: Light brown to yellowish-brown; saturated; hard; massive; slightly fractured; slightly weathered; slightly oxidized.							
30				50/ 6"	■		14.8	115.2	
		Notes Total Depth = 30.5 Feet Groundwater @ +/- 9 Feet No Caving.							

PLATE A-9

EXPLORATION LOG - V3 160-04D.GPJ PETRA.GDT 5/4/06

APPENDIX B

LABORATORY TEST CRITERIA

LABORATORY TEST DATA

PETRA

APPENDIX B

Laboratory Test Criteria

Soil Classification

Soils encountered within the exploration borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D2488). The samples were re-examined in the laboratory and the classifications reviewed and then revised where appropriate. The assigned group symbols are presented in the boring logs, Appendix A.

In-Situ Moisture and Density

Moisture content and unit dry density of in-place soil and bedrock materials were determined in representative strata. Test data are summarized in the boring logs, Appendix A.

Laboratory Maximum Dry Density

Maximum dry density and optimum moisture content were determined for selected samples of soil and bedrock materials in accordance with ASTM D1557. Pertinent test values are given on Plate B-1.

Expansion Index

Expansion index tests were performed on selected samples of soil and bedrock materials in accordance with ASTM D4829. Expansion potential classifications were determined from 2001 CBC Table 18-I-B on the basis of the expansion index values. Test results and expansion potentials are presented on Plate B-1.

Collapse Potential

Collapse potential tests were performed in general accordance with ASTM D5333. Axial loads were applied in several increments to a laterally restrained 1-inch-high sample. Loads were applied in a geometric progression by doubling the previous load, and the resulting deformations were recorded at selected time intervals. The test samples were inundated at a surcharge loading in order to evaluate the effects of a sudden increase in moisture content (hydrocollapse potential). Results of these tests in terms of percent hydroconsolidation are presented on Plate B-1.

Atterberg Limits

Atterberg limit tests (Liquid Limit, Plastic Limit and Plasticity Index) were performed on selected samples to verify visual classifications. These tests were performed in accordance with ASTM D4318. Test results are presented on Plate B-1.

Direct Shear

The Coulomb shear strength parameters, angle of internal friction and cohesion, were determined for undisturbed and disturbed (bulk) samples remolded to approximately 90 percent of maximum dry density. These tests were

performed in general accordance with ASTM D3080. Three specimens were prepared for each test. The test specimens were artificially saturated, and then sheared under varied normal loads at a maximum constant rate of strain of 0.05 inches per minute. Results are summarized on Plates B-2 through B-7.

Consolidation

Consolidation tests were performed in general accordance with ASTM D2435. Axial loads were applied in several increments to a laterally restrained 1-inch-high sample. Loads were applied in a geometric progression by doubling the previous load, and the resulting deformations were recorded at selected time intervals. The test samples were inundated at a surcharge loading approximately equal to the existing or proposed total overburden pressures in order to evaluate the effects of a sudden increase in moisture content (hydrocollapse potential). Results of these tests are graphically presented on Plates B-8 through B-11.

LABORATORY MAXIMUM DRY DENSITY

Boring/Depth (feet)	Soil Type	Optimum Moisture[1] (%)	Maximum Dry Density[1] (pcf)
BA-2 @ 1.0 – 5.0	Silty SAND	8.5	130.5

EXPANSION INDEX TEST DATA

Boring/Depth (feet)	Soil Type	Expansion[2] Index	Expansion[3] Potential
BA-1 @ 2.0 – 5.0	Clayey SAND/Sandy CLAY	37	Low
BA-1 @ 30.0	CLAYSTONE	173	Very High

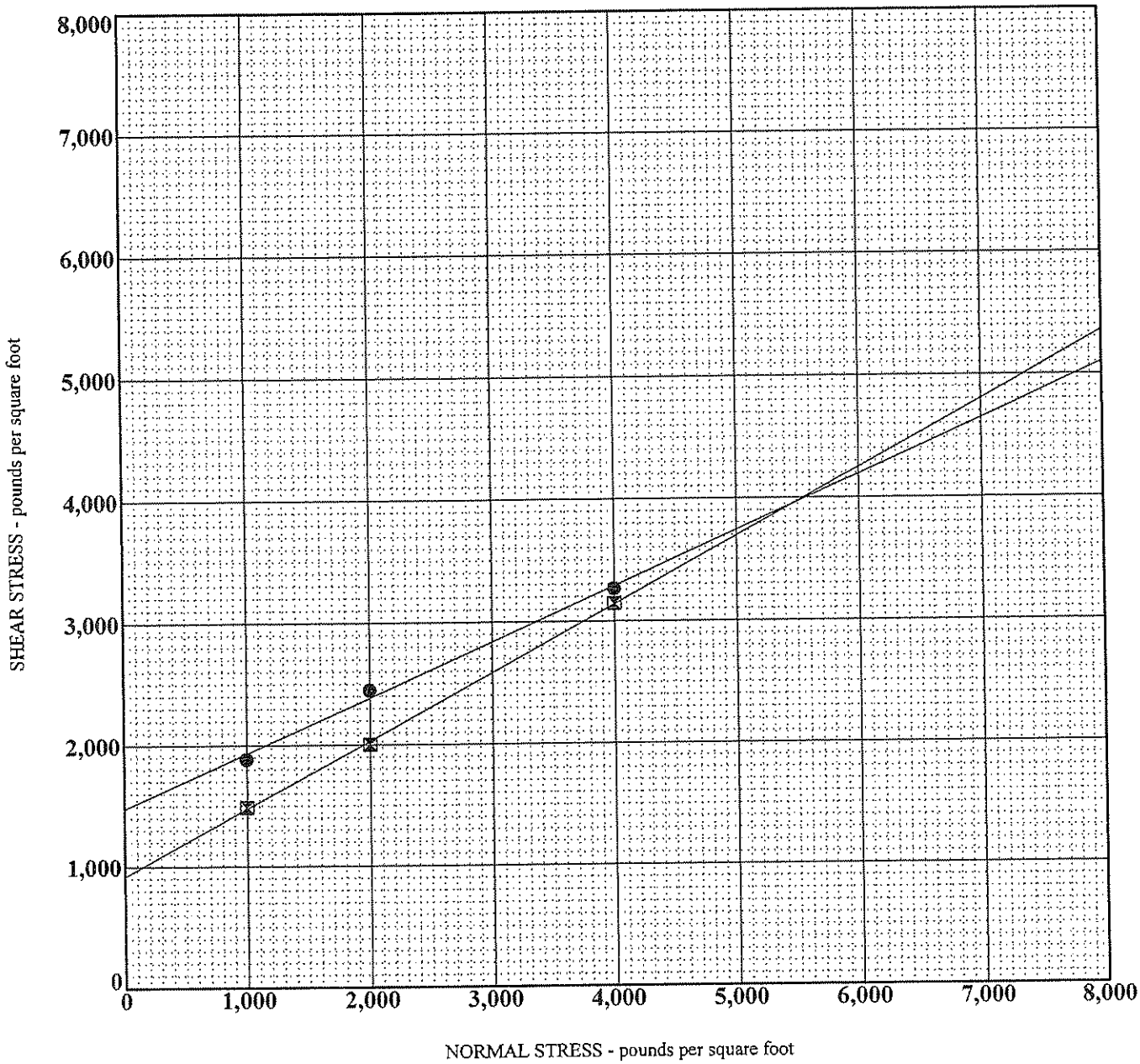
COLLAPSE POTENTIAL TEST[4]

Boring/Depth (feet)	Surcharge (ksf)	Settlement (%)
B-2 @ 20.0	2	0.63
B-3 @ 55.0	2	0.34
B-7 @ 25.0	2	0.81
B-22 @ 3.0	2	0.28

ATTERBERG[5]

Boring/Depth (feet)	Soil Type	LL	PL	PI
BA-1 @ 2.0 – 5.0	Clayey SAND/Sandy CLAY	32	15	17

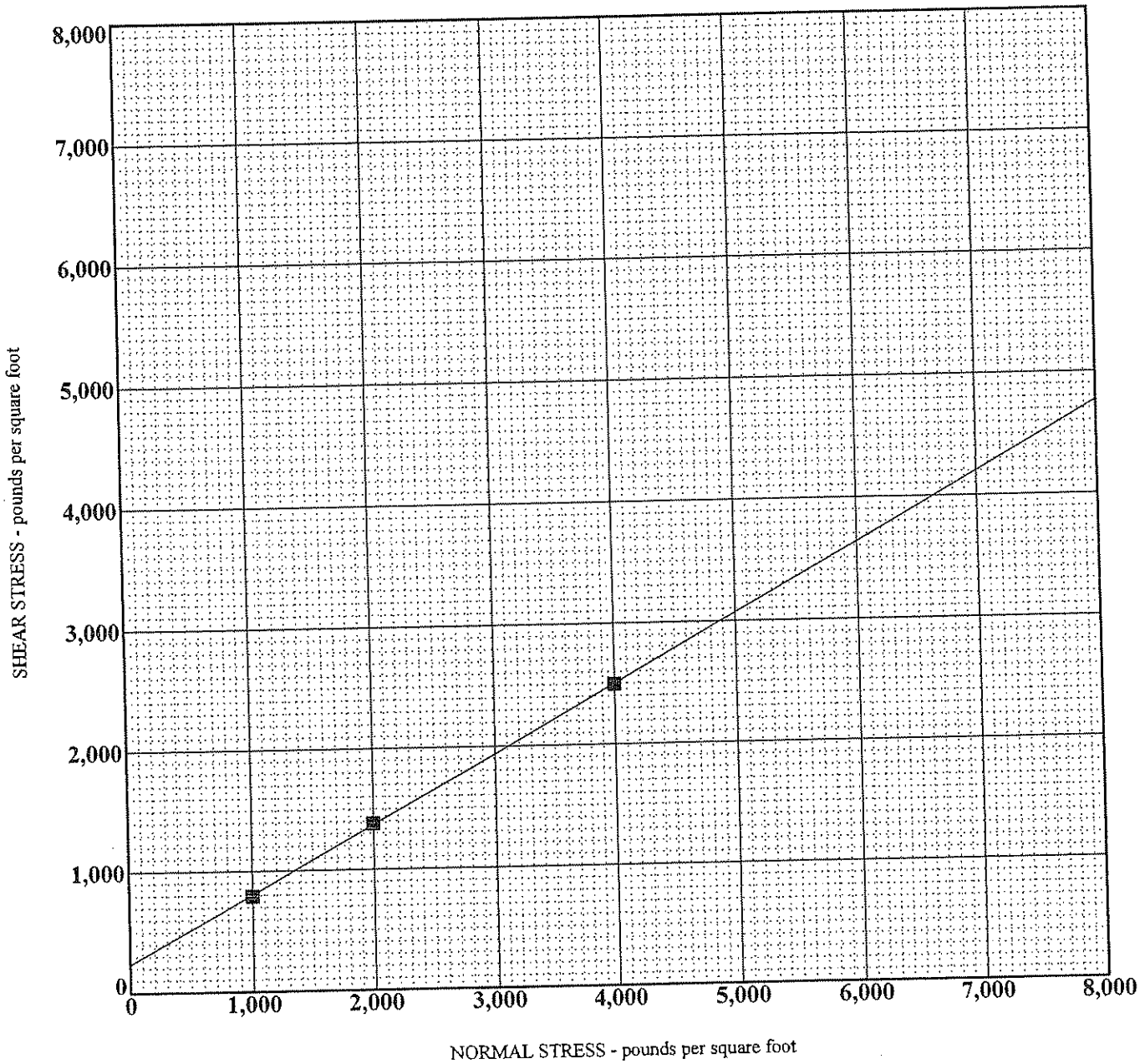
(1) PER ASTM D1557
(2) PER ASTM D4829
(3) PER 2001 CBC TABLE 18-I-B
(4) PER ASTM D5333
(5) PER ASTM D4318



SAMPLE LOCATION (feet)	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-11 @ 10.0	Clayey SAND - Peak	24	1475
⊠ B-11 @ 10.0	Clayey SAND - Ultimate	29	915

J.N. 137-07 & 140-07	DIRECT SHEAR TEST DATA	February, 2007
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-2

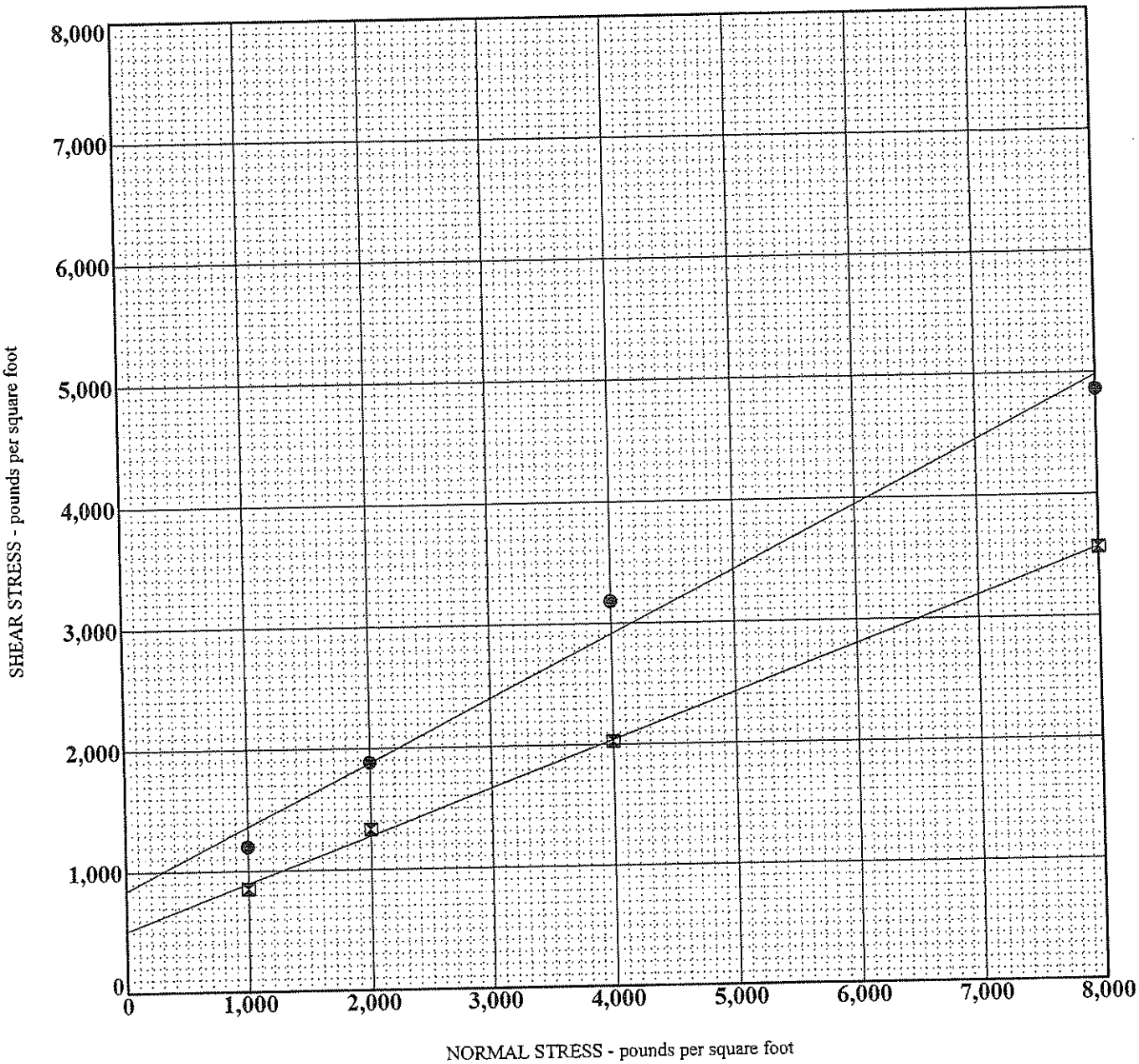
DIRECT SHEAR 137-07 140-07.GPJ PETRA.GDT 2/27/07



SAMPLE LOCATION (feet)	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-4 @ 5.0	Silty SAND - Peak	30	230
⊠ B-4 @ 5.0	Silty SAND - Ultimate	30	230

DIRECT SHEAR 137-07 140-07.GPJ PETRA.GDT 2/27/07

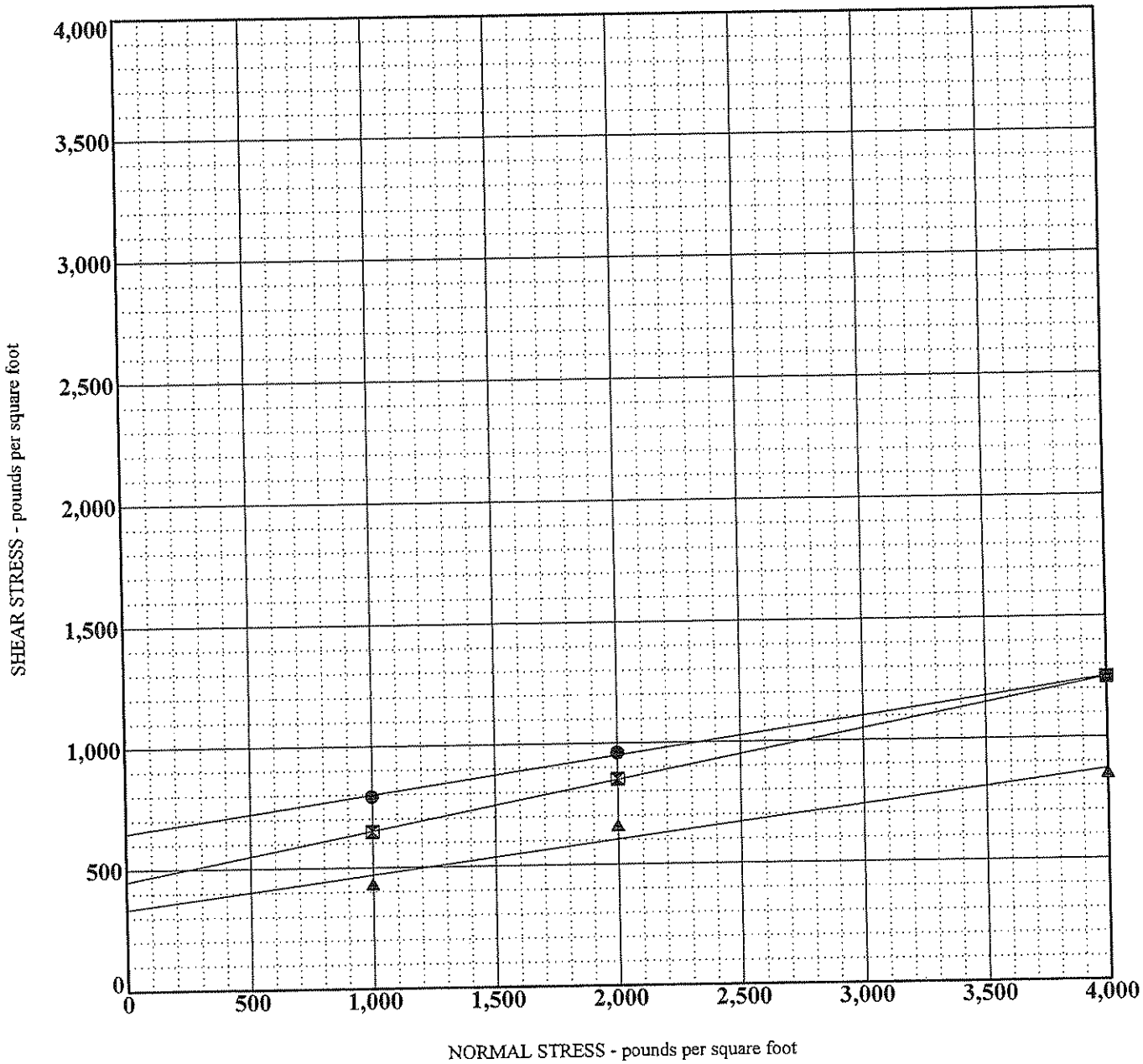
J.N. 137-07 & 140-07	DIRECT SHEAR TEST DATA	February, 2007
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-3



SAMPLE LOCATION (feet)	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● B-4 @ 30.0	CLAYSTONE - Peak	27	840
⊠ B-4 @ 30.0	CLAYSTONE - Ultimate	21	510

DIRECT SHEAR 137-07 140-07.GPJ PETRA.GDT 2/27/07

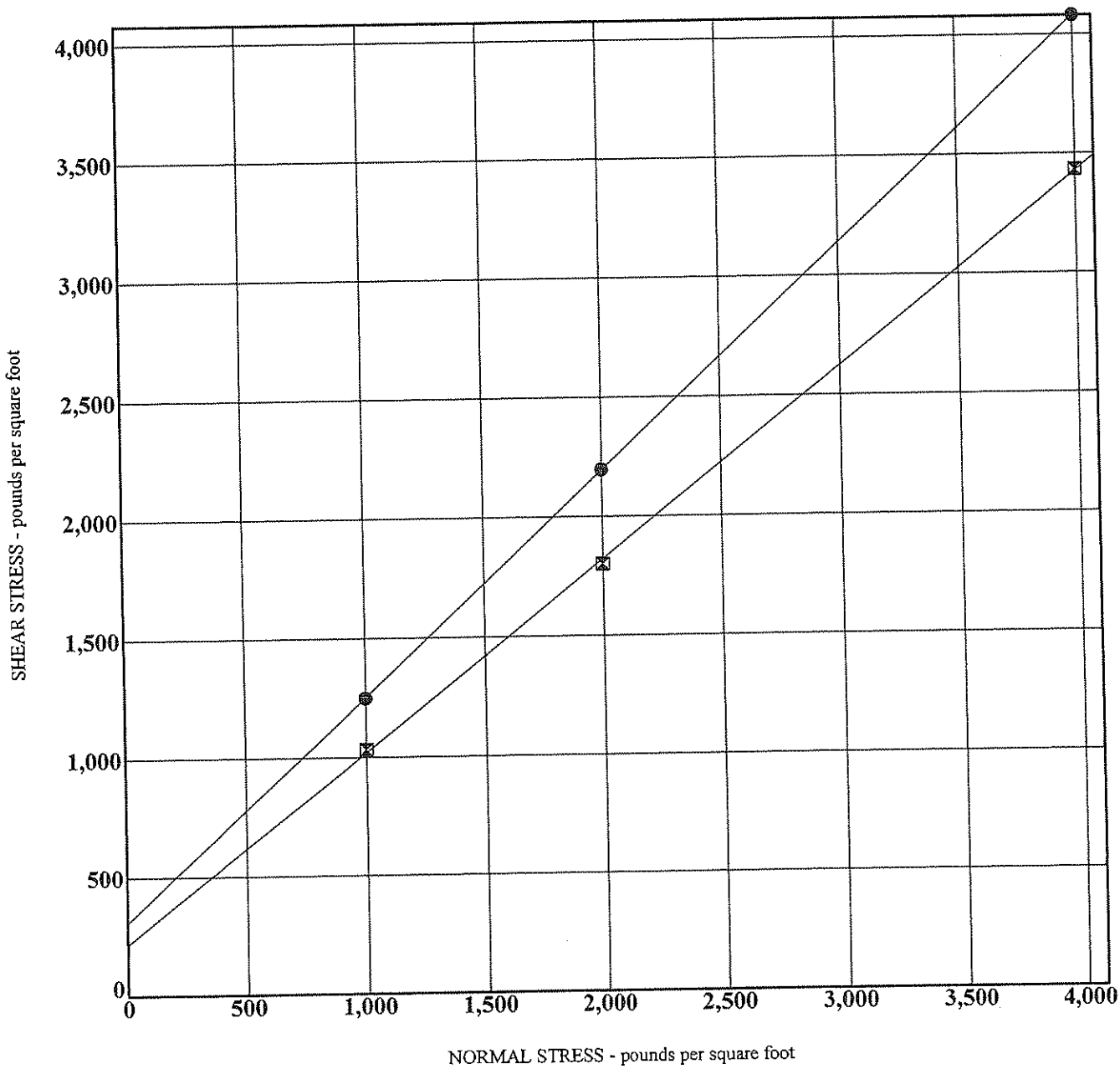
J.N. 137-07 & 140-07	DIRECT SHEAR TEST DATA	February, 2007
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-4



SAMPLE LOCATION (feet)	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● BA-1 @ 30.0	CLAYSTONE	9	645
⊠ BA-1 @ 30.0	CLAYSTONE - Ultimate	11	450
▲ BA-1 @ 30.0	CLAYSTONE - Residual	8	335

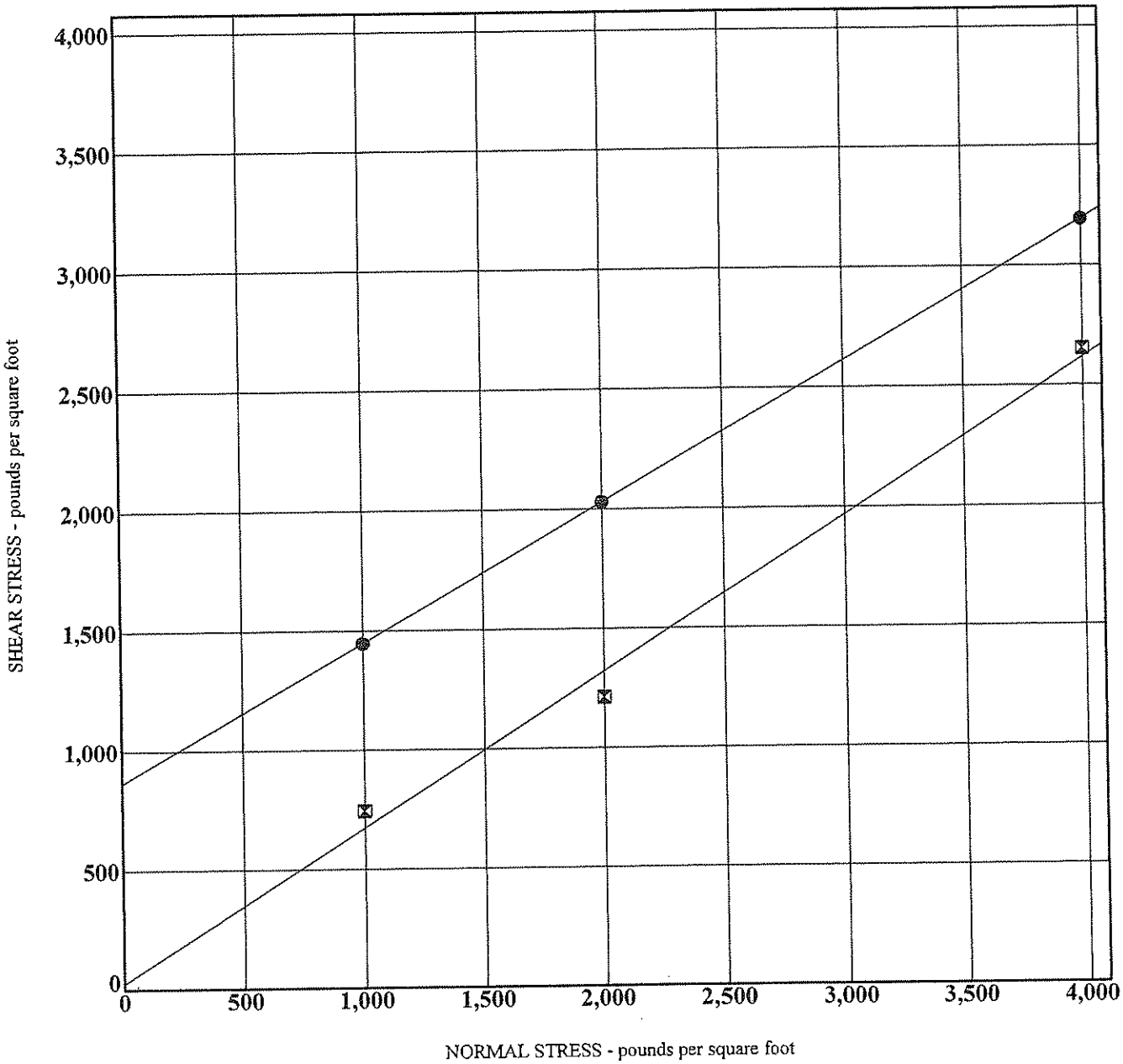
DIRECT SHEAR 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

J.N. 137-07 & 140-07	DIRECT SHEAR TEST DATA	February, 2007
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-5



SAMPLE LOCATION (feet)	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● BA-2 @ 30.0	Silty SAND w/ Gravel - Peak	43	305
⊠ BA-2 @ 30.0	Silty SAND w/ Gravel - Ultimate	39	215

J.N. 137-07 & 140-07	DIRECT SHEAR TEST DATA	February, 2007
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-6

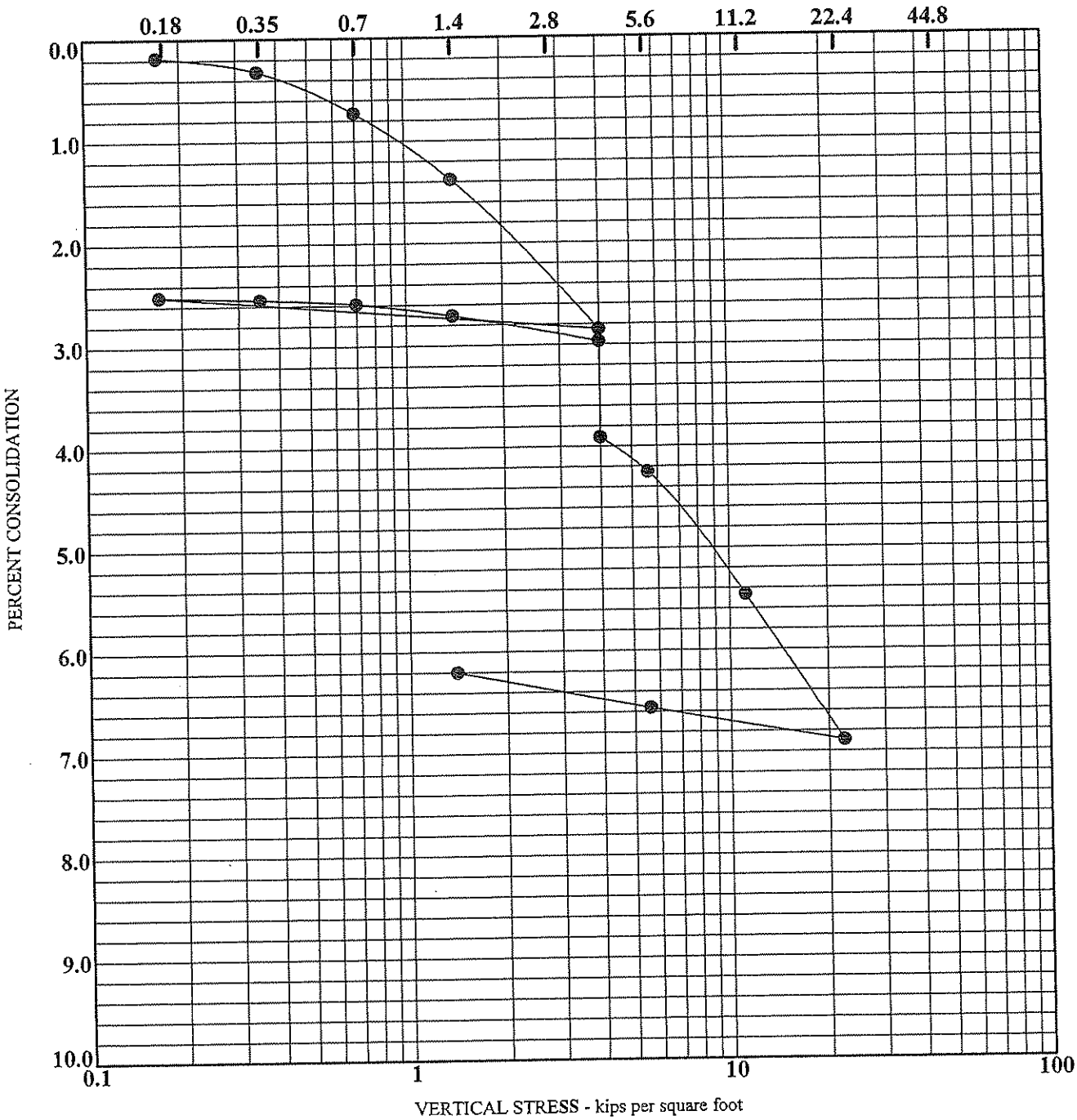


SAMPLE LOCATION (feet)	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● BA-3 @ 51.0	SAND - Peak	30	860
⊠ BA-3 @ 51.0	SAND - Ultimate	33	20

DIRECT SHEAR 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

J.N. 137-07 & 140-07	DIRECT SHEAR TEST DATA	February, 2007
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-7

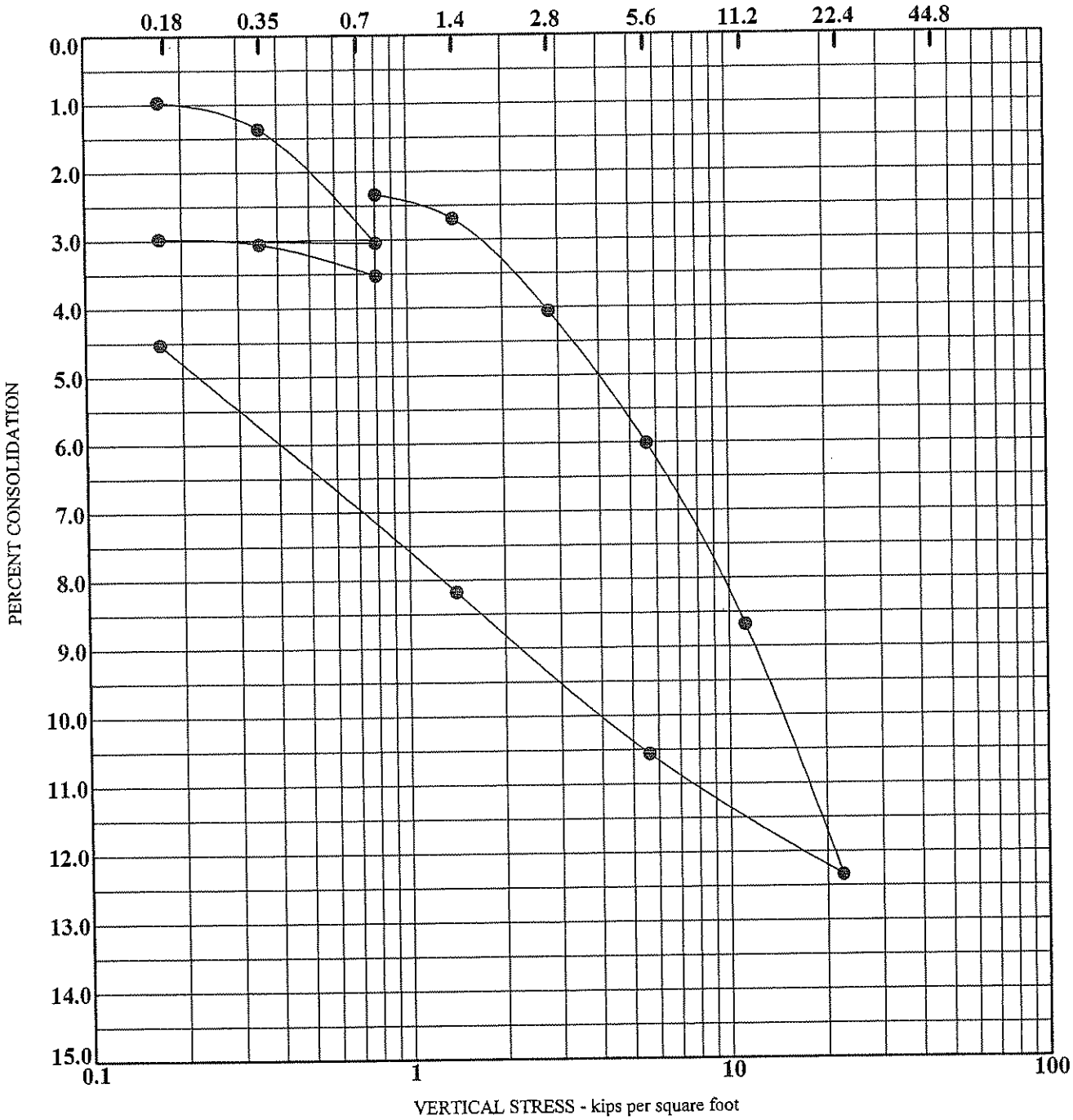
SAMPLE LOCATION (feet)	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● B-2 @ 35.0	Silty SAND	117.9	9.0	56	4.00



J.N. 137-07 & 140-07	CONSOLIDATION TEST RESULTS	February, 2007
PETRA GEOTECHNICAL, INC.		PLATE B-8

CONSOLIDATION - STRAIN 137-07 140-07.GPJ PETRA.GDT 2/27/07

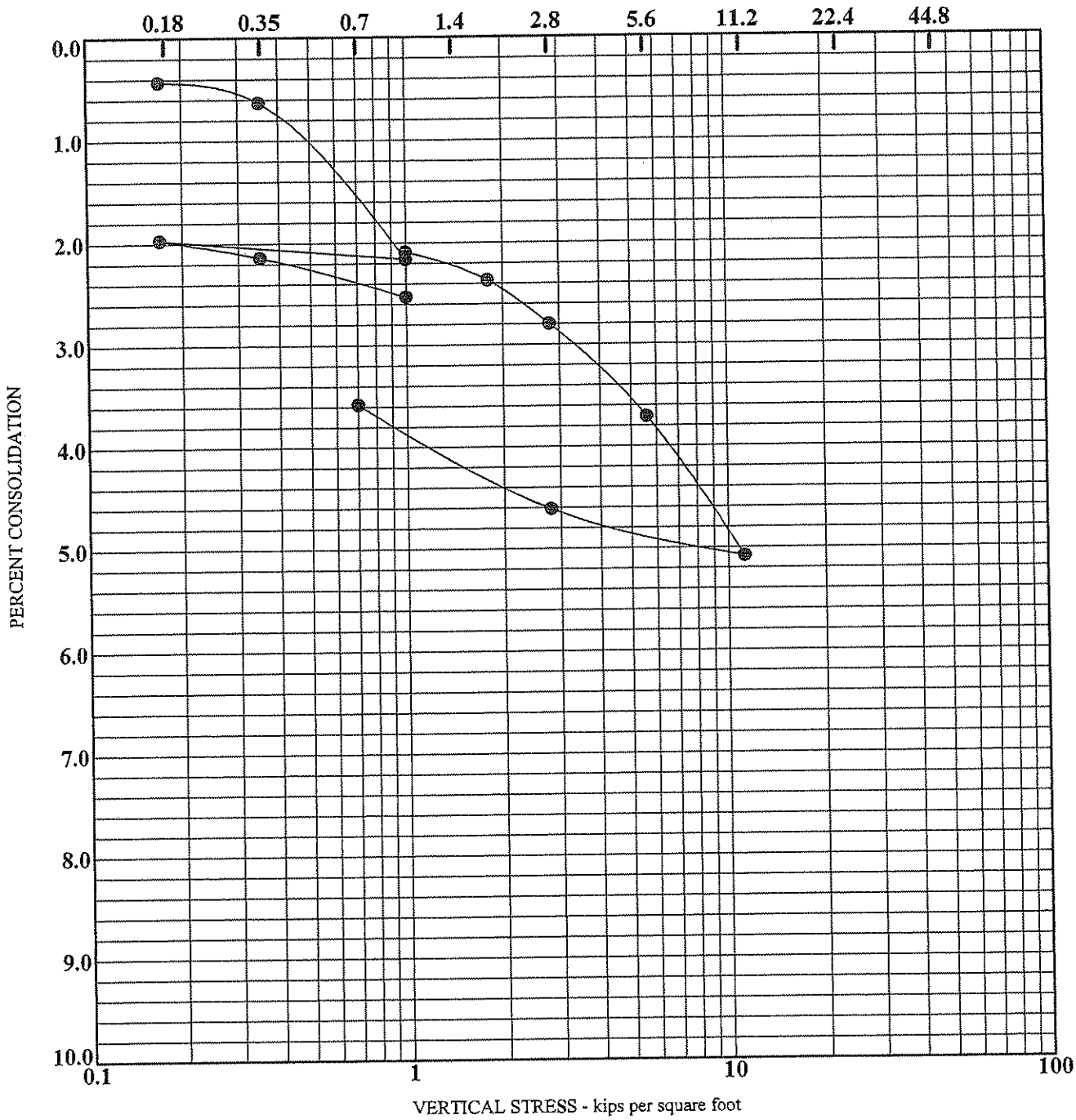
SAMPLE LOCATION (feet)	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● B-5 @ 7.0	CLAY	88.1	29.6	88	0.80



J.N. 137-07 & 140-07	CONSOLIDATION TEST RESULTS	February, 2007
PETRA GEOTECHNICAL, INC.		PLATE B-9

CONSOLIDATION - STRAIN 137-07 140-07.GPJ PETRA.GDT 2/27/07

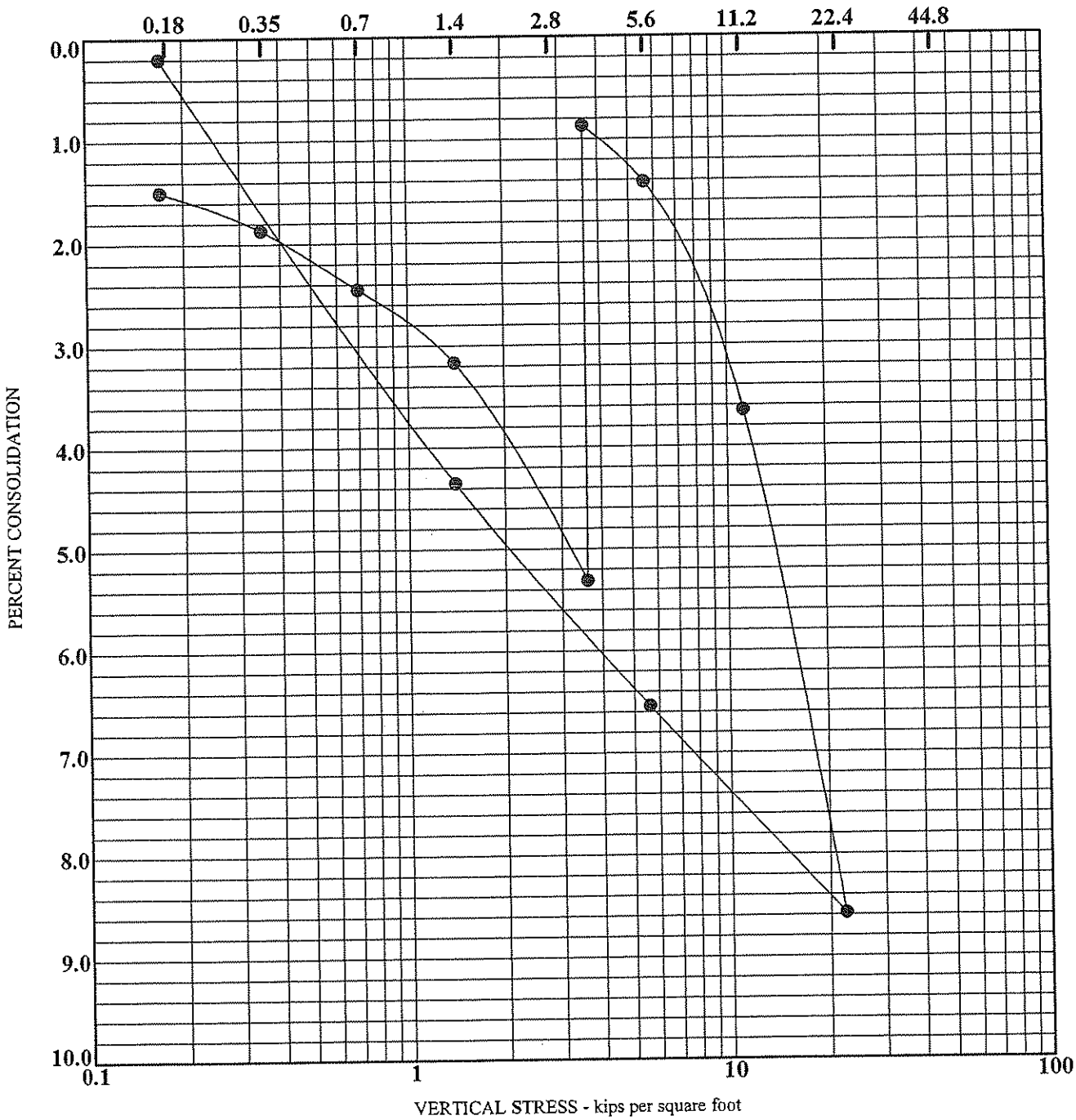
SAMPLE LOCATION (feet)	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● B-8 @ 10.0	Sandy CLAY	112.1	16.1	87	1.00



J.N. 137-07 & 140-07	CONSOLIDATION TEST RESULTS	February, 2007
PETRA GEOTECHNICAL, INC.		PLATE B-10

CONSOLIDATION - STRAIN 137-07 140-07.GPJ PETRA.GDT 2/27/07

SAMPLE LOCATION (feet)	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● BA-1 @ 30.0	CLAYSTONE	97.6	26.9	95	3.60



J.N. 137-07 & 140-07	CONSOLIDATION TEST RESULTS	February, 2007
PETRA GEOTECHNICAL, INC.		PLATE B-11

CONSOLIDATION - STRAIN 137-07A 140-07A.GPJ PETRA.GDT 2/27/07

APPENDIX C

SEISMIC ANALYSIS

PETRA

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*                    *
*    U B C S E I S   *
*                    *
*    Version  1.03   *
*                    *
**********************
```

COMPUTATION OF 1997
UNIFORM BUILDING CODE
SEISMIC DESIGN PARAMETERS

JOB NUMBER: 108-07 DATE: 01-25-2007

JOB NAME: Commercial site

FAULT-DATA-FILE NAME: CDMGUBCR.DAT

SITE COORDINATES:
SITE LATITUDE: 33.7130
SITE LONGITUDE: 117.3830

UBC SEISMIC ZONE: 0.4

UBC SOIL PROFILE TYPE: SD

NEAREST TYPE A FAULT:
NAME:
DISTANCE: 2.0 km

NEAREST TYPE B FAULT:
NAME:
DISTANCE: 20.0 km

NEAREST TYPE C FAULT:
NAME:
DISTANCE: 50.0 km

SELECTED UBC SEISMIC COEFFICIENTS:
Na: 1.5
Nv: 2.0
Ca: 0.66
Cv: 1.28
Ts: 0.776
To: 0.155

```
*******************************************************************
* CAUTION:  The digitized data points used to model faults are    *
*           limited in number and have been digitized from small- *
*           scale maps (e.g., 1:750,000 scale).  Consequently,    *
*           the estimated fault-site-distances may be in error by *
*           several kilometers.  Therefore, it is important that  *
*           the distances be carefully checked for accuracy and   *
*           adjusted as needed, before they are used in design.   *
*******************************************************************
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SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
ELSINORE-GLEN IVY	3.7	B	6.8	5.00	SS
ELSINORE-TEMECULA	8.4	B	6.8	5.00	SS
CHINO-CENTRAL AVE. (Elsinore)	21.3	B	6.7	1.00	DS
ELSINORE-WHITTIER	28.2	B	6.8	2.50	SS
SAN JACINTO-SAN JACINTO VALLEY	33.3	B	6.9	12.00	SS
SAN JACINTO-SAN BERNARDINO	35.9	B	6.7	12.00	SS
SAN JACINTO-ANZA	43.2	A	7.2	12.00	SS
NEWPORT-INGLEWOOD (Offshore)	44.0	B	6.9	1.50	SS
ELSINORE-JULIAN	50.7	A	7.1	5.00	SS
NEWPORT-INGLEWOOD (L.A.Basin)	51.3	B	6.9	1.00	SS
SAN ANDREAS - Southern	51.6	A	7.4	24.00	SS
SAN JOSE	52.4	B	6.5	0.50	DS
CUCAMONGA	52.4	A	7.0	5.00	DS
SIERRA MADRE (Central)	56.3	B	7.0	3.00	DS
NORTH FRONTAL FAULT ZONE (West)	62.4	B	7.0	1.00	DS
CLEGHORN	63.0	B	6.5	3.00	SS
ROSE CANYON	65.0	B	6.9	1.50	SS
SAN ANDREAS - 1857 Rupture	67.8	A	7.8	34.00	SS
PALOS VERDES	68.3	B	7.1	3.00	SS
CORONADO BANK	70.6	B	7.4	3.00	SS
PINTO MOUNTAIN	72.1	B	7.0	2.50	SS
CLAMSHELL-SAWPIT	72.6	B	6.5	0.50	DS
RAYMOND	76.5	B	6.5	0.50	DS
NORTH FRONTAL FAULT ZONE (East)	79.7	B	6.7	0.50	DS
VERDUGO	85.1	B	6.7	0.50	DS
SAN JACINTO-COYOTE CREEK	85.8	B	6.8	4.00	SS
HELENDALE - S. LOCKHARDT	87.2	B	7.1	0.60	SS
HOLLYWOOD	90.4	B	6.5	1.00	DS
EARTHQUAKE VALLEY	94.8	B	6.5	2.00	SS
BURNT MTN.	96.6	B	6.5	0.60	SS
LENWOOD-LOCKHART-OLD WOMAN SPRGS	99.3	B	7.3	0.60	SS
EUREKA PEAK	101.0	B	6.5	0.60	SS
LANDERS	102.4	B	7.3	0.60	SS
SANTA MONICA	103.3	B	6.6	1.00	DS
SIERRA MADRE (San Fernando)	105.1	B	6.7	2.00	DS
SAN GABRIEL	106.8	B	7.0	1.00	SS
JOHNSON VALLEY (Northern)	109.2	B	6.7	0.60	SS
MALIBU COAST	112.1	B	6.7	0.30	DS
EMERSON So. - COPPER MTN.	117.8	B	6.9	0.60	SS
SANTA SUSANA	123.3	B	6.6	5.00	DS
SAN JACINTO - BORREGO	123.9	B	6.6	4.00	SS
ANACAPA-DUME	125.0	B	7.3	3.00	DS
ELSINORE-COYOTE MOUNTAIN	125.8	B	6.8	4.00	SS
CALICO - HIDALGO	126.0	B	7.1	0.60	SS
HOLSER	132.2	B	6.5	0.40	DS
PISGAH-BULLION MTN.-MESQUITE LK	133.1	B	7.1	0.60	SS

SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
GRAVEL HILLS - HARPER LAKE	135.9	B	6.9	0.60	SS
OAK RIDGE (Onshore)	143.6	B	6.9	4.00	DS
SIMI-SANTA ROSA	145.8	B	6.7	1.00	DS
BLACKWATER	149.7	B	6.9	0.60	SS
SAN CAYETANO	150.8	B	6.8	6.00	DS
SUPERSTITION MTN. (San Jacinto)	157.1	B	6.6	5.00	SS
BRAWLEY SEISMIC ZONE	160.3	B	6.5	25.00	SS
ELMORE RANCH	160.5	B	6.6	1.00	SS
SUPERSTITION HILLS (San Jacinto)	162.7	B	6.6	4.00	SS
SANTA YNEZ (East)	169.7	B	7.0	2.00	SS
GARLOCK (West)	174.8	A	7.1	6.00	SS
ELSINORE-LAGUNA SALADA	177.0	B	7.0	3.50	SS
VENTURA - PITAS POINT	177.2	B	6.8	1.00	DS
GARLOCK (East)	184.5	A	7.3	7.00	SS
M.RIDGE-ARROYO PARIDA-SANTA ANA	185.1	B	6.7	0.40	DS
PLEITO THRUST	186.2	B	6.8	2.00	DS
IMPERIAL	189.7	A	7.0	20.00	SS
RED MOUNTAIN	191.5	B	6.8	2.00	DS
BIG PINE	194.3	B	6.7	0.80	SS
SANTA CRUZ ISLAND	199.6	B	6.8	1.00	DS
WHITE WOLF	201.4	B	7.2	2.00	DS
So. SIERRA NEVADA	208.3	B	7.1	0.10	DS
LITTLE LAKE	212.4	B	6.7	0.70	SS
TANK CANYON	214.8	B	6.5	1.00	DS
OWL LAKE	215.7	B	6.5	2.00	SS
PANAMINT VALLEY	215.8	B	7.2	2.50	SS
SANTA YNEZ (West)	225.2	B	6.9	2.00	SS
DEATH VALLEY (South)	228.8	B	6.9	4.00	SS
SANTA ROSA ISLAND	236.0	B	6.9	1.00	DS
DEATH VALLEY (Graben)	265.9	B	6.9	4.00	DS
LOS ALAMOS-W. BASELINE	268.2	B	6.8	0.70	DS
OWENS VALLEY	281.1	B	7.6	1.50	SS
LIONS HEAD	285.6	B	6.6	0.02	DS
SAN JUAN	286.9	B	7.0	1.00	SS
SAN LUIS RANGE (S. Margin)	292.3	B	7.0	0.20	DS
CASMALIA (Orcutt Frontal Fault)	302.5	B	6.5	0.25	DS
HUNTER MTN. - SALINE VALLEY	307.4	B	7.0	2.50	SS
INDEPENDENCE	316.9	B	6.9	0.20	DS
DEATH VALLEY (Northern)	318.5	A	7.2	5.00	SS
LOS OSOS	321.7	B	6.8	0.50	DS
HOSGRI	331.7	B	7.3	2.50	SS
RINCONADA	339.2	B	7.3	1.00	SS
BIRCH CREEK	373.4	B	6.5	0.70	DS
WHITE MOUNTAINS	377.7	B	7.1	1.00	SS
SAN ANDREAS (Creeping)	388.8	B	5.0	34.00	SS
DEEP SPRINGS	396.1	B	6.6	0.80	DS

SUMMARY OF FAULT PARAMETERS

	APPROX.	SOURCE	MAX.	SLIP	FAULT

ABBREVIATED FAULT NAME	DISTANCE (km)	TYPE (A,B,C)	MAG. (Mw)	RATE (mm/yr)	TYPE (SS,DS,BT)
DEATH VALLEY (N. of Cucamongo)	401.2	A	7.0	5.00	SS
ROUND VALLEY (E. of S.N.Mtns.)	408.8	B	6.8	1.00	DS
FISH SLOUGH	416.2	B	6.6	0.20	DS
HILTON CREEK	435.0	B	6.7	2.50	DS
HARTLEY SPRINGS	459.6	B	6.6	0.50	DS
ORTIGALITA	470.0	B	6.9	1.00	SS
CALAVERAS (So.of Calaveras Res)	477.6	B	6.2	15.00	SS
MONTEREY BAY - TULARCITOS	483.7	B	7.1	0.50	DS
PALO COLORADO - SUR	487.2	B	7.0	3.00	SS
QUIEN SABE	490.2	B	6.5	1.00	SS
MONO LAKE	495.7	B	6.6	2.50	DS
ZAYANTE-VERGELES	509.6	B	6.8	0.10	SS
SARGENT	514.4	B	6.8	3.00	SS
SAN ANDREAS (1906)	514.9	A	7.9	24.00	SS
ROBINSON CREEK	527.0	B	6.5	0.50	DS
SAN GREGORIO	558.7	A	7.3	5.00	SS
GREENVILLE	561.6	B	6.9	2.00	SS
HAYWARD (SE Extension)	563.6	B	6.5	3.00	SS
MONTE VISTA - SHANNON	564.5	B	6.5	0.40	DS
ANTELOPE VALLEY	567.5	B	6.7	0.80	DS
HAYWARD (Total Length)	582.8	A	7.1	9.00	SS
CALAVERAS (No.of Calaveras Res)	582.8	B	6.8	6.00	SS
GENOA	593.2	B	6.9	1.00	DS
CONCORD - GREEN VALLEY	629.2	B	6.9	6.00	SS
RODGERS CREEK	668.4	A	7.0	9.00	SS
WEST NAPA	668.7	B	6.5	1.00	SS
POINT REYES	689.5	B	6.8	0.30	DS
HUNTING CREEK - BERRYESSA	690.0	B	6.9	6.00	SS
MAACAMA (South)	730.5	B	6.9	9.00	SS
COLLAYOMI	746.7	B	6.5	0.60	SS
BARTLETT SPRINGS	749.2	A	7.1	6.00	SS
MAACAMA (Central)	772.0	A	7.1	9.00	SS
MAACAMA (North)	830.8	A	7.1	9.00	SS
ROUND VALLEY (N. S.F.Bay)	835.8	B	6.8	6.00	SS
BATTLE CREEK	855.0	B	6.5	0.50	DS
LAKE MOUNTAIN	894.1	B	6.7	6.00	SS
GARBERVILLE-BRICELAND	911.8	B	6.9	9.00	SS
MENDOCINO FAULT ZONE	968.8	A	7.4	35.00	DS
LITTLE SALMON (Onshore)	974.0	A	7.0	5.00	DS
MAD RIVER	976.0	B	7.1	0.70	DS
CASCADIA SUBDUCTION ZONE	983.0	A	8.3	35.00	DS
McKINLEYVILLE	986.6	B	7.0	0.60	DS
TRINIDAD	988.0	B	7.3	2.50	DS
FICKLE HILL	988.7	B	6.9	0.60	DS
TABLE BLUFF	994.7	B	7.0	0.60	DS
LITTLE SALMON (Offshore)	1007.9	B	7.1	1.00	DS

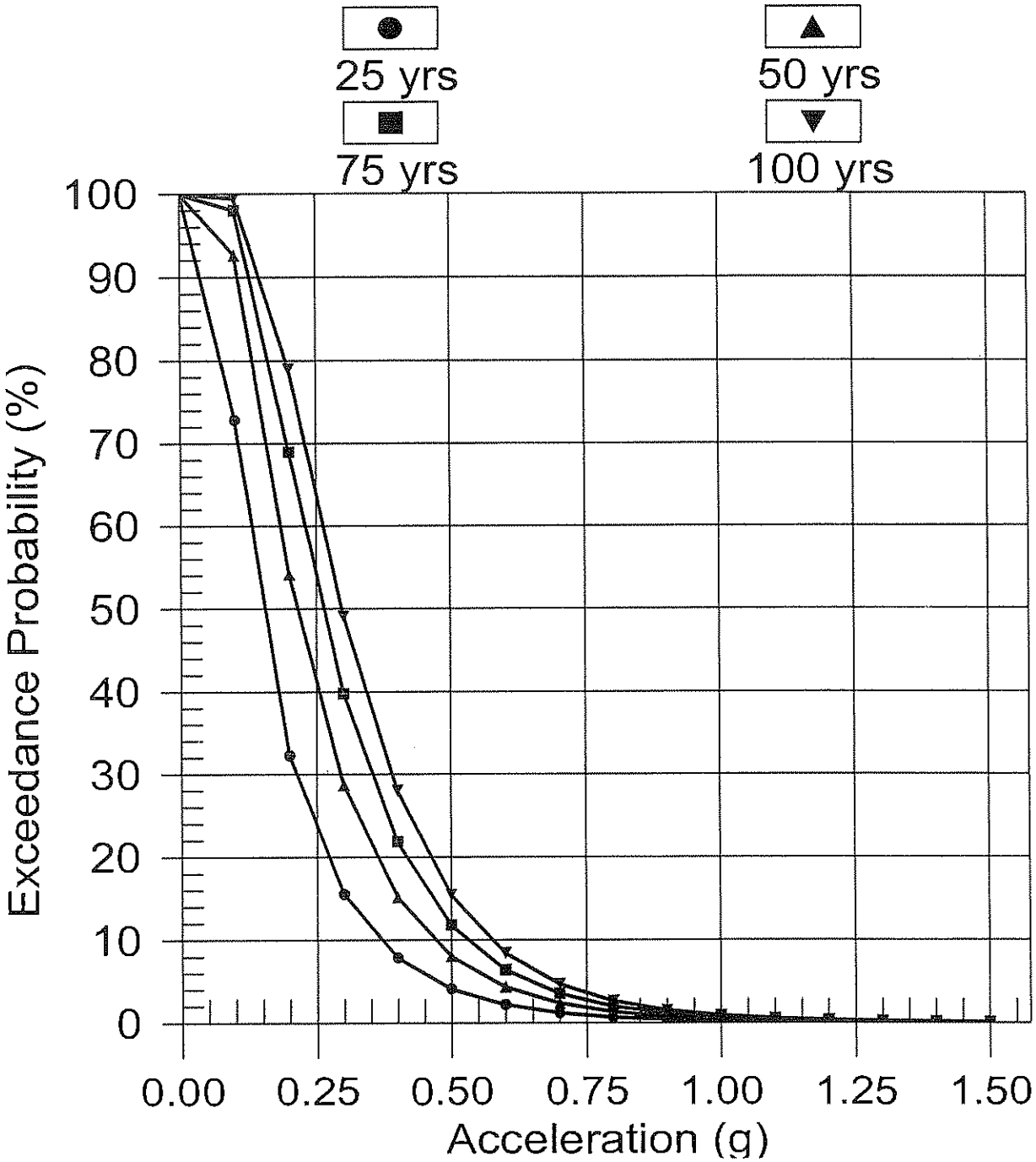
SUMMARY OF FAULT PARAMETERS

Page 4

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)

PROBABILITY OF EXCEEDANCE

BOZ. ET AL.(1999)HOR PS UNC 1



FAULT INVESTIGATION
TENTATIVE TRACT 28198
CITY OF LAKE ELSINORE
RIVERSIDE COUNTY, CALIFORNIA

REAL ESTATE DEVELOPMENT SPECIALISTS, INC.
5826 Magnolia Avenue
Riverside, California 92506

January 21, 2004
J.N. 382-03

January 21, 2004
J.N. 382-03

REAL ESTATE DEVELOPMENT SPECIALISTS, INC.
5826 Magnolia Avenue
Riverside, California 92506

Attention: Mr. John Ford

Subject: Fault Investigation, Tentative Tract 28198, City of Lake Elsinore, Riverside County, California

At your request, Petra Geotechnical, Inc. is pleased to submit this fault investigation report for the 34-acre site located northwest of the western terminus of Mountain Street in the City of Lake Elsinore, California. The southern approximately two-thirds of the property lies within the City of Lake Elsinore and the northern one-third of the property is located in Riverside County. Rice Canyon Wash borders the northwestern portion of the site currently planned for development. This report presents the results of our field investigation, as well as our engineering geologic judgement, opinions and conclusions with respect to onsite faulting issues and their impact on the proposed residential and commercial development.

From an engineering geologic point of view, it is our opinion that the subject property is considered suitable for the proposed residential development, with respect to faulting, provided the conclusions and recommendations presented in this report are addressed

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the contents of this report or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Robert L. Gregorek, II
Senior Associate Geologist

Distribution: (5) Addressee

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Site Location and Description 1
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References
Figure 1 - Site Location Map
Figure 2 - Geologic Fault Map
Figures 3 - 24 - Geotechnical Trench Logs
Plate 1 - Geologic Map (in pocket)

FAULT INVESTIGATION
TENTATIVE TRACT 28198
CITY OF LAKE ELSINORE, RIVERSIDE COUNTY
CALIFORNIA

INTRODUCTION

This report presents the results of Petra Geotechnical, Inc.'s (Petra) fault investigation within the 34-acre site for the proposed residential development located in the City of Lake Elsinore (southern two-thirds of the site) and Riverside County (northern one-third of the site). This firm analyzed local stereoscopic-aerial photographs, reviewed published geologic maps and logged excavated *fault* trenches within the site in order to determine the style, location and age of surface geomorphic features that could be associated with the *active* Elsinore fault zone. With this information we were able to establish fault set-back zones adjacent to identified faults that may be active and to evaluate whether or not faults existed in other portions of the property. Within our analysis of onsite faulting, we also provide a review of published and unpublished literature, including geologic maps, pertaining to local and regional faulting and geologic rock units which could have an impact on the site.

Site Location and Description

The roughly triangular-shaped, 34-acre site is located at the western terminus of Mountain Street and at the northern terminus of Lincoln Street in the City of Lake Elsinore, California. Rice Canyon Wash borders the northwestern portion of the site currently planned for development (see Figure 1). It is our understanding that you also own a property of similar size adjacent to the subject site toward the northwest separated by Rice Canyon Wash. A number of dirt roads transect the property, one of which leads to adjacent residential properties located west and northwest of the subject site. Surrounding the property are a school and residential homes to the south, mostly residential homes to the east and the Rice Canyon Wash along the northwestern property line.

Geomorphically, the site is regionally located on the eastern escarpment of the Santa Ana Mountains and exhibits a combination of gently eastward-dipping slopes containing Quaternary-age fan deposits and some relatively higher rolling hills composed of Cretaceous-age granodiorite and likely Jurassic-age metamorphic rocks (Figure 2 and Plate 1). Topographically, the site has a total relief of approximately 108 feet, extending from an elevation of 1,514 feet above mean seal level (msl) in the northern corner of the property to 1,622 feet msl in the southwestern corner of the property.

Most of the site was covered with natural vegetation consisting of native chaparral and a few trees. Much of the site, with the exception of the active wash and relatively higher hills, contained a surficial layer of undocumented fill soils. In addition, a large stockpile of rock existed in the southwestern portion of the site. Trash debris has been dumped along some of the dirt roadways within the property.

Proposed Development

Based on the preliminary 100-scale (1 inch equals 100 feet) grading plans dated May 18, 1994, prepared by The Keith Companies, 108 residential lots and associated roads are proposed to be constructed within the property. Based on these plans, cut and fill slopes as high as approximately 18 feet are proposed during construction of the residential pads. This firm was informed by you that a bridge will be constructed across Rice Canyon Wash to allow access to properties west of the subject site. In addition, a levee is proposed for Rice Canyon Wash.

Purpose and Scope of Services

The primary objective of this investigation was to determine the location and age of surface-rupture deformation due to past earthquakes across various mapped fault strands associated with the active Elsinore fault zone (Hart and Byrant, 1997; Jennings, 1994; Weber, 1977) within the property. Surface deformation can include the

identification of *active* faults (a fault that ruptured the surface of the earth during the past 11,000 years - Holocene time for the State of California), *potentially active* faults (ruptured the surface sometime between 11,000 and 500,000 years ago - Late Pleistocene), near-surface fracture zones (cracking caused by earthquakes) and minor folding and tilting of rock units

In proximity to the subject site, the Elsinore fault zone consists of numerous faults within an approximately 3,000- to 4,000-foot wide zone (Greenwood and Morton, 1991; Weber, 1977). Based on our review of these geologic maps and our analysis of aerial photographs, the dominant fault within this zone is the Glen Ivy North strand along the eastern side of the Elsinore fault zone (Figure 2). The Glen Ivy North fault itself is mapped by Weber (1977) as two fault strands in the vicinity of the property, one of which is mapped as possibly entering the northernmost portion of the site (Figure 2).

The site exists within a California State-designated Alquist-Priolo Earthquake Fault Hazard Zone (formerly referred to as Alquist-Priolo Special Studies Zones) for the Elsinore fault zone (Figure 2). The California State Earthquake Fault Hazard Zone (EFHZ) transects the central portion of the subject site at the southeast end of two parallel and relatively short un-named fault strands. The two strands are approximately 3,000 to 4,000 feet in length. To our knowledge, these faults have not been positively identified by a fault-trenching study and the geologic maps suggest that their existence and location are uncertain at this time.

As required by the California State Fault Hazard Zone laws (Hart, 1997), we excavated a single trench that extended across the California State EFHZ within the property. The exploratory trench was approximately 1,000 feet in length (FT-1 on Plate 1). A trench was also excavated across the mapped location of the southern strand of the two parallel short-scale faults within the state EFHZ on the adjacent property toward the

northwest (FT-4 on Plate 1). Additional trenches were excavated in the northern portion of the property to investigate the possibility of faulting associated with the Glen Ivy North fault zone (FT-2 and FT-3).

The scope or our investigation consisted of the following:

- Review of pertinent geologic literature;
- Geologic mapping of the subject site and portions of the adjacent property toward the northwest;
- Stereoscopic aerial-photograph analysis;
- Excavation of four fault trenches, totaling approximately 1,530 lineal feet, to a depths of up to approximately 33 feet;
- Review of Fault Trench FT-1 by Dr. Thomas Rockwell from San Diego State University;
- Geologic logging of fault trenches;
- Evaluation of faulting at the site based on the collected data;
- Carbon-14 age-dating and sampling in Fault Trench FT-1;
- Loose/uncompacted backfill of fault trenches;
- Preparation of geologic map (Plate 1) and fault trench logs (Figures 3 through 24); and
- Preparation of this report presenting our findings, conclusions and recommendations for submittal to the governing agency.

FIELD INVESTIGATION

Field Investigation

Our initial field investigation was conducted in November of 2003, and included geologic reconnaissance and mapping and a subsurface investigation consisting of four exploratory fault trenches excavated with a trackhoe. Cumulatively, the fault trenches totaled 1,530 lineal feet and extended to depths of up to approximately 33 feet. Geology of the site was determined by field mapping and review of published regional geologic maps. The location of the fault trenches and local geology is depicted on the Geologic Map (Plate 1).

The fault trenches were logged by geologists from our firm. Additionally, the trenches were reviewed by California State-registered geologists from our firm and by Dr. Rockwell from San Diego State University. Trench logs are presented as Figures 3 through 24. The fault trenches were backfilled without compaction effort or moisture conditioning within 1 day to 1 week upon completion of their logging.

The geologic units described in this section represent units identified on both the subject site and the adjacent property of approximately equal size located northwest of the subject site which is owned by you. Our field mapping and trench logging identified five sedimentary units that ranged in age from Holocene to Late Pleistocene (Quaternary; Qsc, Qcol, Qal, Qfy and Qfo). Also identified during our investigation was Cretaceous granitics (Kgr) and highly metamorphosed Jurassic Bedford Canyon Formation (Jb). Typically, Unit Jb represents *roof pendants* within the relatively younger Kgr unit. The Quaternary fan deposits exhibited numerous internal structures, such as channel lenses, erosional contacts, bedding planes and buried soils (paleosols). As part of our investigation, the age of Unit Qfy was evaluated via the radioactive isotope Carbon-14 method in order to place age constraints on some of the onsite faults. Two samples were collected in Fault Trench FT-1 at depths of

approximately 11 feet below the surface, which were determined to be 2,875 and 2,825 years old (40± years). Based on Weber (1977), the age of Unit Qfo (Weber's Qof or Qov) is likely to be in the range of 25,000 to 50,000 years old (Late Pleistocene). It is our professional opinion, based on the deep red, well-developed soil developed in the upper portions of this unit, that it is a minimum of 40,000 years old.

Aerial-Photograph Analysis

Stereoscopic-aerial photographs covering the site and surrounding area were reviewed and analyzed by Petra for the years 1962, 1984 and 1995. The photographs were obtained from Riverside County Flood Control and are at scales ranging from 1 inch equals approximately 2,000 feet and 1 inch equals 1,500 feet (see References). Stereoscopic-aerial photographs present a three-dimensional view of geomorphic features on the earth's surface that may be associated with past faulting. These features often include vegetation lines, scarps, offset stream channels and linear valleys.

No fault-related features were observed in the aerial photographs we examined within the California State EFHZ portion of the site. Two geomorphic *erosional* lineaments were identified within the California State EFHZ in the elevated hills on your adjacent property that exhibited a northwest strike. These two lineaments coincide with the faults shown on Weber's (1977) geologic map and the faults zoned by the State of California. Only the southern lineament is depicted on the geologic map by Greenwood and Morton (1991).

A strong lineament was observed in the aerial photos very close to the northern property line of the subject site. This lineament closely coincides with the southern fault strand of the Glen Ivy North fault mapped by both Weber (1977) and Greenwood and Morton (1991).

We identified a northeast- to southwest-trending ridge located on the east bank of Rice Canyon Wash along the western property line of the subject site. From our field work it was discovered that this ridge represents exposed Unit Qfo, which was not identified on geologic maps we reviewed (Plate 1). Based on our aerial-photo review, we believe that the northwest and southeast edges of this ridge represented a bedrock erosional remnant (inselberg) within the surrounding younger alluvial-fan deposits to the east and wash deposits toward the west. However, the northeastern and southwestern termination of this ridge were suspect in that they could be associated with faulting that could have allowed for the ridge to be elevated after numerous past earthquakes. In addition, the southwestern termination of the ridge *lines up* with the northwest-striking lineaments identified within the California State EFHZ. Fault Trench FT-1 examined whether or not faulting is associated with the southwest termination of the ridge on the property, which is discussed below in the Findings Section of this report. Our geologic field mapping discovered a fault in the cut-bank on the west side of Rice Canyon Wash that trended toward the northeast termination of the suspect ridge. Fault Trenches FT-2 and FT-3 were excavated at the northwest termination/escarpment of the ridge to determine whether or not faulting occurred in this area. Our findings from our field investigation are found in the section below.

FINDINGS

Regional Geologic Setting

The site is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Range Province is characterized by northwest-trending mountain ranges separated by a series of sub-parallel fault zones associated with the San Andreas Fault System (Powell, 1993). From west to east, these faults include primarily the Rose Canyon-Newport Inglewood, Elsinore, San Jacinto and San Andreas fault zones. The mountain ranges consist generally of Cretaceous igneous rocks of the Southern

California Batholith, Jurassic metasediments and metavolcanics and late Cretaceous to Cenozoic marine and terrestrial sedimentary units near the coast. Many local valleys contain terrestrial sedimentary units that typically consist of either colluvium, stream deposits (channel sands, flood plane, alluvial fans) or lake sediments.

Local Soil Conditions

The Earth materials found during our fault investigation consist of Quaternary-age artificial fill, stream channel, colluvium, alluvium and fan deposits and bedrock consisting of Cretaceous-age granitics and Jurassic metamorphic rocks. The limits of these units are shown on the Geotechnical Map (Plate 1). Detailed descriptions of the specific member units encountered in the fault trenches are found on Plate 1. Generalized descriptions of these unit, from youngest to oldest, are provided below.

- Quaternary Artificial Fill Soils (map symbol - Qaf) -- Considerable undocumented fill soils exist on the site. A large boulder stockpile existed in the southwestern portion of the site that was approximately 10 to 15 feet high and contained numerous boulders between 2 feet to 5 feet in diameter. Based on our fault trenches and, in particular Fault Trench FT-1, much of the area that is mapped as Qfy on Plate 1 actually contains between 1 to 3 feet of artificial fill. These fills, where observed, consisted typically of fine- to coarse-grained soils and contained a relatively small amount of trash debris.

- Quaternary Stream Channel (map unit Qsc) -- This Quaternary unit was contained within Rice Canyon Wash and represented an active braided stream-channel deposit. This unit was not exposed in the trenches and its description is based on surficial exposures within the Rice Canyon Wash. It consisted of interbedded friable units ranging from fine to medium sands, relatively well-sorted conglomerates and minor, relatively thin-bedded silty fine sands. This unit basically represents the youngest soils of Unit Qfy and at depth is likely interbedded with members of Unit Qfy.

- Quaternary Colluvium (map unit Qcol) -- Quaternary colluvium was observed in small swales along the eastern escarpment of the low-lying hills adjacent to the western riverbank of Rice Canyon Wash and in Fault Trench FT-4. Thus, Unit Qcol is located on the adjacent property toward the northwest (Figure 2). Unit

Qcol is typically interbedded with adjacent alluvial (fan) deposits and generally consists of massively bedded, silty sands and gravels derived from the adjacent hills.

- Quaternary Younger-Fan Deposits (map unit Qfy) -- Quaternary younger-fan deposits existed across most of the gentle dipping slopes on the site and were deposited by the transport of eroded materials from the local mountains and hillsides located south of the site. This unit is dominated by interfingering, well-bedded lenses (members) of generally friable, coarse-grained sediments (gravels). Minor members within this unit are composed of relatively well-sorted, fine to coarse sands exhibiting weak to strong bedding planes and some very weak sandy silt paleosols (buried soils). Numerous well-defined basal erosional contacts are exhibited within the unit.

  The unit contains numerous subrounded gravel clasts (cobbles to small boulders), which are granitic (Kgr) and metamorphic (Unit Jb) in composition. These clasts are typically very dense and weakly weathered to a depth of generally 10 to 13 feet; however, below this depth, the granitic gravel clasts are mechanically weathered in-situ and easily fall apart into coarse-grained sandy material. This transition in weathering of the cobbles is also associated with a change in color of Unit Qfy for more light to medium greys and browns in the upper 10 to 13 feet to more yellowish hues at deeper depths.

  Weber (1977) assigned an age for this unit between approximately 10,000 to 25,000 years. Dr. Rockwell examined the Unit Qfy in Fault Trench Qfy to a depth of 15 feet and it was his opinion that this unit was likely Holocene in age and not Pleistocene. Based on this analysis, we had two charcoal samples dated utilizing the Carbon-14 method in Fault Trench FT-1 at a depth of approximately 11 feet. These samples provided ages of 2,825 years before present (ybp); 40± years) and 2,875 ybp (40± years). These data indicate that the upper 11 to 12 feet of Unit Qfy is Holocene in age.

- Quaternary Older Fan Deposits (Map unit Qfo) -- On the subject site, this unit is exposed in the northeast- to southwest-trending ridge located on the east side of Rice Canyon Wash. Unit Qfo is also exposed on the hills in the northern portion of the adjacent property just west of Rice Canyon Wash.

  The unit consists of nonfriable, very dense silty sand with gravels (cobbles to medium-size boulders). It generally is massively bedded with some more distinct erosional contacts between interbedded units and exhibits a very well-developed deep reddish brown soil in the upper 3 feet that is likely older than 40,000 years.

The cobbles are generally granitic and metamorphic in composition and are weathered in-situ (disintegrate upon hand scraping).

- Cretaceous Granodiorite (map unit Kgr) -- Cretaceous-age granitic rocks (65 to 144 million years ago) likely underlie the site and are exposed in the local hillsides along the southeastern boundary of the site. The unit is typically highly weathered by chemical and mechanical processes. some of which is associated with near-surface soil development; however, this unit also appears to be ubiquitously altered by penetrative groundwater (leaching, altered feldspars and mica, etc.) in many areas. Exposures of this unit in the local hillsides and in the fault trenches exhibit abundant anastomosing joints and fractures that are about 1 to 2 inches wide that are lined with iron-oxide mineralization and clay minerals. It appears that large paleo-slides of bedrock materials may have slipped eastward from the eastern flanks of the Santa Ana Mountains similar to documented slides in the eastern flanks of the Peninsular Ranges to the south.

- Jurassic Bedford Canyon Formation (map unit Jb) -- This Jurassic unit is typically exposed as highly metamorphosed small *roof pendants* and intercalated sheets within the Cretaceous granitics within the fault trenches. In addition, a less metamorphosed, relatively larger body of this unit was identified in the hills located on the adjacent property. It consists generally of very dark bluish brown, fine-grained metamorphic rock.

Groundwater

No indication of groundwater or seepage was observed during our field investigation. Thus, no springs, seeps, running or standing water were observed in the field. Residential or other development may result in significant changes to existing local groundwater conditions.

It should be noted that changes in rainfall, irrigation practices or site drainage could produce seepage or locally perched-groundwater conditions at locations within the soil or bedrock underlying the site. This seepage occurs typically at underlying unit contact interfaces or along joint surfaces of less permeable materials such as the Cretaceous-age granitics.

Faulting

Numerous active faults exist in southern California most of which exist to accommodate right-lateral shear deformation associated with the relative motion between the Pacific and North American tectonic plates. Thus, southern California is along a tectonic plate boundary, with most of the motion between the plates accommodated by the San Andreas Fault System (Powell, 1993). Within this system, most of the active faults in southern California strike toward the northwest and include (east to west) the San Andreas fault (proper), the San Jacinto fault, the Elsinore fault, the Rose Canyon-Newport Inglewood fault and various offshore faults.

The site exists within the bounds of a *Fault Hazard Zone* for the Elsinore fault zone, as defined by the state of California in the Alquist-Priolo Earthquake Fault Zoning Act. In the State of California, an *active* fault is considered to have had surface displacement within Holocene time or approximately during the past 11,000 years. The property is located in an area of relatively complex faulting within the Elsinore fault zone that exhibits numerous faults across a 3,000- to 4,000-foot wide zone. This complexity is partly associated with a large *step over* within the Elsinore fault zone that consists of the Glen Ivy North fault on the north side of Lake Elsinore and the Wildomar fault on the south side of Lake Elsinore. The subject site resides essentially at the northern end of the *step over*.

The northern fault strand within the 3,000- to 4,000-foot wide fault zone in the area of the site is called the Glen Ivy North fault, which, in our professional opinion, is likely the main fault of the Elsinore fault zone in the area. However, this portion of the fault is not within the California State EFHZ. The Glen Ivy North fault is currently mapped near the northern boundary of the property.

Two lineaments, which are mapped and zoned as faults in the California State EFHZ maps, are shown to exist in the adjacent property to the west of the subject site. These two lineaments are suggested by the California State map to trend into the central portion of the subject site. To our knowledge, these faults have not been positively identified in the field and their existence is based primarily on geomorphology as evaluated from aerial photographs.

Based on our aerial-photograph analysis and field mapping, there was concern regarding the possibility of faulting along the northern escarpment of a topographic ridge within the central portion of the subject site but outside of the California State EFHZ. We identified a fault that offset Unit Qfo in an erosional cut-bank on the western side of Rice Canyon Wash on the adjacent property toward the northwest. The trend of this fault aligned with the northern escarpment of the linear ridge, which suggested that the escarpment itself may be the result of faulting.

Evaluation of Onsite Faulting

Four fault trenches were excavated and geologic mapping was conducted across the properties in order to determine the age, location and style of surface deformation (faulting, folding, tilting, fractures, lateral spreading, etc.), due to the Elsinore fault zone within the property. The fault trenches were excavated close to perpendicular to the general strike of the Elsinore fault zone and identified air-photo lineaments.

Detailed descriptions of pertinent fault information for each trench is provided below. The logs for the fault trenches and the geotechnical map showing their locations on the property are located on Plate 1.

- Fault Trench FT-1 -- Fault Trench FT-1 was excavated across the width of the California State EFHZ. It was approximately 1,145 feet long, averaged 12 to 15 feet deep and had an average trend (strike) of north 35 degrees east (N35E). The trench exposed Quaternary fan deposits (Units Qfy and Qfo), which exhibited

internal sedimentary structures, such as channel margins, erosional contacts, buried soils (paleosols) and bedding planes, that assisted in the identification of possible faults. No faulting was observed in FT-1. Minor joints were identified in the trench between Stations +35 and +70; however, no offset was observed across the joints.

Six radio Carbon-14 samples were collected from FT-1 at depths of approximately 11 feet below the surface and within Unit Qfy. Samples 1 and 6 were sent to Lawrence Livermore Laboratory for age determination. Sample 1 was collected near Station +193 at a depth of close to 12 feet and within a weak buried soil structurally above Sample 6. Sample 6 was collected near Station +210 at a depth of approximately 11.5 feet (see Figures 3 through 18) in a silty coarse sand. Analysis of these samples yielded ages of 2,875 years (40± years) old for Sample 1 and 2,825 years (40± years) old for Sample 2.

- Fault Trench FT-2 -- Fault Trench FT-2 was approximately 130 feet long, averaged 12 to 15 feet deep and trended North 18 degrees East (N18E). This trench was located at the northern escarpment of the northwest-trending ridge and in alignment with the trend of fault located in the cut-bank along the western side of Rice Canyon Wash (Plate 1). The trench exposed Units Qfy, Qfo and Kgr.

  Two zones of faulting were observed in FT-2 near Stations 35 to 40 and 15 to 20, respectively. These faults dip toward the northeast and show evidence of dip-slip motion. The fault between Stations 35 to 40 offsets Units Qfo and Kgr but does not offset a well-defined erosion surface developed in Units Qfo and Kgr, which is overlain by Unit Qfy. Thus, this fault does not offset Unit Qfy, which is likely less than 3,000 years old in this area of the trench. This zone of faulting has a minimum throw (apparent vertical displacement) of approximately 10 feet, as determined by the offset of the exposed Unit Qfo. The base of Unit Qfo was not observed across this fault; thus the exact throw value cannot be determined. The age of this zone of faulting is currently unknown but it is our professional opinion that it should be considered active by the California State guidelines because Holocene activity cannot be ruled out.

  The fault zone between Stations 15 and 20 exists within Unit Kgr at depth, then propagates upwards into a buried soil developed in the Kgr and overlying Qfy. The age of Unit Qfy in this area of the trench is unknown but is likely less than 3,000 years old. Thus, this fault should be considered *active* by the California State guidelines.

- Fault Trench FT-3 -- Fault Trench FT-3 was 140 feet long, averaged 17 feet deep and trended approximately North 35 degrees West (N35W). This trench exposed Units Qfy and Kgr. It was located at the northern escarpment of the northwest trending ridge and in alignment with the trend of fault located in the cut-bank along the western side of Rice Canyon Wash and just west of Fault Trench FT-2. The purpose of this trench was to determine the location of the faults observed in Fault Trench FT-2 to the west.

  No faults were observed in Fault Trench FT-3. It is likely that the fault in FT-2 between Stations 15 to 20 dies-out toward the west prior to the location of FT-3. The zone of faulting in FT-2 between Stations 35 to 40 may exist at depth beneath the bottom of the exposure in FT-3 and continue westward because it aligns on-strike with a very similar fault exposed in the erosional cut-bank of Rice Canyon Wash.

- Fault Trench FT-4 -- Fault Trench FT-4 was approximately 115 feet long, 18 to 33 feet deep and trended approximately North 20 degrees East (N20E). It was located in a relatively narrow swale in your adjacent property (Plate 1). The purpose of this trench was to excavate in an area containing relatively young sedimentary units overlying old bedrock across the mapped location of the southern un-named fault within the California State EFHZ. The trench exposed Units Qcol and Qfy overlying bedrock units of Kgr and Jb. No evidence of faulting was observed across the erosional contact between the Quaternary-age sediments and underlying bedrock, which was exposed across most of the trench. In addition, no evidence of faulting was observed within the bedrock units Kgr and Jb.

CONCLUSIONS AND RECOMMENDATIONS

General

From a soils engineering and engineering geologic point of view, the subject property is considered suitable for the proposed residential development provided the following conclusions and recommendations are incorporated into the design criteria and project specifications.

Faulting

Based on our review of the literature, aerial photographs, field mapping and fault trenching within the property, it is our professional opinion that Holocene-age faulting has occurred in the northern portion of the property (FT-2); however no evidence of faulting was observed within the California State EFHZ.

We recommend an approximately 50-foot fault-setback zone within the property bounding the faults found in Fault Trench FT-2. We also recommend that the fault-setback zone be extended across the site to include the fault identified in the erosional cut-bank of Rice Canyon Wash toward the west.

INVESTIGATION LIMITATIONS

This report is based on the proposed project and geotechnical data as described herein. The materials encountered on the project site, described in other literature and utilized in our laboratory investigation are believed representative of the total project area and the conclusions and recommendations contained in this report are presented on that basis. However, soils can vary in characteristics between points of exploration, both laterally and vertically and those variations could effect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the construction phase of the project are essential to confirming the basis of this report. To provide the greatest degree of continuity between the design and construction phases, consideration should be given to retaining Petra for construction services.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and in the same time period. The contents of this report are professional opinions and, as such, are not to be

considered a guaranty or warranty. This report should be reviewed and updated after a period of 1 year or if the site ownership or project concept changes from that described herein.

This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Robert J. Fulton
Senior Project Geologist

Miles D. Kenney Ph.D.
Project Geologist

Robert L. Gregorek II, CEG
Senior Associate Geologist

REGISTERED GEOLOGIST
ROBERT L. GREGOREK II
No. 1257
CERTIFIED ENGINEERING GEOLOGIST
1/21/05
STATE OF CALIFORNIA

MDK/RJF/RLG/GRW/mm/keb

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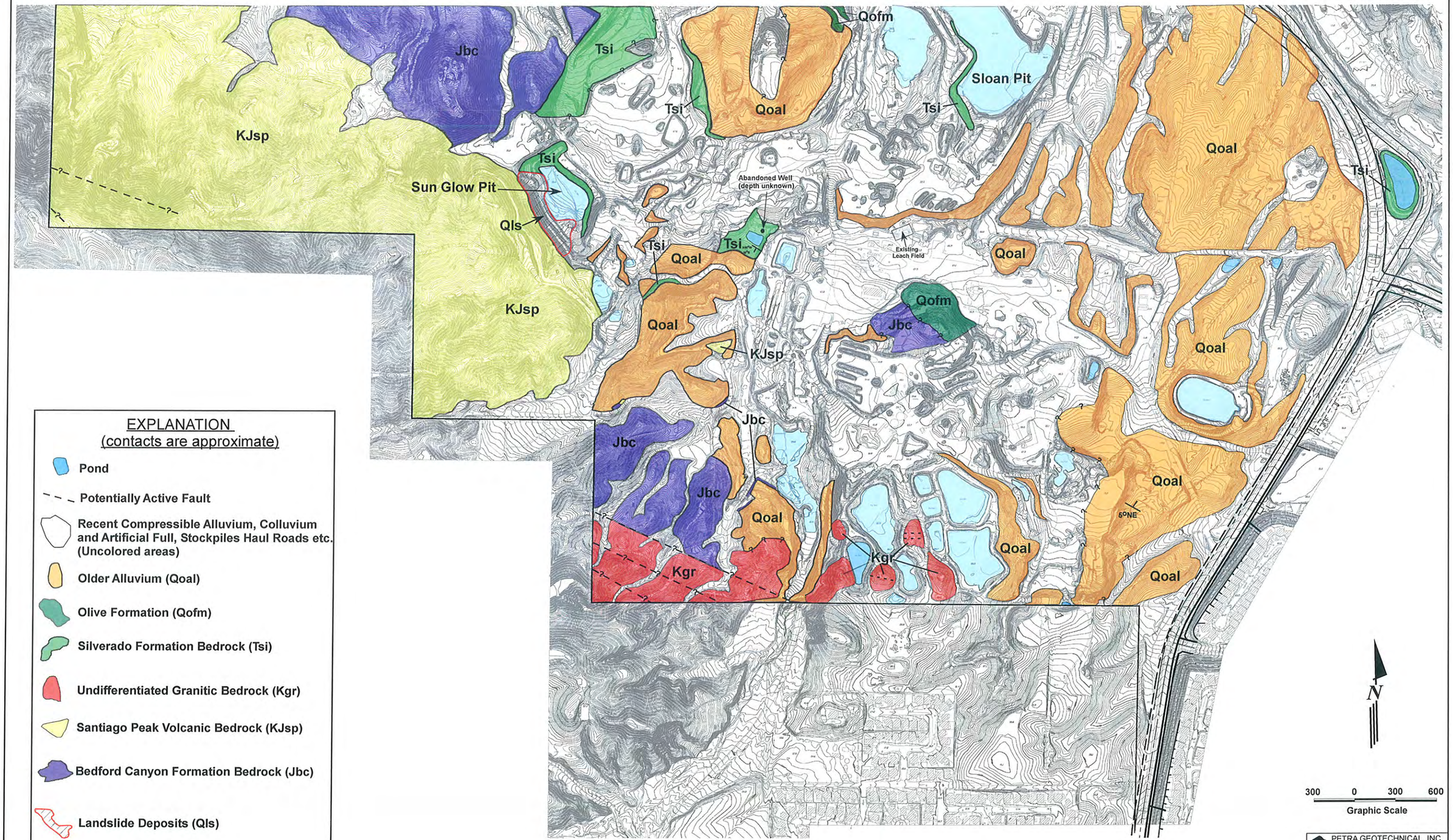
Riverside County Flood Control Aerial-Photographs Reviewed

Date	Photo Number	Scale 1 inch = --- feet
01/30/62	3-449, 450	2,000
01/20/84	932-933	1,500
01/30/95	11-8, 11-9	1,500



EXPLANATION
(contacts are approximate)

- Pond
- Potentially Active Fault
- Recent Compressible Alluvium, Colluvium and Artificial Full, Stockpiles Haul Roads etc. (Uncolored areas)
- Older Alluvium (Qoal)
- Olive Formation (Qofm)
- Silverado Formation Bedrock (Tsi)
- Undifferentiated Granitic Bedrock (Kgr)
- Santiago Peak Volcanic Bedrock (KJsp)
- Bedford Canyon Formation Bedrock (Jbc)
- Landslide Deposits (Qls)
- N80°W / 10°S Strike and Dip of Bedding Planes

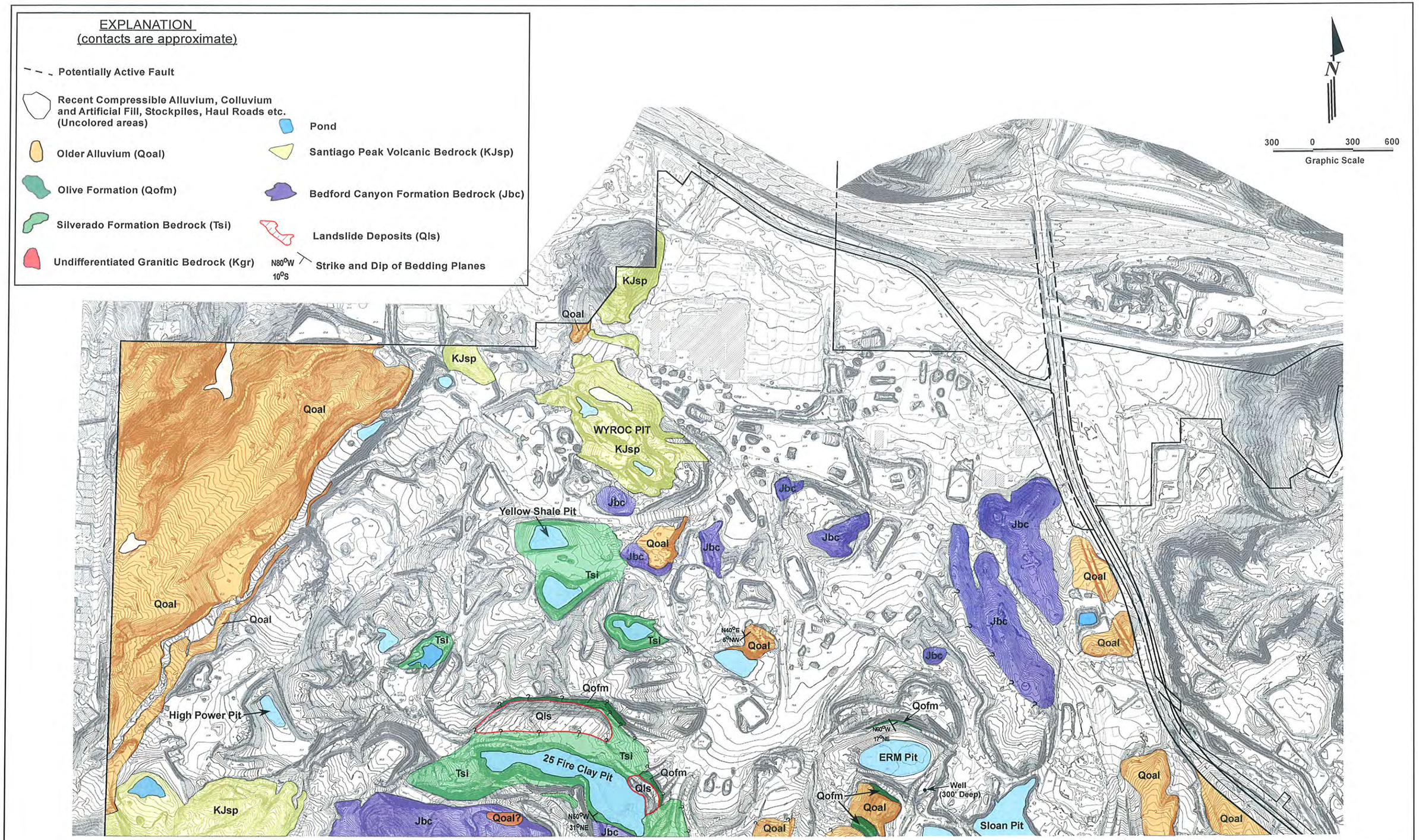
Base Map Provided by KWC Engineers, 2010, Topo flown by Inland Aerial Surveys, Inc., 5-5-08

PETRA GEOTECHNICAL, INC.
30685 SKY CANYON DRIVE, SUITE A
MURRIETA, CALIFORNIA 92563
COSTA MESA MURRIETA PALM DESERT SAN DIEGO SANTA CLARITA

GEOLOGIC MAP

Pacific Clay Property, EIR Submittal
Lake Elsinore, Riverside County, California

DATE: February 2010	J.N.	PLATE 1
DWG BY: DLJ	SCALE: 1" = 300'	



Base Map Provided by KWC Engineers, 2010, Topo flown by Inland Aerial Surveys, Inc., 5-5-08

PETRA GEOTECHNICAL, INC.
38650 SKY CANYON DRIVE, SUITE A
MURRIETA, CALIFORNIA 92563
COSTA MESA MURRIETA PALM DESERT SAN DIEGO SANTA CLARITA

GEOLOGIC MAP

Pacific Clay Property, EIR Submittal
Lake Elsinore, Riverside County, California

DATE: February 2010		PLATE 2
DWG BY: DLJ	SCALE: 1" = 300'	