Preliminary Geotechnical Investigation

Science/Health Lab Building
Victor Valley Community College
Victorville, CA.

Prepared For:
Victor Valley Community College District
18422 Bear Valley Rd.
Victorville, CA 92395
Attn: Steve Garcia

MEC No: 12.0132.0155
October 2, 2012
October 2, 2012

Victor Valley Community College District
18422 Bear Valley Rd.
Victorville, CA. 92395
Attn: Steve Garcia

Re: Geotechnical Investigation
    Science/Health Lab Building
    Victor Valley Community College

Mr. Garcia,

In accordance with your authorization, we have performed a preliminary soils investigation for the above-referenced project. The following report presents our findings based on the results of our field and laboratory investigation.

The investigation was planned and performed using the information provided by your firm in the development of this project. Our report includes recommendations for the development of this site, and presents an evaluation of existing conditions for the design of proposed foundations within this project site.

We anticipate the enclosed information to be highly useful during the design and construction phases of this project. If you have questions, please do not hesitate to contact our firm.

Sincerely,

Merrell Engineering Company, Inc.

James J. Stone, Geotechnical Engineer
RGE 808 Exp. 12/31/2013

Ryan T. Heywood
Project Manager
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Introduction

Investigation

The purpose of this investigation was to explore and evaluate the subsurface soil conditions specifically for the proposed Science/Health Lab Building, and to provide recommendations for site grading, design and construction of the proposed building foundation(s) and site improvements.

We have performed a foundation investigation and compiled this report with our findings. This report represents the results of a subsurface geotechnical investigation at the site. The location of the proposed development is on the enclosed Site Vicinity Map (attachment C2).

This report was written specifically for this project as described in this report. It is intended to be used by Victor Valley Community College District and associated design professionals in the development of this project. Since this report is intended for use by the designer(s), it should be recognized that it is impossible to include all construction details at this phase in the project. Additional consultation may be prudent to interpret these findings for contractors, or possibly refine these recommendations based upon the final and actual conditions encountered during construction.

Scope of Services

Specifically, the scope of the investigation consisted of the following:

- Field investigation consisting of a total of five exploratory excavations. The exploratory excavations extended to a maximum depth of fifty feet below the existing surface elevations. Standard penetration tests (SPT) were conducted every 5’. The sampler was driven a total of 18”. SPT counts recorded on the attached boring logs represent the number of blows to drive the sampler 6” increments.
- Laboratory Investigation consisting of Sieve Analysis, Compaction Characteristics (moisture density test), Consolidation, pH, Resistivity, Sulfate, Chloride and Sulfide, Expansion Index, Atterberg Limits, and Direct Shear.
- Preparing this report, presenting our findings, conclusions and recommendations.

The scope of our investigation did not include the following:
- The determination of dynamic soils properties.
- The assessment of general site environmental conditions for the presence of contaminants in the soils and groundwater.

Site Conditions

Victor Valley Community College campus is located at 18422 Bear Valley Rd. in Victorville, CA. The Science/Health Lab Building is located on the upper campus at N34.474111° W117.264248° (see attached Vicinity Map C2). The proposed building site is located approximately 20’ northwest of the existing Science Building. The southeast area of the proposed site is partially landscaped with grass, sidewalk, curb and gutter, etc., and the northwest area is currently a parking lot with flexible asphalt concrete pavement. The topography of the site is relatively level (see attached Topographic Map C1).

Proposed Development

The details provided to our office in regards to the proposed development are that Victor Valley Community College District intends to construct a new 350’ x 70’ single story Science/Health Lab Building of approximately 22,000 gross square feet to match construction of the existing science building (slab on grade, CMU walls, steel roof framing). It is to align with and center on the existing building west wall. The structural details for the proposed structure were not available at the time of this report. It should be noted that once the final details for the structure are available, our office should be provided a set of plans for review and comment in order to develop additional recommendations if necessary.

It is believed that the grading operations for the site will consist of foundation excavation and compaction to create uniformly compacted and level building pads for the proposed structures. If grading limits/operations are in excess of those stated, our office should be notified to evaluate the conditions and develop additional recommendations if necessary.

Findings

Field Investigation

The soil conditions underlying the site were explored by means of five exploratory excavations extending 18’ to 50’ in depth. Auger refusal occurred at two of the five borings. The exploratory
borings were logged by Ryan Heywood of Merrell-Johnson Companies, and conducted by 2R drilling with a CME drill rig equipped with 8" x 5' hollow stem augers.

A continuous log of the subsurface conditions encountered within the exploratory excavations was recorded at the time of excavation operations and has been included as Attachment A2 within this report. Disturbed samples and relatively undisturbed samples of typical soil types were obtained and returned to the laboratory for testing and evaluation.

**Laboratory Investigation**

The laboratory tests for the soil types encountered consisted of the following:

- B1 Laboratory Compaction Characteristics of Soil (Moisture Density Test)
- B2 Grain Size Analysis
- B3 Atterberg Limits
- B4 pH, Resistivity, Sulfide, Chloride & Sulfate
- B5 Expansion Index
- B6 Consolidation
- B7 Direct Shear

**Subsurface Conditions**

Data from our exploratory excavations indicate that the soil profile typically consists of naturally occurring alluvial and colluvial materials to the maximum depth explored. The subsurface soils consist of interlayered medium dense to dense, well to poorly graded sands, silty sands and silty gravel with sand. Auger refusal occurred in borings one (18’) and three (32’).

It should be noted that some caving of the excavations occurred during drilling.

Free water was not encountered in our field excavations. In 1956 a well approximately 830’ to the southeast indicated depth to ground water to be at 89’. In 1950 a well approximately 1,850’ to the northwest indicated depth to groundwater to be at 85’. Between 1967 and 2010, wells near the general area indicated that depth to ground water ranged between 45’ and 78’. Between 1992 and 2010, a well approximately 0.75 miles to the east of the site (adjacent to the eastern bank of the Mojave River) indicated depth to ground water ranged from 35’ to 67’. Between 1994 and 2010, a well approximately one mile to the southwest indicated ground water ranged from 202’ to 233’. Groundwater was not encountered in the borings and is estimated to be around 85’ to 130’+/− at the site. ([http://wdr.water.usgs.gov/nwisgmap/](http://wdr.water.usgs.gov/nwisgmap/))
Site Class, Site Coefficient and Seismic Design Category

Based on the available information gathered for the proposed project, the soils underlying the site are classified as Site Class D according to the 2010 CBC. The Design Acceleration Parameters were determined according to Chapter 11 of ASCE 7-05 and are provided in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
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<tbody>
<tr>
<td>Mapped Spectral Acceleration Parameters</td>
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<td>$S_1 = 0.60$</td>
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<tr>
<td>Site Coefficients</td>
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<td>$F_v = 1.50$</td>
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<tr>
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<tr>
<td>Design Spectral Acceleration Parameters</td>
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<td>$S_{D1} = 0.600$</td>
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</table>

Conclusions and Recommendations

Conclusions

Based upon our field investigation and test data, combined with our engineering analysis, experience, and judgment, the on-site natural soils are considered to have good strength characteristics and low to moderate compressibility under relatively light to moderately heavy loads.

The existing upper soils overlying some areas of the site are not considered suitable for the support of permanent foundations, floor slabs and pavements. The underlying native soils below these upper soils are generally in a dense state and are considered adequate for support. From a foundation standpoint, the underlying natural soils are considered competent bearing materials.

Based on the soil types encountered and the nature of the materials as determined by laboratory testing, the on-site soils have a very low potential for expansion. Further testing may be necessary during construction should other soil types be encountered.

The potential for encountering groundwater is unlikely, and the subsoils are medium dense to dense. The liquefaction potential consequently is low. In the unlikely event of liquefaction at the site, it is expected to be localized and would not have an impact on the development.

It is our opinion that the proposed development is feasible, provided the recommendations in
this report are implemented and special consideration/precautions are taken in design of the foundations and structures.

**General Recommendations**

Prior to the commencement of grading, a pre-job conference meeting should be held with representatives of this firm. The purpose of this meeting would be to clarify any questions related to the recommendations and specifications of this report.

**General Grading Requirements**

All grading operations should be observed and tested by our firm. Imported fill material should be approved for use prior to importing. The governmental agencies having jurisdiction over the project should be notified prior to commencement of grading so that the necessary grading permits may be obtained and arrangements may be made for the required inspection(s).

**Clearing & Grubbing**

Debris, vegetation, irrigation lines and asphalt concrete and concrete pavement should be removed prior to any grading work performed.

No debris or vegetation should be placed as site fill or grading operations. Deleterious materials (asphalt concrete, concrete, wood, trash, etc.) should be disposed in accordance with the owner’s instructions. Roots should be removed to a depth of five feet below the pad elevation.

**Scarification**

Areas to receive fill, and areas of cut to support sub-grade soils should be scarified to a depth of 12 inches. Scarified material should be brought to within +/- 2 percentage points of optimum moisture content and compacted to a minimum 90 percent relative compaction based on the ASTM D1557 laboratory test method, prior to the placement of fill (See Appendix E General Grading Specifications).

**Compacted Fill Material**

Fill material should consist of clean soils containing no rocks or other particles with a maximum dimension larger than four inches. Our Engineer or representative should approve imported fill prior to placement. The on-site soils, less the oversized particles, debris or organic matter, can be used as fill.
Compacted Fill Placement

Fill placement and compaction should be in accordance with the specification contained in this report, see Appendix E General Grading Specifications.

Sub-Excavation

Areas to support footings, slabs, and pavements should be over-excavated to a depth of 3’ below the bottom of the footings, slabs and pavement structural sections. Over-excavation should extend horizontally 5’ beyond perimeter foundation, slab and pavement lines. Rocks exceeding 4” in maximum dimension encountered during sub-excavation and scarification operations should be removed and not used in fill.

The sub-excavation requirements should be followed in cut areas also if any portion of the foundation is founded in fill (see Attachment D-1, Transition Lot Detail).

Sub-excavation and replacement with compacted fill will provide a layer of competent material below the new structure that will provide uniform support if deeper layers of soil compress as a result of inundation with water.

Imported Soils

Imported soils required to complete the grading operations should consist of predominantly granular material with an expansion index less than 20 when tested in accordance with ASTM D4829 and should have a minimum R-Value of 60. All imported material should be inspected and approved by our Engineer or representative prior to placement. Imported material utilized for trench backfill operations should consist of granular material with a minimum sand equivalent of 35.

Foundation Design

The planned structures can be supported on shallow spread footings with bottom levels in the compacted subgrade soil or new compacted fill. Footings should have bottom levels at a minimum depth of 18” below the lowest adjacent finished grade. A minimum width of 18” is recommended for continuous footings. Isolated footings should be at least 24” wide. Footings can be designed for a maximum soil bearing pressure of 3000 pounds per square foot for dead plus long term live loads. This bearing pressure may be increased by 250 pounds per square foot for each additional foot of depth to a maximum bearing pressure of 3500 pounds per square foot for dead plus long term live loads. These values can be increased by ⅓ for the total of all
loads, including wind or seismic forces. The actual allowable bearing value of the fill will depend on the material used and the compaction methods employed. The quoted bearing value should be applicable if the on-site or other acceptable materials are used and compacted as recommended. The bearing value of the fill should be confirmed upon completion of the grading operations.

Since the recommended bearing value is a net value, the weight of the concrete within the footings may be taken as equal to 50 pounds per cubic foot, and the weight of soil backfill may be neglected in determining the downward foundation loads for footing design.

Foundation concrete should be placed in compacted trenches with no caving of the sidewalls. The foundation excavation should be properly backfilled as recommended for site fill and tested for the percent of compaction. Concrete forms should not be placed until our office has inspected and conducted the field and laboratory testing recommended.

All footing excavations should be observed by personnel of our firm to verify satisfactory of supporting soils. Footings should be deepened if necessary to extend into satisfactory supporting soils.

Concrete foundations should be designed according to current local and state codes and constructed with a minimum 28-day compressive strength of 3000 pounds per square inch and a water/cement ratio as dictated by the American Concrete Institutes Manuals of Concrete Practice. The foundation reinforcement should be designed and calculated by the structural engineer in accordance with the Uniform Building Code or the California Building Code as indicated by the governing agency.

To reduce the potential for sulfate attack on concrete in contact with on-site soils, Type II modified or Type V cement is recommended for use in concrete mix design.

Foundations should be designed with continuous reinforcing steel top and bottom. Reinforcing steel should maintain minimum clearances specified by applicable codes and job specifications.

Foundation size and depth, the foundation soils and the loads imposed can affect the estimated settlements. For preliminary design purposes, the total post-construction settlement is estimated to be approximately ¾” for spread footings with a maximum column load of 60 kips and a vertical bearing pressure of 3000 pounds per square foot founded in compacted fill and prepared in accordance with the recommendations in this report.

Column spacing, loads imposed, and foundation size and depth can all affect differential
settlements. However, based on our investigation of the site, post-construction differential settlements of spread footing foundations are anticipated to be ½” in 40’ or less. When detailed foundation load information is available, comprehensive settlement analysis can be performed to evaluate total and differential settlements.

**Slabs on Grade**

If the sub-grade is prepared as recommended in this report, building floor slabs can be supported on grade. To provide adequate support, concrete slabs on-grade should bear in compacted soil. The final pad surface should be rolled to provide a smooth dense surface upon which to place the concrete. We recommend that our field representative observe grading operations and the condition of the final sub-grade soils immediately prior to slab-on grade construction and if necessary, perform density and moisture content tests to determine the suitability of the final prepared sub-grade.

Slabs-on-grade should be underlain by a 4” thick blanket of clean, poorly graded, coarse sand or crushed rock. A moisture vapor retarder/barrier should be placed beneath slabs where floor coverings will be installed. Typically, plastic is used as a vapor retarder/barrier. If plastic is used, a minimum 10 mil is recommended. The plastic should comply with ASTM E 1745. Plastic installation should comply with ASTM E 1643.

Current construction practice typically includes placement of a 2” thick sand cushion between the bottom of the concrete slab and the moisture vapor retarder/barrier. This cushion can provide some protection to the vapor retarder/barrier during construction, and may assist in reducing the potential for edge curling in the slab during curing. However, the sand layer also provides a source of moisture vapor to the underside of the slab that can increase the time required to reduce moisture vapor emissions to limits acceptable for the type of floor covering placed on top of the slab. The floor covering manufacturer should be contacted to determine the volume of moisture vapor allowable and any treatment needed to reduce moisture vapor emissions to acceptable limits for the particular type of floor covering installed.

Concrete slabs on grade should be minimum thickness of 4” with a 28-day compressive strength of 2500 pounds per square inch and a water/cement ratio as dictated by the American Concrete Institute Manual of Concrete Practice. Type II modified or Type V cement should be used. Slabs on grade should have a minimum reinforcement per the American Concrete Institutes Manual of Concrete Practice and minimum code concrete to steel ratios for temperature and shrinkage requirements. *The slab on grade reinforcement should be tied into the foundation reinforcement.*
All concrete slabs should be designed to have concrete construction (i.e. jointing, etc.) in conformance with the American Concrete Institute Manual of Concrete Practice Design and Construction Standards.

**Lateral Loading**

Resistance to lateral loads against the faces of footings and other structural elements below grade will be provided by passive earth pressure by friction along the base of footings and slabs. For footings bearing against approved native fill, the passive earth pressure can be taken as 350 pounds per square foot per foot of depth. Base friction 0.35 times the actual dead load. Base friction and passive earth pressure can be combined without reduction. Retaining structures (up to 8’ in height) should be designed for an equivalent fluid pressure of 35 pounds per square foot per foot of height, plus any additional building or equipment surcharges.

**Drainage**

It is important that all water be kept a minimum of 10’ from structures and slabs. No ponding adjacent to buildings/structures should be allowed. Surfaces should have a positive 2 percent minimum slope away from structures.

*Retaining walls should be designed to resist hydrostatic pressures or be provided with a drainpipe, weep holes and/or the necessary drainage capabilities for the wall.*

If a basement or subterranean structure is constructed a subsurface drainage system is recommended.

**Utility Excavations**

Utility excavations for this project may require sloping sidewalls or shoring. Excavations should be made in accordance with California Administrative Code, Title 8, Industrial Relations, Chapter 4, Division of Industrial Safety, Subchapter 4, Construction Safety Orders, Article 6.

**Excavation Procedures**

Temporary excavations of on-site soils should be shored or sloped in accordance with Cal OSHA requirements. Presented herein are guidelines for temporary slope construction and recommendations for shoring in granular soils, (Type C Soils), which were the predominant soils encountered in our excavations. In addition, alternate guidelines are provided for temporary slope construction in clayey soils, (Type B Soils) which may be encountered in the areas of
planned excavations.

**Temporary Slopes**

Temporary excavations of on-site granular soils (Type C Soils) should be sloped no steeper than 1.5 horizontal to 1 vertical for excavations up to 20’ in depth. Compound excavations with vertical sides in lower portions should be properly shielded to a minimum height of 18” above the top of the vertical side, with the upper portion having a maximum allowable slope of 1.5 horizontal to 1 vertical.

Temporary excavations in site clayey soils (Type B Soils), if encountered, should be sloped no steeper than 1 horizontal to 1 vertical for trenches up to 20’ in depth. Benched excavations 20’ in depth or less in site clayey soils should be sloped no steeper than 1 horizontal to 1 vertical, with a maximum bench height of 4’. Compound excavations with vertical sides in the lower portions should be properly shielded to a minimum height of 18” above the top of the vertical side, with upper portion having a maximum allowable slope of 1 horizontal to 1 vertical.

A Registered Professional Engineer should design slopes or benching for excavations greater than 20’ in depth.

Should running sand conditions be experienced during excavations operations, flattening of cut slope faces, or other special procedures, may be required to achieve stable, temporary slopes.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the “competent person” required by OSHA to evaluate the soil conditions. Close coordination between the competent person and the soils engineer should be maintained to facilitate construction.

**Shoring**

Temporary shoring will be required for those excavations where temporary slope cuts as recommended above are not feasible. Internally braced shoring can be utilized for excavations, however, it is anticipated that difficulties will be experienced during shoring installation due to the presence of dry loose soils in some areas. It is recommended that temporary braced shoring retaining site sandy/gravelly soils be designed considering a uniform lateral earth pressure distribution for the full height of the shoring, with a maximum pressure equal to 22H in pounds per square foot, where H is the height of shoring in feet.

The recommended soil pressure will apply to level soil conditions behind braced shoring. Where
a combination of slope embankment and braced shoring is used, the soil pressure will be greater and must be evaluated for actual conditions.

In addition to the above recommended lateral earth pressures, a minimum uniform lateral pressure of 125 pounds per square foot should be incorporated in the design of the upper ten feet of shoring when normal traffic is permitted within ten feet of the shoring. The design of temporary shoring should also include the surcharge loading effects of delivery and construction equipment adjacent to the shoring, as appropriate.

Limitations and Additional Services

Limitations

The recommendations given in this report are based on results of field and laboratory investigations, combined with interpolation of subsurface conditions between exploration locations. The nature and extent of variations between the explorations may not become evident until construction. If variations are exposed during construction, this office should be notified so the variations can be reviewed and the recommendations of this report modified or verified in writing.

If changes in the nature, design or action of the structure are planned, the recommendations contained in this report should not be considered valid unless the changes are reviewed and the recommendations of this report modified or verified in writing.

This report has been prepared to aid in the evaluation of this site and to provide geotechnical recommendations for the design of this project. Any person using this report for bidding or construction purposes should be aware of the limitations of this report as mentioned above and should conduct an independent investigation as deemed necessary to satisfy themselves as to the surface and subsurface conditions to be encountered, and the procedures to be used in the performance of work on this project.

Our professional services have been performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineering consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

This report is issued with the understanding that the owner has the responsibility to bring the information and recommendations contained herein to the attention of the designers and
builders of this project. The owner also has the responsibility to verify that the contractors/builders follow such recommendations. It is understood that the owner is responsible for submittal of the report to the appropriate governing agencies.

This report is based on the assumption that adequate client consultation, construction monitoring, and testing will be performed during the final design and construction to be incompliant with the recommendations of this report.

Additional Testing

Maintaining Merrell Johnson Companies as the soils engineering consultant from beginning to end of the project will provide continuity of services. The engineering firm providing testing and observations shall assume the responsibility of Geotechnical Engineer of Record.

Construction monitoring and testing would be additional services provided by this firm. The costs of these services are not included in our present professional service agreement or part of our current scope of work. It is recommended that this firm be contacted to perform additional earthwork and materials observation and testing during the following phases of the project:

- Foundation/Footing Excavation & Utility Trench Backfill
- Over-excavation and re-compaction per this report
- Retaining Wall Construction and Backfill
- Sub-grade Preparation in New Pavement Areas
- Unusual Conditions Encountered
- Materials Testing and Special Inspections

Closure

We appreciate the opportunity to be of service. Should you have any questions or need further assistance, please do not hesitate to contact our office.
ATTACHMENT A

EXPLORATORY LOGS
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<tr>
<th>Major Divisions</th>
<th>Letter</th>
<th>Typical Descriptions</th>
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<tr>
<td><strong>Clean Gravels</strong></td>
<td>GW</td>
<td>Well-Graded Gravels, Gravel-Sand Mixtures</td>
</tr>
<tr>
<td><strong>Gravel And Gravelly Soils</strong></td>
<td>GP</td>
<td>Poorly-Graded Gravels, Gravel-Sand Mixtures</td>
</tr>
<tr>
<td><strong>Gravels w/ Fines</strong></td>
<td>GM</td>
<td>Silty Gravels, Gravel-Sand-Silt Mixtures</td>
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<tr>
<td><strong>Clean Sand</strong></td>
<td>GC</td>
<td>Clayey Gravels, Gravel-Sand-Clay Mixtures</td>
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<td><strong>Sand And Sandy Soils</strong></td>
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<td><strong>Sands w/ Fines</strong></td>
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<td>Silty-Sands, Sand-Silt Mixtures</td>
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<td>Clayey Sands, Sand-Clay Mixtures</td>
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<tr>
<td><strong>Clayey Gravels</strong></td>
<td>ML</td>
<td>Inorganic Silts And Very Fine Sands, Rock, Silty Or Clayey Fine Sands Or Clayey Silts</td>
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<td><strong>Gravels w/ Fines</strong></td>
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<td>Inorganic Clays Of Low To Medium Plasticity</td>
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<td>Gravelly Clays, Sandy Clays, Silty Clays</td>
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<td><strong>Sands w/ Fines</strong></td>
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<td><strong>Sandy Soils</strong></td>
<td>CH</td>
<td>Inorganic Silts, Micaceous Or Diatomaceous</td>
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<td>OH</td>
<td>Fine Sand Or Silty Soils</td>
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<tr>
<td><strong>Clean Gravels</strong></td>
<td>PT</td>
<td>Peat, Humus, Swamp Soils With High Organic Contents</td>
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### Relationship of SPT to Relative Denisty of Sand

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<thead>
<tr>
<th>Description</th>
<th>SPT N Blows/ft.</th>
<th>Relative Density %</th>
<th>Boulders</th>
<th>Cobbles</th>
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<tbody>
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<td>0-15</td>
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<td>Loose</td>
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<td>15-35</td>
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<td>Dense</td>
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### Relative Proportions of Sand and Gravel

<table>
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<th>Percent of Dry Weight</th>
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<td>Trace</td>
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<td>With</td>
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### Relative Proportions of Fines

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**SOIL CLASSIFICATION CHART**

- **Project:** Science/Health Lab Building
- **Project No:** 12.0132.0155
- **Client:** Victor Valley Community College District
- **Sample ID:** NA
- **Attachment:** A1
- **Sheet:** 1 of 1
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**Conducted By:** Ryan Heywood  
**Exploration Type:** Boring  
**Equipment Operator:** 2R Drilling  
**Equipment Type:** CME Drill Rig  
**Boring Orientation:** Vertical  
**Advance Method:** None  
**Field Tests Conducted:** SPT  
**Shoring Type Used:** None  
**Weather Conditions:** None to note  
**Start / End Date:** 06/25/12 / 06/25/12  
**Equipment:** 8" x 18'  
**Drive Weight / Type:** 140 lbs  
**Drill Rod; Type / Dim.:** Hollow stem auger / 8" x 5'  
**Sampler Insertion:** Driven  
**Sample Preservation:** ASTM D4220  
**Backfilled / Date:** 6/25/2012  
**Groundwater Level:** Not Encountered  
**Start / End Time:** 7:30 / 8:30

**EXPLORATORY LOG**  
ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550  
**Project:** Science/Health Lab Building  
**Project No:** 12.0132.0155  
**Client:** Victor Valley Community College District  
**Location No.:** B1  
**Location:** See Attachment C4  
**Attachment:** A2  
**Surface Elev:** Approximately 2,888'  
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**Conducted By:** Ryan Heywood  
**Equipment Operator:** 2R Drilling  
**Equipment Type:** CME Drill Rig  
**Boring Orientation:** Vertical  
**Advance Method:** None  
**Field Tests Conducted:** SPT  
**Shoring Type Used:** None to note  
**Weather Conditions:** None to note  
**Start / End Date:** 06/27/12 / 06/27/12  

**EXPLORATORY LOG**
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Conducted By: Ryan Heywood
Exploration Type: Boring
Equipment Type: CME Drill Rig
Boring Orientation: Vertical
Advance Method: None
Field Tests Conducted: SPT
Shoring Type Used: None
Weather Conditions: None to note
Start / End Date: 06/27/12 / 06/27/12
Equipment Operator: 2R Drilling
Dimensions: 8" x 50'
Drive Weight / Type: 140 lbs
Drill Rod; Type / Dim.: Hollow stem auger / 8" x 5'
Sampler Insertion: Driven
Sample Preservation: ASTM D4220
Backfilled / Date: 6/27/2012
Groundwater Level: Not Encountered
Start / End Time: 7:00 / 9:00

EXPLORATORY LOG
ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550
Project: Science/Health Lab Building
Client: Victor Valley Community College District
Location: See Attachment C4
Surface Elev: Approximately 2,890'
Project No: 12.0132.0155
Location No.: B2
Attachment: A2
Sheet: 3 of 7
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**EXPLORATORY LOG**

- **Conducted By:** Ryan Heywood
- **Equipment Operator:** 2R Drilling
- **Equipment Type:** CME Drill Rig
- **Boring Orientation:** Vertical
- **Advance Method:** None
- **Field Tests Conducted:** SPT
- **Shoring Type Used:** None
- **Weather Conditions:** None to note
- **Start / End Date:** 06/27/12 / 06/27/12

- **Equipment Dimensions:** 8" x 32'
- **Drive Weight / Type:** 140 lbs
- **Drill Rod; Type / Dim.:** Hollow stem auger / 8" x 5'
- **Sampler Insertion:** Driven
- **Sample Preservation:** ASTM D4220
- **Backfilled / Date:** 6/27/2012
- **Groundwater Level:** Not Encountered
- **Start / End Time:** 9:00 / 10:30

- **Project:** Science/Health Lab Building
- **Project No:** 12.0132.0155
- **Client:** Victor Valley Community College District
- **Location No:** B3
- **Location:** See Attachment C4
- **Attachment:** A2
- **Surface Elev:** Approximately 2,888'
- **Sheet:** 4 of 7
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Conducted By: Ryan Heywood  
Equipment Operator: 2R Drilling  
Exploration Type: Boring  
Equipment Type: CME Drill Rig  
Boring Orientation: Vertical  
Advance Method: None  
Field Tests Conducted: SPT  
Shoring Type Used: None  
Weather Conditions: None to note  
Start / End Date: 06/27/12 / 06/27/12  
Equipment Type: 8" x 50'  
Drive Weight / Type: 140 lbs  
Drill Rod; Type / Dim.: Hollow stem auger / 8" x 5'  
Sampler Insertion: Driven  
Sample Preservation: ASTM D4220  
Backfilled / Date: 6/27/2012  
Groundwater Level: Not Encountered  
Start / End Time: 10:30 / 12:30  
Explanatory Log:  
ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550  
Project: Science/Health Lab Building  
Project No: 12.0132.0155  
Client: Victor Valley Community College District  
Location No: B4  
Location: See Attachment C4  
Attachment: A2  
Surface Elev: Approximately 2,889'  
Sheet: 5 of 7
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<th>SPT (ft.)</th>
<th>Sample Type</th>
<th>WC (%)</th>
<th>In-Place Density</th>
<th>Lab Tests</th>
<th>USCS Group</th>
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**Conducted By:** Ryan Heywood  
**Exploration Type:** Boring  
**Equipment Type:** CME Drill Rig  
**Boring Orientation:** Vertical  
**Advance Method:** None  
**Field Tests Conducted:** SPT  
**Shoring Type Used:** None  
**Weather Conditions:** None to note  
**Start / End Date:** 06/27/12 / 06/27/12  
**Equipment Operator:** 2R Drilling  
**Dimensions:** 8" x 50'  
**Drive Weight / Type:** 140 lbs  
**Drill Rod; Type / Dim.:** Hollow stem auger / 8" x 5'  
**Sampler Insertion:** Driven  
**Sample Preservation:** ASTM D4220  
**Backfilled / Date:** 6/27/2012  
**Groundwater Level:** Not Encountered  
**Start / End Time:** 10:30 / 12:30
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**EXPLORATORY LOG**

- **Conducted By:** Ryan Heywood
- **Exploration Type:** Boring
- **Equipment Type:** CME Drill Rig
- **Boring Orientation:** Vertical
- **Advance Method:** None
- **Field Tests Conducted:** SPT
- **Shoring Type Used:** None
- **Weather Conditions:** None to note
- **Start / End Date:** 06/27/12 / 06/27/12
- **Equipment Operator:** 2R Drilling
- **Dimension:** 8" x 30'
- **Drive Weight / Type:** 140 lbs
- **Drill Rod; Type / Dim.:** Hollow stem auger / 8" x 5'
- **Sampler Insertion:** Driven
- **Sample Preservation:** ASTM D4220
- **Backfilled / Date:** 6/27/2012
- **Groundwater Level:** Not Encountered
- **Start / End Time:** 12:30 / 13:30

**ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550**
ATTACHMENT B

LABORATORY TESTING
Laboratory Compaction Characteristics
ASTM D1557, D2488

Project Number: 12.0132.0155
Project Title: Science and Health Lab Building
Project Location: Victor Valley College
Client: Victor Valley Community College District

Sample ID: RTH06271229
Maximum Dry Unit Weight (lb/ft³): 125.0
Optimum Moisture Content (%): 11.0

Classification, ASTM D2488: (SM) Silty F/C Sand
Sample Origin: Boring 4 at 0-2'.

Tested By: CRG
Received Moisture: 14.0%
Preparation: Dry
Specific Gravity:
SG Method:

Start Weight (lb): 25.5
Retained on 3/4" (lb): 0.0
Retained on 3/8" (lb): 0.5
Retained on No. 4 (lb): 3.5
Retained on 3/4" (%): 2.0%
Retained on 3/8" (%): 13.7%
Oversize Correction:

Volume of Mold: 30.00
Tare Weight: 5.29
Rammer Used: Manual

Method Used: ☑ A ☐ B ☐ C

Weight of Soil and Tare (lb): 9.64 9.93 9.89 9.73
Wet Weight (g): 350.5 342.5 306.7 320.2
Dry Weight (g): 325.0 306.8 269.1 275.6
Moisture Content (%): 7.8% 11.6% 14.0% 16.2%
Dry Unit Weight (lb/ft³): 121.0 124.7 121.1 114.6

The Material Was Not Meets the requirements of the DSA approved documents.
The Material Tested Was Not Meets the requirements of the DSA approved documents.

Sampled & tested in accordance with the reqs. of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Kevin Luce / Laboratory Manager

Name / Title

Merrell Johnson

concept to completion
ENGINEERING | SURVEYING | TESTING | INSPECTION
**Grain Size Analysis**

**ASTM C 136, C 117, D2487**

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<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
<th>C_u</th>
<th>C_c</th>
<th>MC</th>
<th>D_100</th>
<th>D_60</th>
<th>D_30</th>
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<th>PL</th>
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**Classification / Description (D 2487):**

(GM) Silty Gravel With Sand

**Color (Moist, Munsell):**

Not Determined

**Sample Origin:**

Boring Two at Surface

**Method/Procedure Used (C 117, D 1140):**

Procedure A

**Size of Initial Dry Mass (g):**

396.1

**Determination of Dry Mass (D 1140):**

Not Applicable

**Particles; Shape & Hardness (D 422):**

Not Applicable

**Dispersion Device/Period (D 422):**

Not Applicable

**Difficulty, Type & Amount of Agent (D 422):**

Not Applicable

**Laboratory Comments:**

-
Gravel Sand Fines Cu Cc MC D100 D60 D30 D10 LL PL PI SG FM
39 55 6 25 2 1.4% 25.000 4.700 1.250 0.190 ND ND ND ND 3.92

Sample ID: Boring Two at 5' to 7'
Sample Origin: Not Applicable
Procedure A
14.7
Classification / Description (D 2487): (SW-SM) Well Graded Sand With Silt and Gravel
Color (Moist, Munsell): Not Determined
Sample Origin: Boring Two at 5' to 7'
Method/Procedure Used (C 117, D 1140): Procedure A
Size of Initial Dry Mass (g): 14.7
Determination of Dry Mass (D 1140): Not Applicable
Particles; Shape & Hardness (D 422): Not Applicable
Dispersion Device/Period (D 422): Not Applicable
Difficulty, Type & Amount of Agent (D 422): Not Applicable
Laboratory Comments: -

GRAIN SIZE ANALYSIS
ASTM C 136, C 117, D2487

Project: Science/Health Lab Building
Client: Victor Valley Community College District
Sample ID: RTH06271204
Attachment: B2
Sheet: 2 of 10
### GRAIN SIZE ANALYSIS

**ASTM C 136, C 117, D2487**

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#### Table: Grain Size Analysis

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</table>

**Gravel Sand Fines Cu Cc MC D100 D60 D30 D10 LL PL PI SG FM**

| 62 | 35 | 3 | 16 | 2 | 0.8% | 50.000 | 10.200 | 3.650 | 0.625 | ND | ND | ND | ND | 4.89 |

#### Notes:
- **Color (Moist, Munsell):** Not Determined
- **Sample Origin:** Boring Two at 8' to 10'
- **Method/Procedure Used (C 117, D 1140):** Procedure A
- **Size of Initial Dry Mass (g):** 7611.2
- **Determination of Dry Mass (D 1140):** Not Applicable
- **Particles; Shape & Hardness (D 422):** Not Applicable
- **Dispersion Device/Period (D 422):** Not Applicable
- **Difficulty, Type & Amount of Agent (D 422):** Not Applicable
- **Laboratory Comments:** -
### Classification / Description (D 2487):
(SW) Well Graded Sand

### Color (Moist, Munsell):
Not Determined

### Sample Origin:
Boring Two at 15'

### Method/Procedure Used (C 117, D 1140):
Procedure A

### Size of Initial Dry Mass (g):
929.3

### Determination of Dry Mass (D 1140):
Not Applicable

### Particles; Shape & Hardness (D 422):
Not Applicable

### Dispersion Device/Period (D 422):
Not Applicable

### Difficulty, Type & Amount of Agent (D 422):
Not Applicable

### Laboratory Comments:
-
Classification / Description (D 2487): (SW-SM) Well Graded Sand With Silt and Gravel

Color (Moist, Munsell): Not Determined

Sample Origin: Boring Two at 25'

Method/Procedure Used (C 117, D 1140): Procedure A

Size of Initial Dry Mass (g): 337.8

Determination of Dry Mass (D 1140): Not Applicable

Particles; Shape & Hardness (D 422): Not Applicable

Dispersion Device/Period (D 422): Not Applicable

Difficulty, Type & Amount of Agent (D 422): Not Applicable

Laboratory Comments: -
Classification / Description (D 2487): (SW-SM) Well Graded Sand With Silt
Color (Moist, Munsell): Not Determined
Sample Origin: Boring Two at 35'
Method/Procedure Used (C 117, D 1140): Procedure A
Size of Initial Dry Mass (g): 398.4
Determination of Dry Mass (D 1140): Not Applicable
Particles; Shape & Hardness (D 422): Not Applicable
Dispersion Device/Period (D 422): Not Applicable
Difficulty, Type & Amount of Agent (D 422): Not Applicable
Laboratory Comments: -

GRAIN SIZE ANALYSIS
ASTM C 136, C 117, D2487

Project: Science/Health Lab Building
Client: Victor Valley Community College District
Sample ID: RTH06271213
Attachment: B2
Sheet: 6 of 10
Classification / Description (D 2487): (SM) Silty Sand

Color (Moist, Munsell): Not Determined

Sample Origin: Boring Two at 45'

Method/Procedure Used (C 117, D 1140): Procedure A

Size of Initial Dry Mass (g): 358.9

Determination of Dry Mass (D 1140): Not Applicable

Particles; Shape & Hardness (D 422): Not Applicable

Dispersion Device/Period (D 422): Not Applicable

Difficulty, Type & Amount of Agent (D 422): Not Applicable

Laboratory Comments: -
**GRAIN SIZE ANALYSIS**  
ASTM C 136, C 117, D2487

**Sample Origin:** Boring Three at 25'  
**Method/Procedure Used (C 117, D 1140):** Procedure A  
**Size of Initial Dry Mass (g):** 845.9  
**Determination of Dry Mass (D 1140):** Not Applicable  
**Particles; Shape & Hardness (D 422):** Not Applicable  
**Dispersion Device/Period (D 422):** Not Applicable  
**Difficulty, Type & Amount of Agent (D 422):** Not Applicable  
**Laboratory Comments:** -

**Classification / Description (D 2487):** (SP-SM) Poorly Grade Sand With Silt  
**Color (Moist, Munsell):** Not Determined

---

**U.S. Standard Sieve Number**

| U.S. Sieve Opening In Inches | 3 | 2 | 1.5 | 1 | 3/4 | 3/8 | 4 | 8 | 10 | 16 | 20 | 30 | 40 | 50 | 60 | 100 | 140 | 200 |
|------------------------------|---|---|-----|---|-----|-----|---|---|----|----|----|----|----|----|----|-----|-----|-----|-----|
| Hydrometer                    |   |   |     |   |     |     |   |   |     |     |     |     |     |     |     |     |     |     |     |

---

**Gravel Sand Fines Cu Cc MC D100 D60 D30 D10 LL PL PI SG FM**

<table>
<thead>
<tr>
<th>Gravel</th>
<th>Sand</th>
<th>Fines</th>
<th>C_u</th>
<th>C_c</th>
<th>MC</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
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<th>PL</th>
<th>PI</th>
<th>SG</th>
<th>FM</th>
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<tr>
<td>13</td>
<td>79</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0.1%</td>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>2.59</td>
</tr>
</tbody>
</table>

---

**Project:** Science/Health Lab Building  
**Project No:** 12.0132.0155  
**Client:** Victor Valley Community College District  
**Sample ID:** RTH06271226  
**Attachment:** B2  
**Sheet:** 8 of 10
**Classification / Description (D 2487):**
(SM) Silty Sand

**Sample Origin:**
Boring Four at 45’

**Method/Procedure Used (C 117, D 1140):**
Procedure A

**Size of Initial Dry Mass (g):**
953.4

**Determination of Dry Mass (D 1140):**
Not Applicable

**Particles; Shape & Hardness (D 422):**
Not Applicable

**Dispersion Device/Period (D 422):**
Not Applicable

**Difficulty, Type & Amount of Agent (D 422):**
Not Applicable

**Laboratory Comments:**
-
Classification / Description (D 2487): (SM) Silty Fine to Medium Sand

Color (Moist, Munsell): Not Determined

Sample Origin: Boring Four at 50’

Method/Procedure Used (C 117, D 1140): Procedure A

Size of Initial Dry Mass (g): 525.4

Determination of Dry Mass (D 1140): Not Applicable

Particles; Shape & Hardness (D 422): Not Applicable

Dispersion Device/Period (D 422): Not Applicable

Difficulty, Type & Amount of Agent (D 422): Not Applicable

Laboratory Comments: -

**GRAIN SIZE ANALYSIS**

ASTM C 136, C 117, D2487

**Project:** Science/Health Lab Building **Project No:** 12.0132.0155

**Client:** Victor Valley Community College District **Sample ID:** RTH06271240

**Attachment:** B2 **Sheet:** 10 of 10
<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results</th>
<th>Units</th>
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<tr>
<td>Saturated Resistivity</td>
<td>1700</td>
<td>ohm-cm</td>
</tr>
<tr>
<td>Chloride</td>
<td>ND (Not Detected)</td>
<td>ppm</td>
</tr>
<tr>
<td>Sulfate</td>
<td>15</td>
<td>ppm</td>
</tr>
<tr>
<td>PH</td>
<td>8.4</td>
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<tr>
<td>Redox Potential</td>
<td>129</td>
<td>mV</td>
</tr>
<tr>
<td>Sulfide</td>
<td>Negative</td>
<td>NA</td>
</tr>
</tbody>
</table>

Sample Origin: Boring Four at Surface
Initial Water Content: 9.0
Degree of Saturation: 51.0
Density at Compaction: 114.4
Initial Dial Reading: 0.0119
Final Dial Reading: 0.0106
Expansion Index: 0
Expansion Potential: Very Low
Final Water Content: 13.4
Sample Location: Boring 3 at 0-3'
<table>
<thead>
<tr>
<th>Sample Origin:</th>
<th>Boring Two at 13'</th>
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</thead>
<tbody>
<tr>
<td><strong>Angle of Internal Friction (°)</strong></td>
<td><strong>Cohesion (PSF)</strong></td>
</tr>
<tr>
<td>31.0</td>
<td>120</td>
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</tbody>
</table>
Classification
SM

Boring Number: 2  
Initial Moisture Content (%) 3.5

Depth (ft): 13  
Final Moisture Content (%) 23.6

Specimen Diameter (in) 2.5  
Initial Dry Density (pcf)

Specimen Thickness (in) 1.0
ON SITE PHOTOGRAPHS

Project: Science/Health Lab Building  
Client: Victor Valley Community College District  
Sample ID: NA  
Attachment: C5  
Sheet: 1 of 2
ATTACHMENT D

DETAIL ILLUSTRATIONS
CUT-FILL LOT

NOTE:
DEEPER OVEREXCAVATION AND RECOMPACTION SHALL BE PERFORMED IF DETERMINED NECESSARY BY SOILS ENGINEER.

CUT LOT
**BENCHING DETAIL**

**Project:** Science/Health Lab Building  
**Project No:** 12.0132.0155  
**Client:** Victor Valley Community College District  
**Sample ID:** NA  
**Attachment:** D2  
**Sheet:** 1 of 1

**Fill Slope**
- **Projected Plane:** (1 to 1 max. from toe of slope to approved ground)
- **Natural Ground**
- **Compacted Fill**
- **Remove Unsuitable Material**
- **Bench Height:** (Varies)
- **Lowest Bench:** (Key) 12' Min.
- **Cut Face:** (To be constructed prior to fill placement)
- **2' Min. Key Depth**
- **2% Min.**

**Fill-Over-Cut Slope**
- **Natural Ground**
- **Compacted Fill**
- **Remove Unsuitable Material**
- **Finished Surface**
- **Cut Face:** (To be constructed prior to fill placement)
- **Bench Height:** (Varies)
- **Lowest Bench:** (Key) 12' Min.
- **2' Min. Key Depth**
- **2% Min.**

**Cut-Over-Fill Slope**
- **Natural Ground**
- **Compacted Fill**
- **Remove Unsuitable Material**
- **Overbuild & Trim Back**
- **Bench Height:** (Varies)
- **Lowest Bench:** (Key) 12' Min.
- **2' Min. Key Depth**
- **2% Min.**

**Notes:**
- Lowest Bench: depth and width subject to field change based on soils engineer's inspection.
- Subdrainage: back drains may be required at the discretion of the soils engineer.
### TOP OF SLOPE

<table>
<thead>
<tr>
<th>SLOPE HEIGHT (h) (feet)</th>
<th>SETBACK (A) (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10'</td>
<td>5' MIN.</td>
</tr>
<tr>
<td>10' - 20'</td>
<td>h/2 MIN.</td>
</tr>
<tr>
<td>20'+</td>
<td>10'</td>
</tr>
</tbody>
</table>

### TOE OF SLOPE

<table>
<thead>
<tr>
<th>SLOPE HEIGHT (h) (feet)</th>
<th>SETBACK (B) (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10'</td>
<td>5' MIN.</td>
</tr>
<tr>
<td>10' - 30'</td>
<td>h/2 MIN.</td>
</tr>
<tr>
<td>30'+</td>
<td>15'</td>
</tr>
</tbody>
</table>
ATTACHMENT E

GENERAL GRADING SPECIFICATIONS
GENERAL GRADING SPECIFICATIONS

Grading of the subject site should be performed in accordance with the provisions of the Uniform Building Code and/or applicable ordinances. The following is presented for your assistance in establishing proper grading criteria:

1. GENERAL INTENT

These specifications present the general procedure and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of sub-drains, and excavations. The recommendations contained in this geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations, which could supersede these specifications, or the recommendations of this geotechnical report.

2. CONSTRUCTION INSPECTION

A representative of this firm should inspect all grading operations, including site clearing and stripping. The presence of our field representative will be for the purpose of providing observation and field testing, and will not include any supervising or directing of the actual work of the Contractor, his employees or agents. Neither the presence of our field representative nor the observations and testing by our firm shall excuse the Contractor in any way for defects discovered in this work. It is understood that our firm will not be responsible for job or site safety on this project, which will be the sole responsibility of the Contractor.

3. EARTHWORK OBSERVATION & TESTING

Prior to the commencement of grading, a representative of this firm or a qualified geotechnical consultant (soils engineer, engineering geologist, or their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observation so that they may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep the consultant apprised of work schedules and changes so that the consultant may schedule personnel accordingly.
It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes and/or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soils, poor moisture condition, inadequate compaction, adverse weather, etc. are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the conditions are rectified.

4. FILL PLACEMENT AND COMPACTION

4.1. Fill Lifts

Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding eight (8) inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

Fill must be inorganic, granular sands or gravel, free from rocks, or lumps greater than six (6) inches in maximum dimension. Each fill lift should be brought to near optimum moisture content and compacted to at least 95 percent (ASTM D1557, D1556, D2922).

4.2. Fill Moisture

Fill layers at a moisture content no less or more than +/- 2 % of optimum shall be watered and mixed, and over saturated / wet fill layers shall be aerated by scarification or shall be blended with drier material to obtain a moisture content of +/- 2% of the optimum moisture. Moisture-conditioning and mixing of fill layers shall continue until the fill material is at uniform moisture content at or near optimum moisture but within +/- 2% of the optimum moisture.

4.3. Compaction of Fill

After each layer has been evenly spread, moisture conditioned, and mixed, it shall be uniformly compacted to not less than 95 percent of the maximum dry density (ASTM D1557). Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or have proven reliability, to efficiently achieve the specified degree of compaction. In general, the compaction criteria specified below shall be followed unless otherwise noted.
- Footing Subgrade 95% or Greater at +/- 2% Optimum Moisture
- Concrete Slab Subgrade 95% or Greater at +/- 2% Optimum Moisture
- Aggregate Base for Paved Areas 95% or Greater at +/- 2% Optimum Moisture
- Upper 1’ of Subgrade, Paved Areas 95% or Greater at +/- 2% Optimum Moisture
- Matt Foundation Subgrade 95% or Greater at +/- 2% Optimum Moisture
- Cross Gutter Subgrade 95% or Greater at +/- 2% Optimum Moisture
- Structural Fill 90% or Greater at +/- 2% Optimum Moisture
- Curb and Gutter Subgrade 90% or Greater at +/- 2% Optimum Moisture
- Sidewalk Subgrade 90% or Greater at +/- 2% Optimum Moisture
- Retaining Wall Backfill 90% or Greater at +/- 2% Optimum Moisture
- Trench Backfill 90% or Greater at +/- 2% Optimum Moisture

5. FILL SLOPES AND SLOPE CONSTRUCTION
Permanent cut or fill slopes should be constructed with no slopes steeper than 2 horizontal to 1 vertical.

Compacting of slopes shall be accomplished by one of the following procedures:

- By bankrolling of slopes with sheep foot roller at frequent increments of 1 to 2 feet in fill elevation gain, or by other methods producing satisfactory results.

- Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. The relative compaction of the slopes on to the slope face shall be at least 90 percent.

Where fills slopes are to be placed on existing slopes the ground should be benched. Any fills placed on slopes shall be benched and keyed per details of this report

If the fill is properly compacted, fill embankments may constructed at 2:1 (horizontal to vertical) of flatter. Fill slopes should be overfilled and trimmed back to the desired grade to provide a firm surface. All slopes should be provided with adequate drainage and should be planted immediately with erosion-resistant vegetation.

6. BENCHING

The existing surface shall be benched at least 12 feet wide at the lowest bench and shall be at least 2 feet deep into firm materials compacted to 90%. The lowest bench should be tilted in
the slope at a 2% slope into the embankment. Other benches should be excavated into firm material for a minimum width of 4 feet, and all benches should be approximately 2 feet in height. Deeper removal and re-compaction may be required.

The existing slopes shall be benched to key the fill material to the underlying ground. A minimum of 2 feet normal to the slope shall be removed and re-compacted, as the fill is brought up in layers, to ensure that the new work is constructed on a firm foundation fill. Benching may vary based on field conditions and will be verified/confirmed by our field representative.

In no case will horizontal benching be less than 4 feet and vertical lifts more than 2 feet.

7. COMPACTION TESTING

Field-tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at an interval not exceeding two feet in vertical rise and/or 1,000 cubic yards of embankment. Compaction testing will be in performed in accordance with the American Society for Testing and Materials Standards (ASTM), test methods ASTM D1556 and/or D2922 or other applicable standards.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society for Testing and Materials Standards (ASTM), test method ASTM D1557.

8. EXCAVATION

Excavations and cut slopes will be examined during grading. If directed by the consultant, further excavation or over excavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

9. TRENCH BACKFILL

Trench excavations for utility pipes shall be backfilled under engineering supervision. After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean
sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand
backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

The on-site materials, or other soils approved by the consultant, shall be watered and mixed as
necessary prior to placement in lifts over the sand backfill.

The controlled backfill shall be compacted to at least 95 percent of the maximum laboratory
density as determined by the ASTM compaction method described above.

Field density tests and inspection of the backfill procedures shall be made by the consultant
during backfilling to see that proper moisture content and uniform compaction is being
maintained. The contractor shall provide test holes and exploratory pits as required by the
consultant to enable sampling and testing.
ATTACHMENT F

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT
(ASFE PUBLICATION)
More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include:
- the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, your geotechnical engineering report should not be used:
- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report’s development have changed.

MOST GEOTECHNICAL “FINDINGS” ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact. For this reason, most experienced owners retain their geotechnical consultants through the construction stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time. Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers’ reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.
A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. These logs should not under any circumstances be redone for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, give contractors ready access to the complete geotechnical engineering report prepared or authorized for their use. Those who do not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are not exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.
ATTACHMENT G

GEOLOGIC HAZARDS REPORT
GEOLOGIC HAZARDS REPORT
PROPOSED SCIENCE / HEALTH LAB BUILDING
VICTOR VALLEY COLLEGE
18422 BEAR VALLEY ROAD
CITY OF VICTORVILLE, CALIFORNIA

Project No. 122580-3
September 26, 2012

Prepared for:
Merrell Engineering Company, Inc.
128 East Fredricks Street
Barstow, CA 92311

Consulting Engineering Geology & Geophysics
P.O. Box 1090, Loma Linda, CA 92354 • 909 796-4667
INTRODUCTION

At your request, this firm has prepared a Geologic Hazards Report for the proposed Science/Health Lab Building within the Victor Valley College Campus, City of Victorville, California. The purpose for this study was to evaluate the local geologic conditions and seismic hazards, and to develop generalized conclusions and recommendations, if warranted, with respect to the proposed development.

This report has been prepared utilizing the suggested “Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings” (CGS Note 48, 2011), along with the Geologic portion of the “Factors to Be Included in the Geological and Environmental Hazards Report,” which is included as Appendix H of the “School Site Selection and Approval Guide,” prepared by the School Facility Planning Division, California Department of Education, and the requirements outlined by the DSA (2004).

The scope of services provided for this evaluation included the following:

- **Review of available published and unpublished geologic/seismic data in our files pertinent to the site, including photogeologic analysis of aerial photographs.**
- **Field reconnaissance by a State of California Certified Engineering Geologist including observation of exploratory borings performed by Merrell Engineering Company, Inc.**
- **Preparation of this report, presenting our findings, conclusions, and recommendations from a geologic standpoint, with respect to the proposed development.**

**Accompanying Maps, Illustrations, and Appendices**

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<th>Plate 1</th>
<th>Regional Geologic Map</th>
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<td>Plate 2</td>
<td>Earthquake Epicenter Map</td>
</tr>
<tr>
<td>Plate 3</td>
<td>Microseismicity Map</td>
</tr>
<tr>
<td>Appendix A</td>
<td>References</td>
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</tbody>
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TERRA GEOSCIENCES
GEOLOGIC SETTING

The subject site is located within a natural geomorphic province in southern California known as the Mojave Desert. This province consists of a broad interior region of isolated mountain ranges separated by expanses of desert plains, and is characterized by the numerous interior enclosed drainages and playas. The Mojave Desert is in large, bounded structurally on the southwest by the San Andreas Fault and on the northwest by the Garlock Faults, and is ill-defined along the east where the structural patterns resemble the Basin and Range Province to the north and east. This province exhibits interior drainage, including the Mojave River, which has its source in the San Bernardino Mountains and would extend into Death Valley if there was enough water. The geologic units of this region generally consist of three main divisions being: 1) Crystalline rocks of pre-Tertiary age; 2) sediments and volcanic rocks of Tertiary age; and 3) sediments and basalt flows of Quaternary age. Regionally, the site is located along a large alluvial plain, locally underlain by Quaternary age alluvium and older that has been derived predominantly as outwash from the San Bernardino and San Gabriel Mountains to the south and southwest, respectively. These sediments are believed to be as thick as 3,500± feet locally (Subsurface Surveys, 1990).

This alluvial plain is informally referred to as the Victorville fan which originally had it source on the north side of the San Gabriel Mountains, but subsequent right-lateral displacement originating from ground displacement along the San Andreas Fault, has separated it from its source. Figure 1 below depicts the major physiographic features of the region showing the subject site to be located within the Victorville Fan.

![FIGURE 1- Major Physiographic Features (from Morton and Miller, 2006, Figure 3)](image-url)
Locally as mapped by Morton and Miller (2006) and as shown on the Regional Geologic Map, Plate 1, the site is shown to be underlain by middle to early Pleistocene age very old alluvial-fan deposits (map symbol Qvof). They describe these deposits as generally being moderately to well consolidated silt, sand, gravel, and conglomerate, which typically consists of medium to dark, reddish-brown lithic arkose. Subsurface exploratory boring excavations performed by Merrell Engineering Company, Inc. (June 2012) indicate the subject site to be generally underlain by a thinly-stratified and well-interbedded sequence of fine- to coarse-grained sands and silty sands with variable amounts of gravel and cobbles, to a depth of at least 51½ feet. These sediments were noted to be in a generally dense condition.

**FAULTING**

There are at least forty-one major "potentially active/active" (late Quaternary) faults that are within a 100 kilometer (62 mile) radius of the site as shown on Figure 2 below (site shown as small black square in middle). Of these, there are no active faults known to traverse the site based on published literature, photogeologic analysis, and our field reconnaissance. In addition, the site is not located within a State of California “Alquist-Priolo Earthquake Fault Zone” for fault rupture hazard (Bryant and Hart, 2007).

![FIGURE 2](image_url)
The nearest known zoned active fault is associated with the North Frontal Fault Zone (Western Segment, see Figure 3 below for reference). The nearest active fault segment associated with this zone is located approximately 5½ miles to the southeast (C.D.M.G., 1988) which is locally referred to as the Ord Mountain Fault. The North Frontal Fault is a southern dipping reverse fault, being approximately 50.1 kilometers in length, with an estimated maximum moment magnitude of $M_W 7.2$, and an associated slip-rate of $1 \pm 0.5$ mm/year (C.D.M.G., 1996; Cao et al., 2003; and Petersen et al., 2008). In many places there are high well developed scarps, which have formed in older Quaternary deposits and are moderately degraded.

![FIGURE 3- Major Fault Map (from Morton and Miller, 2006, Sheet 2 of 4)](image)

**GROUNDWATER**

The study area lies within the Upper Mojave River Groundwater Basin of southern California. The Mojave River Basin is part of the Mojave Desert region and is bordered by the San Bernardino and San Gabriel Mountains to the south and extends to Afton Canyon to the northeast, with Lucerne Valley and Antelope Valleys bordering the east and west, respectively. The Mojave River, which is located to the east, is the principal source of water recharge to the basin, which originates from the junctions of Deep Creek and West Fork Mojave River at the northern foot of the San Bernardino Mountains. Other sources of recharge include other lesser river tributaries from the San Bernardino and San Gabriel Mountains, as well as deep percolation from rainwater and other artificial means.
The water-bearing deposits are principally unconsolidated and partially consolidated continental sedimentary deposits that form two aquifers (Stamos and Predmore, 1995), the upper one being shallow alluvium (200± feet thick, within 1± mile of the Mojave River), with the regional aquifer underlying most of the basin at depth. The regional aquifer is comprised of unconsolidated older alluvium and fan deposits of Pleistocene to Tertiary age, and partly consolidated to consolidated sediments of Tertiary age. These deposits are as much as 1,000 feet thick in some places and their permeability generally decreases with depth.

Several groundwater reports are available for the region and were used as a guide to determine the historic and recent local groundwater levels and characteristics, which included the following; Lines, 1996; Mendez and Christensen, 1997; Smith, 2000 and 2004; and Stamos and Predmore, 1995. These reports are listed in Appendix A for reference purposes. Additionally, the U.S.G.S. well database was also searched which provided groundwater level data for numerous on-site and nearby wells (U.S.G.S., 2012b). Based on a review of this data, groundwater is shown to vary between depths of around 85 to 130± feet in the general vicinity of the site. Based on subsurface exploration performed by Merrell Engineering, Inc, (June 2012) groundwater was not encountered locally within the proposed building area to a depth of at least 51½ feet.

**CBC SEISMIC SUMMARY**

Included for this study was an evaluation of the seismic parameters for the subject school site. Since the site is not located within a designated Earthquake Fault Zone (Bryant and Hart, 2007), this evaluation is based on the U.S. Seismic “DesignMaps” Web Application; Version 3.0.0 (U.S.G.S., 2012a), with respect to the 2010 California Building Code (CBC) / ASCE 7-10 Standard (derived from 2008 U.S.G.S. hazard data), of which is tabulated below. Geographically, the site is located at Longitude -117.2643 and Latitude 34.4741 (World Geodetic Survey 1984 coordinates).

<table>
<thead>
<tr>
<th>Factor or Coefficient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S_S</td>
<td>1.500g</td>
</tr>
<tr>
<td>S_1</td>
<td>0.600g</td>
</tr>
<tr>
<td>F_a</td>
<td>1.0</td>
</tr>
<tr>
<td>F_v</td>
<td>1.5</td>
</tr>
<tr>
<td>S_DS</td>
<td>1.000g</td>
</tr>
<tr>
<td>S_D1</td>
<td>0.600g</td>
</tr>
<tr>
<td>S_MS</td>
<td>1.500g</td>
</tr>
<tr>
<td>S_M1</td>
<td>0.900g</td>
</tr>
<tr>
<td>T_L</td>
<td>12 Seconds</td>
</tr>
<tr>
<td>PGA</td>
<td>0.563g</td>
</tr>
<tr>
<td>Site Soil Classification</td>
<td>D</td>
</tr>
</tbody>
</table>
HISTORIC SEISMIC ACTIVITY

A computerized search, based on Southern California historical earthquake catalogs, has been performed using the programs EQSEARCH (Blake, 1989-2000b) and EPI (Reeder, 2000). The following table and discussion summarizes the known historic seismic events (≥M4.0) that have been estimated and/or recorded during this time period of 1800 to June 2012, within a 100 kilometer (62 mile) radius of the site.

TABLE 2 - HISTORIC SEISMIC EVENTS; 1800-2012 (100 Kilometer Radius)

<table>
<thead>
<tr>
<th>Richter Magnitude</th>
<th>No. of Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 - 4.9</td>
<td>529</td>
</tr>
<tr>
<td>5.0 - 5.9</td>
<td>65</td>
</tr>
<tr>
<td>6.0 - 6.9</td>
<td>13</td>
</tr>
<tr>
<td>7.0 - 7.9</td>
<td>2</td>
</tr>
<tr>
<td>8.0+</td>
<td>0</td>
</tr>
</tbody>
</table>

It should be noted that pre-instrumental seismic events (generally before 1932) have been estimated from isoseismal maps (Toppozada, et al., 1981 and 1982). These data have been compiled generally based on the reported intensities throughout the region, thus focusing in on the most likely epicentral location. Instrumentation beyond 1932 has greatly increased the accuracy of locating earthquake epicenters. A summary of the historic earthquake data is as follows:

- The closest recorded notable earthquake epicenter (magnitude 4.0 or greater) is a M4.0 event (April 4, 1990), located approximately 14 miles to the southeast.
- The largest estimated historical earthquake magnitude within a 62 mile radius of the site is a M6.9 event of December 8, 1812 (approximately 23 miles west-southwest).
- The largest recorded historical earthquake was the M7.6 (Mw7.3) Landers event, located approximately 51 miles to the east-southeast (June 28, 1992).
- The nearest estimated significant historic earthquake epicenter was approximately 18 miles southwest of the site (July 22, 1899, M6.5).
- The nearest recorded significant historic earthquake epicenter was approximately 21 miles southwest of the site (September 12, 1970, M5.4).

An Earthquake Epicenter Map which includes magnitudes 4.0 and greater for a 100 kilometer radius, and a Microseismicity Map which includes magnitudes 0.0 and greater for a 10 mile radius, have been included as Plates 2 and 3, respectively, for reference purposes. These maps were prepared using the computer program EPI (Reeder, 1997), based on the Caltech fault and earthquake epicenter database of instrumentally recorded events from the period of 1932 to June 2012.
**FLOODING**

According to the Federal Emergency Management Agency (FEMA, 2008), the proposed Science/Health Lab Building is not shown to be located within the boundaries of a 100-year flood (Community Panel Number 06071C-6485H, August 28, 2008), such as shown below in Figure 4 below for reference. This map indicates that the site is located within "Zone X," which is defined as “Areas determined to be outside the 0.2% annual chance floodplain.”

![Flood Zone Map](image)

**FIGURE 4- Flood Zone Map (from FEMA, Community Panel Number 06071C-6485H)**

**SECONDARY SEISMIC HAZARDS**

Secondary permanent or transient seismic hazards generally associated with severe ground shaking that occurs during an earthquake are ground rupture, liquefaction, seiches or tsunamis, flooding (water storage facility failure), landsliding, ground lurching and lateral spreading, rockfalls, and seismically-induced settlement. These are discussed below.

**Ground Rupture:**

Ground rupture is generally considered most likely to occur along pre-existing faults. Since there are no faults (active or otherwise) that are known to traverse the site, the potential for ground rupture is considered to be nil.
**Liquefaction:**
In general, liquefaction is a phenomenon that occurs where there is a loss of strength or stiffness in the soils from repeated disturbances of saturated cohesionless soil that can result in the settlement of buildings, ground failures, or other related hazards. The main factors contributing to this phenomenon are: 1) cohesionless, granular soils having relatively low densities (usually of Holocene age); 2) shallow groundwater (generally less than 40 feet); and 3) moderate-high seismic ground shaking. Due to the absence of shallow groundwater (not encountered within the exploratory borings drilled on-site to a depth of at least 51½ feet) and the relatively dense nature of the underlying alluvial sediments, the potential for liquefaction appears low at this time.

**Seiches/Tsunamis:**
Based on the far distance of large, open bodies of water and the elevation of the site with respect to sea level, the possibility of seiches/tsunamis is considered nil.

**Flooding (Water Storage Facility Failure):**
Since no water storage facility (i.e. water tank, dam, etc.) is located above the site, the potential for flooding, caused by water storage facility failure, is considered nil.

**Landsliding:**
Due to the low-lying relief of the site and vicinity, landsliding due to seismic shaking is considered nil.

**Ground Lurching/Lateral Spreading:**
Ground lurching is the horizontal movement of soil, sediments, or fill located on relatively steep embankments or scarps as a result of seismic activity, forming irregular ground surface cracks. The potential for lateral spreading or lurching is highest in areas underlain by soft, saturated materials, especially where bordered by steep banks or adjacent hard ground. Due to the presence of the 50±-foot high bank along the Mojave River plain located approximately 1,000± feet to the east, the potential for ground lurching and/or lateral spreading should be considered a potential, although at this time appears to be very low.

**Rockfalls:**
Since no large rock outcrops are present at or adjacent to the site, the possibility of rockfalls during seismic shaking is nil.

**Seismically-Induced Settlement:**
Seismically-induced settlement generally occurs within areas of loose granular soils. Based on the provided boring logs, the site appears to be underlain by generally dense sediments therefore the potential for settlement is considered to be low.
CONCLUSIONS AND RECOMMENDATIONS

GENERAL

Based on our review of available pertinent published and unpublished geologic/seismic literature (including the site-specific boring log data), construction of the proposed Science/Health Lab Building appears to be feasible from a geologic standpoint, providing that our recommendations are considered during planning and construction.

CONCLUSIONS:

1. Earth Materials

Based on our review of available published data and the provided borings logs, the earth materials underlying the site consist of older alluvial fan deposits that locally consist of fine- to coarse-grained sands and silty sands with variable amounts of gravel and cobbles, to a depth of at least 51½ feet. These sediments were noted to be in a generally dense condition. These deposits have been derived as fan alluvium originating from the San Bernardino and Gabriel Mountains to the south and southwest respectively and appear to be consistent with regional geologic mapping. No unusual geologic conditions were observed during our field study or literature research.

2. Faulting

No active faults are known to traverse the site, based on published literature, and no surficial indications or geomorphic features were observed that are suggestive of faulting. In addition, the site is not located within a designated Alquist-Priolo Earthquake Fault Zone for fault rupture hazards. The nearest mapped (zoned) “active” fault is the North Frontal Fault (western segment) which is located approximately 5½ miles to the southeast.

3. Seismicity

The primary geologic hazard that exists at the site is that of ground shaking. Ground shaking from earthquakes accounts for nearly all earthquake losses. Many factors determine the severity of ground shaking at a given location, such as size of earthquake, length of fault rupture (if any), depth of hypocenter, type of faulting (dip slip/strike slip), directional attenuation, amplification, earth materials, and others. Due to the location of the site with respect to regional faulting and the recorded historical seismic activity, moderate to severe ground shaking could be anticipated during the life of the proposed school facilities.

4. Flooding

According to the Federal Emergency Management Agency, the proposed building is not located with a designated floodplain and more specifically, is located outside of the 500-year (0.2% annual chance) floodplain.
5. **Groundwater**

Available published data indicates that the depth to groundwater locally varies between 85 to 130± feet. Based on the site-specific exploratory borings excavated within the proposed building area, groundwater was not encountered to a depth of at least 51½ feet. Groundwater if therefore expected to be greater than 51½ feet in depth.

6. **Secondary Seismic Hazards**

Based on the data obtained during this study as previously discussed, there does not appear to be any permanent or transient secondary seismic hazards that are expected to occur at the subject site. The potential for ground lurching and/or lateral spreading is considered to be very low due to the flat-lying, dry, and dense condition of the older alluvial earth materials that comprise the bluff face. No evidence of previous ground lurching and/or lateral spreading was noted during our literature research, field reconnaissance, or photogeologic analysis. At this time, no mitigation measures appear to be warranted for this hazard.

**RECOMMENDATIONS:**

1. It is recommended that all structures be designed to at least meet the current California Building Code provisions in the latest CBC edition (2010) and the ASCE Standard 7-10, where applicable. However, it should be noted that the building code is described as a minimum design condition and is often the maximum level to which structures are designed. Structures that are built to minimum code are designed to remain standing after an earthquake in order for occupants to safely evacuate, but then may have to ultimately be demolished (Larson and Slosson, 1992).

   It is the responsibility of both the property owner and project structural engineer to determine the risk factors with respect to using CBC minimum design values for the subject project. The previously-outlined seismic summary data have been provided for use by the project structural engineer, to aid in evaluating design criteria. This data has been compiled from the U.S.G.S. web application “DesignMaps” using the ASCE 7-10 Standard which was derived from 2008 U.S.G.S. hazard data. This information should be carefully reviewed prior to construction.

2. During peak periods of rainfall heavy runoff could be anticipated and should be properly evaluated by the project Civil Engineer. Any possible flood hazards should also be properly evaluated by the design Civil Engineer.
CLOSURE

Our conclusions and recommendations are based on a field reconnaissance, observation of subsurface exploratory boring excavations, photogeologic analysis, and an interpretation of available existing geotechnical and geologic/seismic data. We make no warranty, either express or implied. Should conditions be encountered at a later date or more information becomes available that appear to be different than those indicated in this report, we reserve the right to reevaluate our conclusions and recommendations and provide appropriate mitigation measures, if warranted. It is assumed that all the conclusions and recommendations outlined in this report are understood and followed. If any portion of this report is not understood, it is the responsibility of the owner, contractor, engineer, and/or governmental agency, etc., to contact this office for further clarification.

Respectfully submitted,

TERRA GEOSCIENCES

Donn C. Schwartzkopf
Certified Engineering Geologist
CEG 1459

TERRA GEOSCIENCES
REGIONAL GEOLOGIC MAP


PARTIAL LEGEND

- **Qw\(_2\)** VERY YOUNG WASH: Unconsolidated mixed sand, gravel, pebble, cobble, and boulder deposits (late Holocene).
- **Qw\(_1\)** VERY YOUNG WASH: Unconsolidated sand and gravel deposits (late Holocene).
- **Qyw3** YOUNG WASH: Unconsolidated silt, sand, and coarse-grained sand to cobble alluvium (early Holocene).
- **Qvof** VERY OLD FAN: Moderately to well consolidated silt, sand, and gravel (middle to early middle Pleistocene).
- **Line** GEOLOGIC CONTACT: Solid where well-located to approximately-located, dashed where inferred.
- **Line** FAULT: Solid where accurately located, dashed where approximate, dotted where concealed.

PROJECT NO. 122580-3

PLATE 1
SITE LOCATION:  34.4741 LAT, -117.2643 LONG.

MINIMUM LOCATION QUALITY: C

TOTAL # OF EVENTS ON PLOT: 1344

TOTAL # OF EVENTS WITHIN SEARCH RADIUS: 535

MAGNITUDE DISTRIBUTION OF SEARCH RADIUS EVENTS:

4.0-4.9 : 479
5.0-5.9 : 52
6.0-6.9 : 2
7.0-7.9 : 2
8.0-8.9 : 0

CLOSEST EVENT: 4.0 ON WEDNESDAY, APRIL 04, 1990 LOCATED APPROX. 23 KILOMETERS SOUTHEAST OF THE SITE

LARGEST 5 EVENTS:

7.3 ON SUNDAY, JUNE 28, 1962 LOCATED APPROX. 81 KILOMETERS SOUTHEAST OF THE SITE
7.1 ON SATURDAY, OCTOBER 15, 1999 LOCATED APPROX. 91 KILOMETERS EAST OF THE SITE
6.5 ON THURSDAY, APRIL 10, 1947 LOCATED APPROX. 87 KILOMETERS NORTHEAST OF THE SITE
6.3 ON SUNDAY, JUNE 28, 1962 LOCATED APPROX. 56 KILOMETERS SOUTHEAST OF THE SITE
5.9 ON THURSDAY, OCTOBER 01, 1987 LOCATED APPROX. 87 KILOMETERS SOUTHWEST OF THE SITE

EARTHQUAKE EPICENTER MAP
SITE LOCATION: 34.4741 LAT. -117.2643 LONG.

MINIMUM LOCATION QUALITY: C

TOTAL # OF EVENTS ON PLOT: 8046

TOTAL # OF EVENTS WITHIN SEARCH RADIUS: 299

MAGNITUDE DISTRIBUTION OF SEARCH RADIUS EVENTS:

0.0-0.9: 20
1.0-1.9: 193
2.0-2.9: 72
3.0-3.9: 4
4.0-4.9: 0
5.0-5.9: 0
6.0-6.9: 0
7.0-7.9: 0
8.0-8.9: 0

CLOSEST EVENT: 5.6 ON TUESDAY, JULY 15, 1989 LOCATED APPROX. 1.5 MILES WEST OF THE SITE

LARGEST 5 EVENTS:

3.5 ON SATURDAY, FEBRUARY 17, 1990 LOCATED APPROX. 8 MILES SOUTHEAST OF THE SITE
3.2 ON FRIDAY, AUGUST 23, 1940 LOCATED APPROX. 8 MILES NORTHWEST OF THE SITE
3.0 ON MONDAY, AUGUST 31, 1959 LOCATED APPROX. 9 MILES NORTHEAST OF THE SITE
3.0 ON FRIDAY, JANUARY 13, 1933 LOCATED APPROX. 5 MILES SOUTHEAST OF THE SITE
2.9 ON SATURDAY, MAY 04, 1985 LOCATED APPROX. 8 MILES SOUTHEAST OF THE SITE

MICROSEISMICITY MAP

PROJECT NO. 122580-3
REFERENCES


California Division of Mines & Geology (C.D.M.G.), 1986, "Guidelines to Geologic/Seismic Reports," Note No. 42.


Reeder, W., 2000, EPI Earthquake Epicenter Computer Program, EPI Software Company.


Toppozada, TR. et al., 1981, Preparation of Isoseismal Maps and Summaries of Reported Effects for pre-1900 California Earthquakes, C.D.M.G. OFR 81-11.


MAPS UTILIZED


California Division of Mines and Geology (C.D.M.G.), 1988, Apple Valley South 7½’ Quadrangle, Earthquake Fault Zone Map, Scale 1” = 2,000’.


Morton, D.M. and Miller, F.K., 2003, Preliminary Geologic Map of the 30’ x 60’ San Bernardino Quadrangle, California, Scale 1:100,000, U.S.G.S. Open-File Report 03-293, 5 sheets, Version 1.0..

Toppozada, T.R. et al., 2000, Epicenters of and Areas Damaged by M≥4 California Earthquakes, Map Sheet 49, Scale 1”=25 Miles.

**AERIAL PHOTOGRAPHS UTILIZED**

Rowe, 1929, Water Resources Institute, California State University San Bernardino, Photo Nos. 13 & 14, Flight 679, Scale 1”=2,000’.

San Bernardino County Flood Control District, 1969, Photo Nos. 4-6, Scale 1” = 2,000’, dated February 1, 1969.