3.6-1 Preliminary Geotechnical Investigation

PRELIMINARY GEOTECHNICAL INVESTIGATION FOR THE OAK CREEK CANYON RESIDENTIAL DEVELOPMENT, ASSESSOR'S PARCEL NUMBERS (APN'S): 362-070-001, -003, -006, -010, -013, -018, -021, -023, -024; 362-008-004, -005, -007, -008, -009, -012; 362-090-004, -009, AND -015 IN THE CITY OF WILDOMAR, COUNTY OF RIVERSIDE, CALIFORNIA

Dated: January 20, 2012

Project No.: I11-2439-10

Prepared For:

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January 20, 2012 Project No. I11-2439-10

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Subject: ***Preliminary Geotechnical Investigation for the Proposed Oak Creek Canyon Residential Development, Assessor's Parcel Numbers (APN's): 362-070-001, -003, -006, -010, -013, -018, -021, -023, -024; 362-008-004, -005, -007, -008, -009, -012; 362-090-004, -009, and -015 in the City of Wildomar, County of Riverside, California***

In accordance with your request, LGC Inland, Inc. (LGC) has prepared this preliminary geotechnical investigation for the proposed single-family "Oak Creek Canyon" residential development, Assessor's Parcel Numbers (APN's) 362-070-001, -003, -006, -010, -013, -018, -021, -023, -024; 362-008-004, -005, -007, -008, -009, -012; and 362-090-004, -009, -015 in the City of Wildomar, County of Riverside, California. This report presents the results of our field investigation, laboratory testing and our engineering judgment, opinions, conclusions, and recommendations pertaining to the geotechnical design aspects of the proposed development.

Based on our investigation and review of the proposed grading plan by VSL Engineering (2012), the proposed development is geotechnically feasible provided the recommendations presented in this report are incorporated into the project design and implemented during rough grading of the subject site.

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

Respectfully submitted,

LGC INLAND, INC.

Mark Bergmann
President

MB/CEJ/SER/LDC

Distribution: (6) Addressee

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1.0 INTRODUCTION

1.1 Purpose and Scope of Services

The purpose of our investigation was to evaluate the pertinent geotechnical conditions at the site and to provide geotechnical design criteria for, but not limited to: grading, construction, foundation design, retaining walls, pavement design and other relevant aspects relative to the proposed development of the site. This report presents the results of our geotechnical investigation for the proposed development. Environmental issues pertaining to the site were not investigated by LGC.

Our scope of services included:

- Review of geologic maps and documents pertinent to the site (Appendix A).
- A subsurface investigation including the excavation, sampling, and logging of twenty-four (24) test pits labeled TP-1 through TP-24. Logs of the test pits are presented in Appendix B, and their approximate locations are depicted on the Geotechnical Map, Plates 1 through 3. All of the excavations were logged and sampled by an engineering geologist from our firm. The test pits were excavated to evaluate the general characteristics of the subsurface conditions on the site including rippability of bedrock units, classification of site soils, determination of depth to groundwater, and to obtain representative soil samples for laboratory testing.
- Geologic mapping of the site.
- Preliminary percolation testing for proposed onsite storm water detention systems (Percolation Test Results-Appendix C).
- Laboratory testing of representative soil samples obtained during our subsurface investigation (Appendix D).
- Slope stability analyses (Appendix E).
- Seismic Refraction Survey (Appendix F).
- Engineering and geologic analysis of the data with respect to the proposed development.
- Preparation of General Earthwork and Grading Specifications (Appendix G).
- Preparation of this report presenting our findings, conclusions and preliminary geotechnical recommendations for the proposed development.

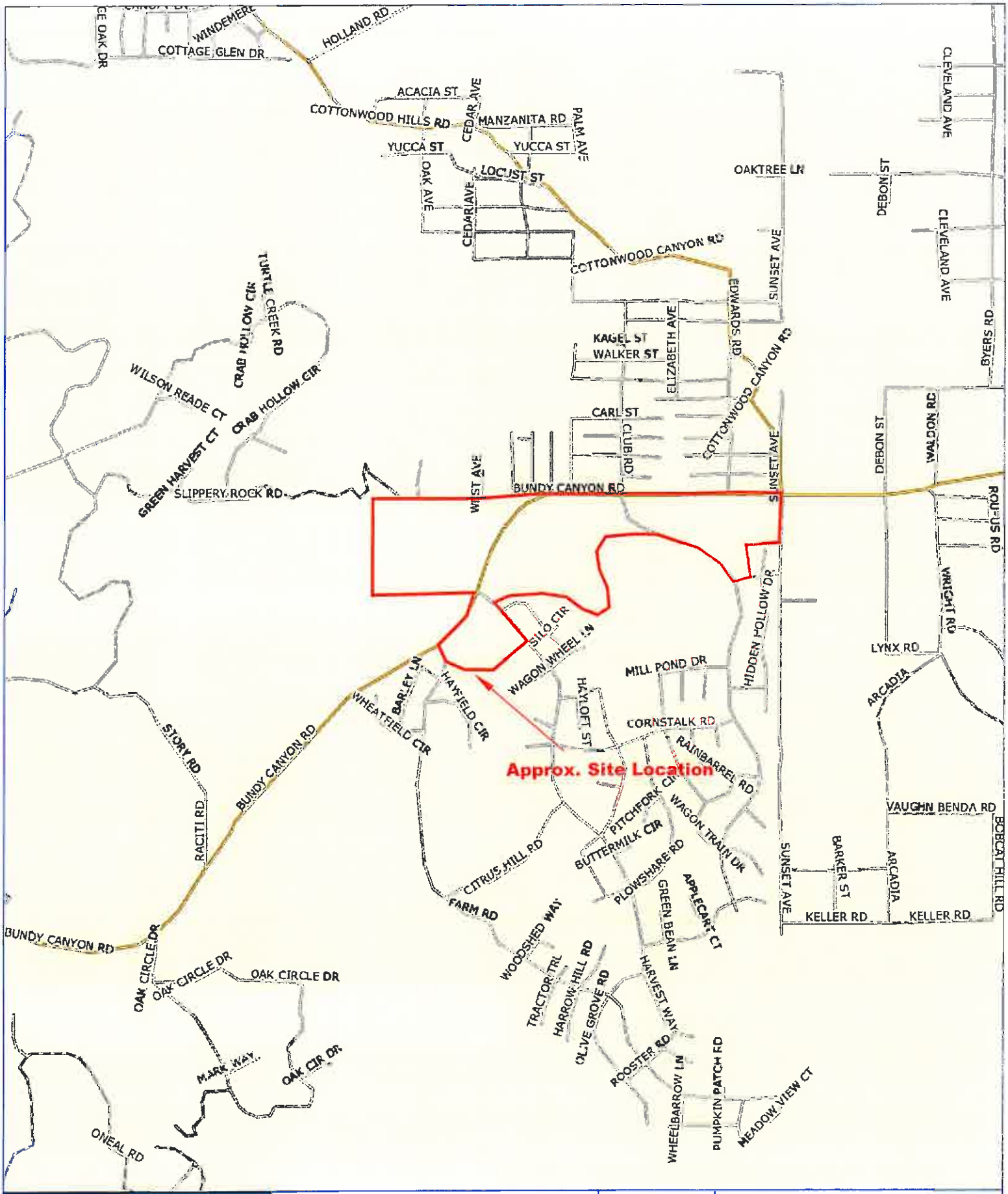

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FIGURE 1
SITE LOCATION MAP

Project Name	Oak Creek Canyon
Project No.	I11-2439-10
Geol./ Eng.	SER/LDC
Scale	NOT TO SCALE
Date	January 2012

1.2 *Location and Site Description*

The subject site is located along and adjacent to Bundy Canyon Road from east of Farm Road to west of Sunset Avenue in the City of Wildomar, Riverside County, California. The general location and configuration of the site is shown on the Site Location Map (Figure 1).

The topography of the site consists of moderate to steeply sloping terrain, with natural drainage channels in the canyon areas, and a general elevation of the property of 1700 to 1950 feet above mean sea level (msl). Local drainage generally flows towards the east to northeast.

Our site reconnaissance indicated the majority of the property has been disked, with canyon areas having a sparse cover of annual weeds and grasses, some small to large trees, and the higher relief areas covered in moderate to dense brush.

Several rock piles and outcrops were observed throughout the site. Areas of artificial fill (undocumented) were observed adjacent to the existing roadways and within a borrow area north of the existing residential tract, generally north of the intersection of Harvest Way East and Deep Well Drive. Additionally, localized areas of artificial fill (undocumented) were observed throughout the project site.

1.3 *Proposed Development and Grading*

The proposed development is expected to consist of 315 single-family residential lots consisting of wood-framed, one to two-story structures utilizing slab on ground construction with associated roadways, retaining walls, driveways, landscape areas, and utilities.

The digital plans provided by VSL Engineering were utilized in our investigation and form the base of our Geotechnical Map, Plates 1 through 3. Cut slopes are proposed at 1.5:1 to 2:1 (h:v) up to a maximum height of approximately 50 feet. Fill slopes are proposed at 2:1 (h:v) or flatter up to a maximum height of approximately 30 feet.

1.4 *Subsurface Investigation*

Our subsurface investigation was performed on December 7, 8, and 19, 2011 for the exploratory test pits. A backhoe and excavator were utilized to excavate twenty-four (24) test pits (TP-1 to TP-24), to depths ranging from approximately 5 to 18 feet below existing ground surface. The locations of the test pits were coordinated on the site in order to avoid potential underground conflicts. Prior to the subsurface work, an underground utilities clearance was obtained from Underground Service Alert of Southern California. The approximate locations of the test pits are shown on the Geotechnical Map, Plates 1 – 3. At the conclusion of the subsurface investigation, all the test pits were backfilled with native materials. Minor settlement of the backfill soils may occur over time.

During our subsurface investigation, representative bulk and relatively undisturbed samples were retained for laboratory testing. Laboratory testing was performed on representative soil samples and included moisture and density tests, maximum dry density and optimum moisture content, Expansion Index, direct shear, and corrosion. A discussion of the tests performed and a summary of the results are presented in Appendix D. The moisture and density test results are presented on the test pit logs in Appendix B.

2.0 GEOTECHNICAL CONDITIONS

2.1 Regional Geologic Setting

Regionally, the site is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by steep, elongated valleys that trend west to northwest. The northwest-trending topography is controlled by the Elsinore fault zone, which extends from the San Gabriel River Valley southeasterly to the United States/Mexico border. The Santa Ana Mountains lie along the western side of the Elsinore fault zone, while the Perris Block is located along the eastern side of the fault zone. The mountainous regions are underlain by Pre-Cretaceous, metasedimentary and metavolcanic rocks and Cretaceous plutonic rocks of the Southern California Batholith. Tertiary and Quaternary rocks are generally comprised of non-marine sediments consisting of sandstone, mudstones, conglomerates, and occasional volcanic units. A map of the regional geology is presented on the Regional Geologic Map, Figure 2.

2.2 Local Geology and Soil Conditions

The property is located in the City of Wildomar in Riverside County, California in an area of shallow alluvium underlain by gabbroic bedrock.

The earth materials on the site are comprised of Artificial Fill, Undocumented or previously placed by others and also undocumented, Topsoil (not a mapped unit), Quaternary Alluvium, Quaternary Older Alluvium, and Cretaceous Gabbro Bedrock. A general description of the soil and bedrock materials observed on the site is provided in the following paragraphs:

- Artificial Fill, Undocumented (map symbols: Afu and Afo): Undocumented artificial fill materials were encountered and mapped throughout the site. These materials are typically locally derived from the native materials and consist generally of brown silty sand with gravel and large rock (locally). These materials are generally inconsistent, poorly consolidated fills and road fills.

- Topsoil (not a mapped unit) Topsoil was encountered mantling the bedrock throughout the site. This unit generally consists of reddish brown to brown, dry to moist, loose, silty to clayey sands. Typically, the topsoil was noted with scattered rocks and rootlets.

- Quaternary Alluvium (map symbol: Qal) Quaternary alluvium was encountered in the drainage channels throughout the site. This alluvial unit consists predominately of brown to red brown silty sand to poorly graded sand. This unit is generally moist and loose to medium dense in condition.

- Quaternary Older Alluvium (map symbol: Qoal) Quaternary older alluvium consisted of dark brown to reddish brown, damp to moist, medium dense silty sand to clayey sand with scattered gravel and cobbles.

- Cretaceous Gabbro (map symbol: Kgb) Cretaceous age granitic rocks composed of a gabbro make up this unit. This rock unit was mapped generally throughout the site and underlies the other units at varying depths. These gabbroic rocks were observed to be light brown and reddish brown, fine to medium grained, unweathered to intensely weathered and in a soft to very hard state.

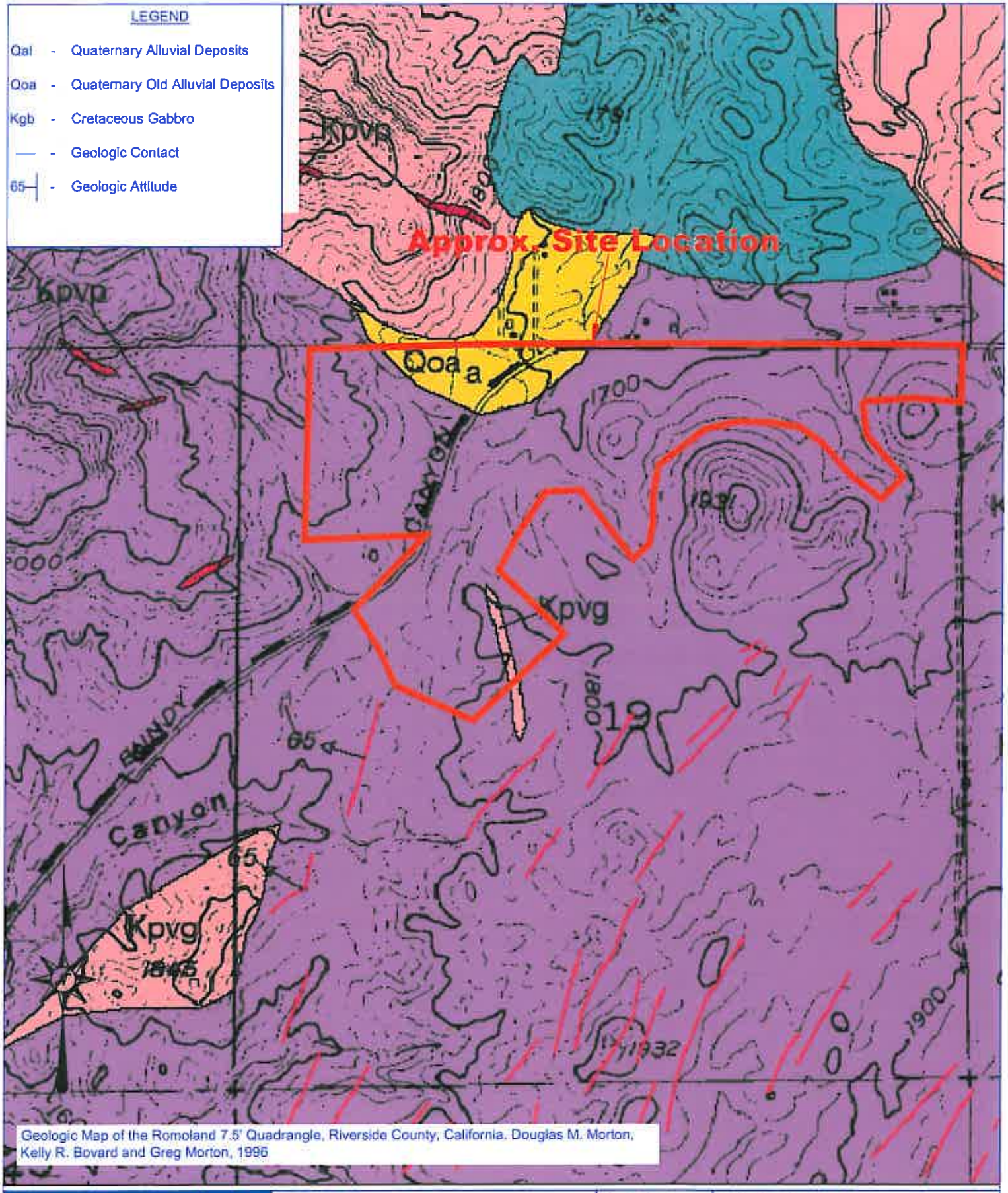

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FIGURE 2
REGIONAL GEOLOGIC MAP

Project Name	Oak Creek Canyon
Project No.	I112439-10
Geol./ Eng.	SER/LDC
Scale	NOT TO SCALE
Date	January 2012

2.3 *Landslides*

Review of geologic literature and geologic mapping did not indicate the presence of landslides on or adjacent to the site. The potential for the existence of landslides is considered insignificant since the site is underlain by hard to very hard gabbroic bedrock which is generally not susceptible to landslides.

2.4 *Groundwater*

Groundwater was not encountered within the test pits during our investigation. However, seasonal perched groundwater is expected to be encountered within the canyon areas where Quaternary alluvial deposits were noted. Therefore, a canyon subdrain system is recommended. A detailed discussion of subdrains is provided in Section 4.1.8.

2.5 *Surface Water*

Based on our review of site maps, surface water flow occurs within the canyons and swales within the site. Surface water runoff relative to project design is the purview of the project civil engineer and should be designed to be directed away from planned structures.

2.6 *Aerial Photograph Interpretation*

No strong geomorphic lineaments were interpreted to project through the site during our review of aerial photographs of the subject property. Geomorphic evidence of active landsliding was not observed on the site. A table summarizing the aerial photographs utilized in our geomorphic interpretation of lineaments and landslides is included in Appendix A - Aerial Photograph Interpretation Table.

2.7 *Faulting*

The subject site is not located within an Alquist-Priolo Earthquake Fault Zone and there are no known faults (active, potentially active, or inactive) onsite. The possibility of damage due to ground rupture is considered nil since active faults are not known to cross the site.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the southern California region, which may affect the site, include soil liquefaction and dynamic settlement. Other secondary seismic effects include shallow ground rupture, seiches, and tsunamis. In general, these secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependant on the distance between the site and causative fault and the onsite geology. The major active fault that could produce these secondary effects is the Elsinore-Temecula fault located approximately 4.5 miles from the site. Other faults within 20 miles to the subject site that may result in shaking to the site include the Elsinore-Glen Ivy Fault, San Jacinto-San Jacinto Valley, Chino-Central Avenue (Elsinore Strand), San Jacinto-San Bernardino, and San Jacinto-Anza faults among others. A risk assessment of these secondary effects is provided in the following sections.

2.7.1 *Liquefaction*

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose to medium dense, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction. Cohesive soils may be susceptible to liquefaction if they meet all of the following criteria that are commonly referred to as the "Chinese Criteria" (Seed et al, 1985):

- Clay content (defined as percent finer than 0.005 mm) less than 15 percent
- A liquid limit less than 35 percent
- An in-situ moisture content greater than 0.9 times the liquid limit

Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures.

Due to the remedial grading and dense nature of onsite Cretaceous Gabbro bedrock, the potential for liquefaction is considered nil; and liquefaction related damages are expected to be remote.

2.7.2 *Shallow Ground Rupture*

Ground rupture due to active faulting is not likely to occur on site due to the absence of known active fault traces. Cracking due to shaking from distant seismic events is not considered a significant hazard, although it is a possibility at any site.

2.7.3 *Tsunamis and Seiches*

Based on the elevation of the proposed development at the site with respect to sea level, the potential for a tsunami at the site is considered nil. In addition, the potential of seiche damages are considered nil due to a lack of nearby enclosed bodies of water.

2.8 *Seismic Design Parameters*

The design spectrum was developed based on the CBC, 2010. A site Coordinate of 33.6403° N, -117.2338° W was used to derive the seismic parameters presented below.

Table 1- Seismic Design Parameters

Seismic Soil Parameters (2010 CBC Section 1613)	
Site Class Definition (Table 1613.5.2)	D
Mapped Spectral Response Acceleration Parameter Ss (for 0.2 second) (Figure 1613.5(3))	1.50
Mapped Spectral Response Acceleration Parameter, S_1 (for 1.0 second) (Figure 1613.5(4))	0.60
Site Coefficient Fa (short period) (Table 1613.5.3(1))	1.00
Site Coefficient F_v (1-second period) (Table 1613.5.2(2))	1.50
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Acceleration Parameter S_{MS} (short period) (Eq. 16-37)	1.50
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Acceleration Parameter S_{M1} (1-second period) (Eq. 16-38)	0.90
Design Spectral Response Acceleration Parameter, S_{DS} (short period) (Eq. 16-39)	1.00
Design Spectral Response Acceleration Parameter, S_{D1} (1-second period) (Eq. 16-40)	0.60

2.9 Slope Stability

Preliminary slope stability analyses was performed for the highest cut slopes (approximately 50 feet) at a 1½:1 (h:v) gradient. The preliminary slope stability analyses indicated a minimum factor of safety of 1.5 under static condition and 1.1 under pseudostatic condition. A detailed description and the results of the slope stability analyses are presented in Appendix E.

2.10 Laboratory Testing

Laboratory testing of the onsite soils was performed on representative samples obtained from the test pits and included moisture and density tests, maximum dry density and optimum moisture, sieve analysis, expansion index, direct shear, sulfate and chloride content, resistivity, and pH. A discussion of the tests performed and a summary of the results are presented in Appendix D. The moisture and density test results are presented on the test pit logs in Appendix B. Many of these results should be confirmed at the completion of site grading.

2.11 Percolation Test Results

The preliminary percolation rates which were recorded in Percolation Test Holes 1 through 7 (see Geotechnical Map), has been provided below in Table 2 below:

Table 2- Percolation Test Results

Percolation Test Hole #	*Basin #*	*Percolation Rate minutes/inch (mpi)*	*Infiltration Rate* (inches/hour)*
P-1	LOT S	16.0	0.86
P-2	LOT O	15.0	0.92
P-3	LOT F	9.1	1.74
P-4	W.Q.B.	48.0	0.26
P-5	LOT K	16.6	0.82
P-6	LOT J	16.6	0.82
P-7	LOT A	14.5	0.96

Converted Utilizing Porchet Method

3.0 CONCLUSIONS

Based on the results of our geotechnical investigation, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided the conclusions and recommendations contained in this report are considered and incorporated into the project design process. The following is a summary of the primary geotechnical factors determined from our geotechnical investigation.

- Based on our subsurface exploration and review of pertinent geologic maps and reports, the site is underlain by Cretaceous Gabbro bedrock.
- The site is not located within a State of California Earthquake fault zone.
- The existing undocumented artificial fills, alluvium, and portions of the old alluvium are not suitable to support the proposed structures.
- The potential for liquefaction on site is nil.
- Active or potentially active faults are not known to exist on the site.
- There are no known landslides impacting the site.
- Laboratory test results of the onsite soils indicated that non-expansive and expansive soils are present onsite. Additional laboratory testing indicated onsite soil has a moderate corrosion potential to buried metals and negligible potential for soluble sulfate attack on normal concrete.
- Laboratory test results indicated that the onsite soils are moderately corrosive to buried metals.
- All existing undocumented artificial fill, topsoil, Quaternary alluvium, Quaternary Old Alluvium, and unsuitable upper intensely weathered Cretaceous Gabbro are prone to potential settlement and should be overexcavated to underlying competent Cretaceous Gabbro, within areas of proposed structures, fill or improvements. Anticipated removal depths range from approximately 2 to 14 feet below the existing surface.
- The existing onsite soil appears, from a geotechnical perspective, to be suitable material for use as fill, provided it is relatively free from rocks (larger than 8 inches in maximum dimension), construction debris, and organic material. It is anticipated that the onsite soil may be excavated with conventional heavy-duty construction equipment. However, localized areas of hard bedrock may be encountered during grading of the site.

4.0 RECOMMENDATIONS

4.1 Site Earthwork

We anticipate that earthwork at the site will consist of site preparation and remedial grading followed by construction of slab-on-grade type foundations, retaining walls, underground utilities, asphalt paving, etc. All earthwork and grading should be performed in accordance with all applicable requirements of the appropriate reviewing agency, Grading Manual of Riverside County, City of Wildomar Grading Ordinance, the provisions of the 2010 California Building Code (CBC), and the General Earthwork and Grading Specifications for Rough Grading included in Appendix G. In case of conflict, the following recommendations shall supersede those included as part of Appendix G.

4.1.1 Site Preparation

Prior to grading of areas to receive structural fill or engineered structures, the areas should be cleared of surface obstructions, any existing debris, potentially compressible material (such as undocumented fill soils, or unsuitable alluvium/older alluvium) and stripped of vegetation. Vegetation and debris should be removed and properly disposed of offsite. All debris from the proposed demolition activities at the site should be removed and properly disposed of offsite. Holes resulting from the removal of buried obstructions or utilities, which extend below finished site grades, should be replaced with suitable compacted fill material. Areas to receive fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition, and recompacted to at least 90 percent relative compaction (based on American Standard of Testing and Materials [ASTM] Test Method D1557).

4.1.2 Removal and Recompaction

The upper portion of the site is underlain by potentially compressible soils (Undocumented artificial fill, alluvium, and older alluvium), which may settle under the surcharge of fill and/or foundation loads. Compressible materials not removed by the planned grading should be excavated to competent material and replaced with compacted fill soils. In bedrock areas, all topsoil and upper weathered bedrock should be removed and recompacted. The removal depths are noted on the Geotechnical Map, Plates 1-3. Localized, deeper removals should be anticipated where deemed necessary by the geotechnical consultant based on observations during grading. The proposed grading should provide at least a 1:1 fill prism extending outwards below the proposed structures. Additionally, where utilities are proposed, the proposed street areas should be overexcavated to approximately 1-foot below the deepest utility. Upon receipt of the proposed underground improvement plans, LGC should review and provide limits of proposed over-excavation for utilities. Localized or perched groundwater is anticipated to be encountered during site grading.

From a geotechnical perspective, material that is removed may be placed as fill provided the material is relatively free from rocks (greater than 6 to 12 inches in maximum dimension), organic material and construction debris, is moisture-conditioned or dried (as needed) to obtain above-optimum moisture content, and then recompacted prior to additional fill placement or construction.

4.1.3 *Import Soils for Grading*

In the event import soils are needed to achieve final design grades, all potential import materials should be free of deleterious/oversize materials, non-expansive, and approved by the project geotechnical consultant prior to commencement of delivery onsite.

4.1.4 *Excavation in Bedrock*

Based on the results of our seismic refraction survey (Appendix F) and review of the referenced test pits, the soil materials and near surface bedrock may be readily excavated with conventional earth moving equipment (in first-class working condition) within the weathered bedrock areas. At depth non-weathered bedrock was noted within the test pits advanced onsite. The non-weathered bedrock areas may require heavy ripping and possibly blasting. Upon final design plans a geotechnical scoping map should be prepared to identify these areas for determination of hardness for heavy ripping and/or blasting. Should blasting be required, LGC should perform a pre/post-blast survey of the subject area and confirm the methodology by the blast contractor.

4.1.5 *Cut/Fill Transition and Fill Differentials*

To mitigate distress to structures related to the potential adverse effects of excessive differential settlement, cut/fill transitions should be eliminated from all building areas where the depth of fill placed within the "fill" portion exceeds proposed footing depths. The entire structure should be founded on a uniform bearing material. This should be accomplished by overexcavating the "cut" portion and replacing the excavated materials as properly compacted fill. Recommended depths of overexcavation are provided in the following Table 3:

TABLE 3
Cut and Fill Differential Thickness

[illegible] FILL ("fill" portion)	DEPTH OF OVEREXCAVATION ("cut" portion)
Up to 5 feet	Equal Depth
5 to 10 feet	5 feet
Greater than 10 feet	One-third the thickness of fill placed on the "fill" portion (20 feet maximum)

Overexcavation of the "cut" portion should extend beyond the perimeter building lines a horizontal distance equal to the depth of overexcavation or to a minimum distance of 5 feet, whichever is greater.

4.1.6 *Shrinkage, Bulkage and Subsidence*

Volumetric changes in earth quantities will occur when excavated onsite earth materials are replaced as properly compacted fill. The following (Table 4) is an estimate of shrinkage and bulking factors for the various geologic units found onsite. These estimates are based on in-place densities of the various materials and on the estimated average degree of relative compaction achieved during grading.

TABLE 4
Shrinkage and Bulkage

GEOLOGIC UNIT	SHRINKAGE PERCENT
Artificial Fill, Undocumented	15 to 20
Quaternary Alluvium	15 to 20
Quaternary Old Alluvium	10 to 15
Cretaceous Gabbro	5 to 10 (bulking)

Subsidence from scarification and recompaction of exposed bottom surfaces in removal areas to receive fill is expected to vary from negligible to approximately 0.05-foot.

The above estimates of shrinkage and subsidence are intended as an aid for project engineers in determining earthwork quantities. **However, these estimates should be used with some caution since they are not absolute values.** These are preliminary rough estimates which may vary with depth of removal, stripping losses, field conditions at the time of grading, etc. (Handling losses, and reduction in volume due to removal of oversized material, are not included in the estimates).

4.1.7 Temporary Stability of Removal Excavations

Due to the recommended depth of remedial grading (up to approximately 14 feet), the temporary stability of the excavations along the perimeter of the site needs to be considered. All excavations for the proposed development should be performed in accordance with current OSHA (Occupational Safety and Health Agency) regulations and those of other regulatory agencies, as appropriate.

Temporary excavations maybe cut vertically up to five feet. Excavations over five feet should be slot-cut, shored, or cut to a 1:1 (H:V) (horizontal: vertical) slope gradient. Surface water should be diverted away from the exposed cut, and not be allowed to pond on top of the excavations. Temporary cuts should not be left open for an extended period of time.

4.1.8 Excavation Characteristics

Based on the results of our exploration, the near surface soil materials, will be readily excavated with conventional earth moving equipment. Three (3) seismic refraction survey lines were performed within the subject site. Seismic Lines SL-1 and Sl-2 both being 125-feet long and Seismic Line SL-3 at 200-feet in length targeted a depth of evaluating the upper 40 to 65± feet. In general, the upper 40 to 65± feet of the subject property can be divided into three (3) major layers. The average weighted velocities of the various layers ranged from 1,273 to 4,637 feet per second (fps). These velocities are typical for the near surface weathered zone commonly found in granitic rocks in the Southern California region.

No major excavating difficulties are expected within V1, the uppermost, low velocity layer. The second layer V2 is believed to consist of highly weathered granitic bedrock material and should also excavate with no major difficulty, assuming appropriate first-class working equipment for the proposed type of excavation. The third layer V3 is believed to consist of moderately-weathered bedrock. Hard excavating area consisting of local higher velocity boulders and/or dikes would most likely be encountered. During excavation, these materials may consist of isolated large boulders, presumably present within this weathered layer and could produce difficult conditions locally. Placement of infrastructures in this material may also be difficult, localized blasting in the second layer cannot be completely ruled out, due to the presence of any encountered fresh, buried boulders or dikes. It should be noted that the rippability described above **may not** correlate well with different excavating equipment, (i.e., trenching equipment). For more details see the enclosed seismic refraction survey report in Appendix F.

4.1.9 Subdrains

Back-cut subdrains should be installed for all stability fills and canyon areas in order to mitigate/reduce potential for perched and seepage conditions toward slopes. In general, subdrains should be placed along the heel of the backcut and be projected towards the toe of the slope, to drain positively at 2% or 2-feet above the toe of the proposed design slope in accordance with the specifications produced in Appendix G, General Earthwork and Grading Specifications.

It is recommended upon completion of cleanouts to competent underlying granitic bedrock for canyons and construction of stability fills and fill-over-cut slopes, subdrain systems should be installed. The canyon subdrain systems should be installed along the axes of all major canyons and tributary areas with a minimum of 10 feet of cover. For stability fills and fill-over-cut slopes the subdrain systems should be roughly parallel with the backcut and outlets should be provided at least every 100 feet. Actual subdrain locations should be identified once final grading plans are completed. In general, these subdrain systems include 6- to 12- inch diameter schedule 40 perforated PVC pipe surrounded by 9 cubic feet per linear foot of ¾ to 1½ inch crushed rock wrapped in geofabric (Mirafi 140N or equivalent). All subdrain systems should be constructed per the specific guidelines provided within the General Earthwork and Grading Specifications (Appendix G). The location of all subdrain systems should be surveyed by the project civil engineer.

4.1.10 Fill Placement and Compaction

From a geotechnical perspective, the onsite soils are generally suitable for use as compacted fill, provided they are screened of rocks greater than 6 inches in maximum dimension, organic materials and construction debris. Areas prepared to receive structural fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to at least optimum-moisture content, and recompacted to at least 90 percent relative compaction (based on ASTM Test Method D1557). All fill should be compacted to the criteria set forth in Table 5 below:

TABLE 5
Fill Depth and Compaction

Depth of Fill	*Relative Compaction*
Finish Grade to 30' below ground surface	*90%*
30' to 50' below ground surface	*93%*

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts generally not exceeding 8 inches in compacted thickness. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant.

In general, oversized material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction. Oversize material may be incorporated into design fills in accordance with our standard grading details.

4.1.11 Rock Disposal

Rocks at various sizes are expected to be encountered during grading. Rock materials with maximum dimension less than 8 inches may be used along with the fill materials. Rock materials greater than 8 inches and less than 12 inches in size may be placed at least 5 feet below the finish grade. Rock materials greater than 12 inches (oversize rocks) will require special handling, such as rock blanket fills, windrows, offsite disposal, or stockpiled onsite and crushed for future use. Where oversize rock is buried in engineered fills, the rock may be placed individually or windrowed in a manner to avoid nesting and then completely covered with granular materials. The granular materials should be watered and/or jetted around the rock and then rolled to ensure the granular fines fill all voids. A typical rock disposal detail is presented in the General Earthwork and Grading Specifications (Appendix G).

Rock blanket fills may also be utilized to place oversize rock in engineered fills. Rock fairly uniform in size (24 to 36 inches in maximum dimension) may be placed in rock blankets (maximum thickness 36 inches) with a granular matrix flooded around the rock to fill the voids between rocks. Once a 36 inch rock blanket is completed, a random fill (containing no oversize rock) with a thickness of 18 to 24 inches may be placed above the rock blanket, prior to placement of another rock blanket. Fill soils should be placed in thin lifts, restricted to 8 to 10 inches in thickness, watered to or near optimum moisture content and mechanically compacted to a minimum of 90 percent relative compaction. Rock windrows and blankets should be placed at least 10 feet below pad grade or 15 feet from slope face. Oversize rock disposal should be performed under the continuous observation and testing by the geotechnical consultant.

4.1.12 Additional Slope Consideration

Our general recommendations for the construction of cut slopes, fill slopes, fill-over-cut slopes, slopes toeing into alluvial canyons, and stabilization fill details are presented in Appendix G. We also have provided additional recommendations for the following conditions.

4.1.12.1 Cut Slopes

If slopes expose highly weathered bedrock or any adverse conditions, a stabilization fill is recommended. Slope conditions should be evaluated during construction to determine the need for a stabilization fill. Stabilization fills should be constructed in accordance with the detail presented in Appendix G.

4.1.12.2 Fill Slopes

According to the grading plan, fill slopes are proposed within the western and central portions of the project at a maximum inclination of 2:1 (h:v). All remedial earthwork should extend at a minimum of a 1:1 (h:v) projection from the toe of the design fill slopes into a competent bottom. Typical construction detail is presented in Appendix G. The minimum keyway dimensions and the anticipated removal depth at each key location are shown on the Geotechnical Map, Plate 1 - Plate 3.

4.1.12.3 Fill-Over-Cut Slopes

Fill-over-cut slopes are proposed throughout the site. A typical construction detail for a fill-over-cut slope is presented in Appendix G. The need for a stabilization fill in the cut portion should be evaluated during grading.

4.1.12.4 Slopes Toeing into Alluvial Canyons

All fill slopes located adjacent to a drainage area, open space, or canyon cleanout region should be considered for this condition. Remedial grading for the proposed slopes should extend at a minimum of a 1:1 (h:v) projection from the toe of the proposed slopes. Backcuts within the alluvial channel should be laid back no steeper than 1:1 (h:v), provided all safety considerations are examined throughout the backcut for adverse conditions.

4.1.13 Deep Fill Settlement Monitoring

Fills in excess of 30 feet will require the placement of settlement monuments. Accordingly, fills in excess of 50 feet will require settlement plates. Monuments and plates will be required at the base and surface of the deep fills in order to monitor post construction settlement of alluvial materials and consolidation of fill materials. A typical settlement monument and plate is presented in Appendix G.

Elevation readings of survey monuments should be made weekly for the first four (4) weeks, bi-weekly for eight (8) weeks, and then monthly until observed settlement has reached tolerable limits. Construction timing in areas of deep fill will be evaluated on a continuous basis, as survey data should be collected and distributed to the Geotechnical Engineer for review.

4.1.14 Trench Backfill and Compaction

The onsite soils may generally be suitable as trench backfill provided they are screened of rocks and other material over 6 inches in diameter and organic matter. Trench backfill should be compacted in uniform lifts (generally not exceeding 8 inches in compacted thickness) by mechanical means to at least 90 percent relative compaction (per ASTM Test Method D1557).

If trenches are shallow and the use of conventional equipment may result in damage to the utilities; clean sand, having sand equivalent (SE) of 30 or greater, should be used to bed and shade the utilities. Sand backfill should be densified. The densification may be accomplished by jetting or flooding and then tamping to ensure adequate compaction. A representative from LGC should observe, probe, and test the backfill to verify compliance with the project specifications.

4.1.15 Cal/OSHA Soil Classification

Based on the soil types encountered during our preliminary investigation, onsite soils should be generally classified as Type B. LGC does not limit the soil classification to one type as soil may locally change over short distances. Furthermore, this classification should not preclude a Cal/OSHA "competent person" from determining soil type on a case-by-case basis.

4.2 Foundation Selection

4.2.1 General

Preliminary recommendations for conventional foundation design and construction are presented herein. When the final structural loads for the proposed structures are known they should be provided to our office for the recommendations presented herein should be verified.

The information and recommendations presented in this section are not meant to supersede design by the project structural engineer or civil engineer specializing in the structural design nor a corrosion consultant.

4.2.2 Conventional Foundations

Exterior continuous footings may be founded at 12-inch and 18-inch minimum depth for single and two-story construction, respectively. Interior continuous footings for both one- and two-story construction may be founded at a minimum depth of 12 inches below the lowest adjacent grade. All continuous footings should have a minimum width of 15 inches.

Shallow foundations may be designed for a maximum allowable bearing capacity of 1,500 lb/ft^2. The above value shall be consistent with continuous footings 15 inches wide and 18 inches deep into certified compacted fill. Spread or isolated (pad) footings should be designed with a minimum of 24 inches wide and 24 inches deep into certified compacted fill. A factor of safety greater than 3 was used in evaluating the above bearing capacity values. The bearing capacities should be re-evaluated when loads and footing sizes have been finalized.

Lateral forces on footings may be resisted by passive earth resistance and friction at the bottom of the footing. Foundations may be designed for a coefficient of friction of 0.35, and a passive earth pressure of 250 lb/ft^2/ft. The passive earth pressure incorporates a factor of safety of about 1.5.

All footing excavations should be cut square and level, and should be free of sloughed materials. Subgrade soils should be pre-moistened to a depth of approximately 12 inches to at or near optimum water content, based upon our laboratory determined very low expansion potential. Final expansion potential determination will be determined upon the completion of grading.

4.2.3 Building Floor Slabs

We recommend a minimum floor slab thickness of 4 inches, reinforced with No. 3 bars spaced a maximum of 18 inches on center, both ways. All slab reinforcement should be supported on concrete chairs or bricks to ensure the desired placement near mid-depth.

Interior floor slabs with moisture sensitive floor coverings should be underlain by a 15-mil thick moisture/vapor barrier to help reduce the upward migration of moisture from the underlying subgrade soils. The moisture/vapor barrier product used should meet the performance standards of an ASTM E 1745 Class A material, and be properly installed in accordance with ACI publication 302. It is the responsibility of the contractor to ensure that the moisture/vapor barrier systems are placed in accordance with the project plans and specifications, and that the moisture/vapor retarder materials are free of tears and punctures prior to concrete placement. Additional moisture reduction and/or prevention measures may be needed, depending on the performance requirements of future interior floor coverings.

Sand layer requirements are the purview of the structural engineer, and should be provided in accordance with ACI Publication 302 "Guide for Concrete Floor and Slab Construction". As a guide 2-inches of sand placed above and below the moisture vapor barrier can be utilized as a guide. Ultimately, the design of the moisture retarder system and recommendations for concrete placement and curing are the purview of the foundation engineer, in consideration of the project requirements provided by the architect and developer.

Prior to placing concrete, the subgrade soils below all floor slabs should be pre-watered to achieve a water content that is at least equal or slightly greater than optimum water content in the upper 12 inches.

4.3 *Lateral Earth Pressures and Retaining Wall Design Considerations*

The following are lateral earth pressures for retaining walls. Due to the very low expansive nature of onsite soils (EI less than 20), we recommend the use of these granular very low expansive soils for retaining wall backfill. If imported soils are selected as a use for retaining wall backfill, we recommend the import of low expansive soils. The recommended lateral pressures for approved import soils (Sand Equivalency greater than 30) for level or sloping backfill are presented on Table 6.

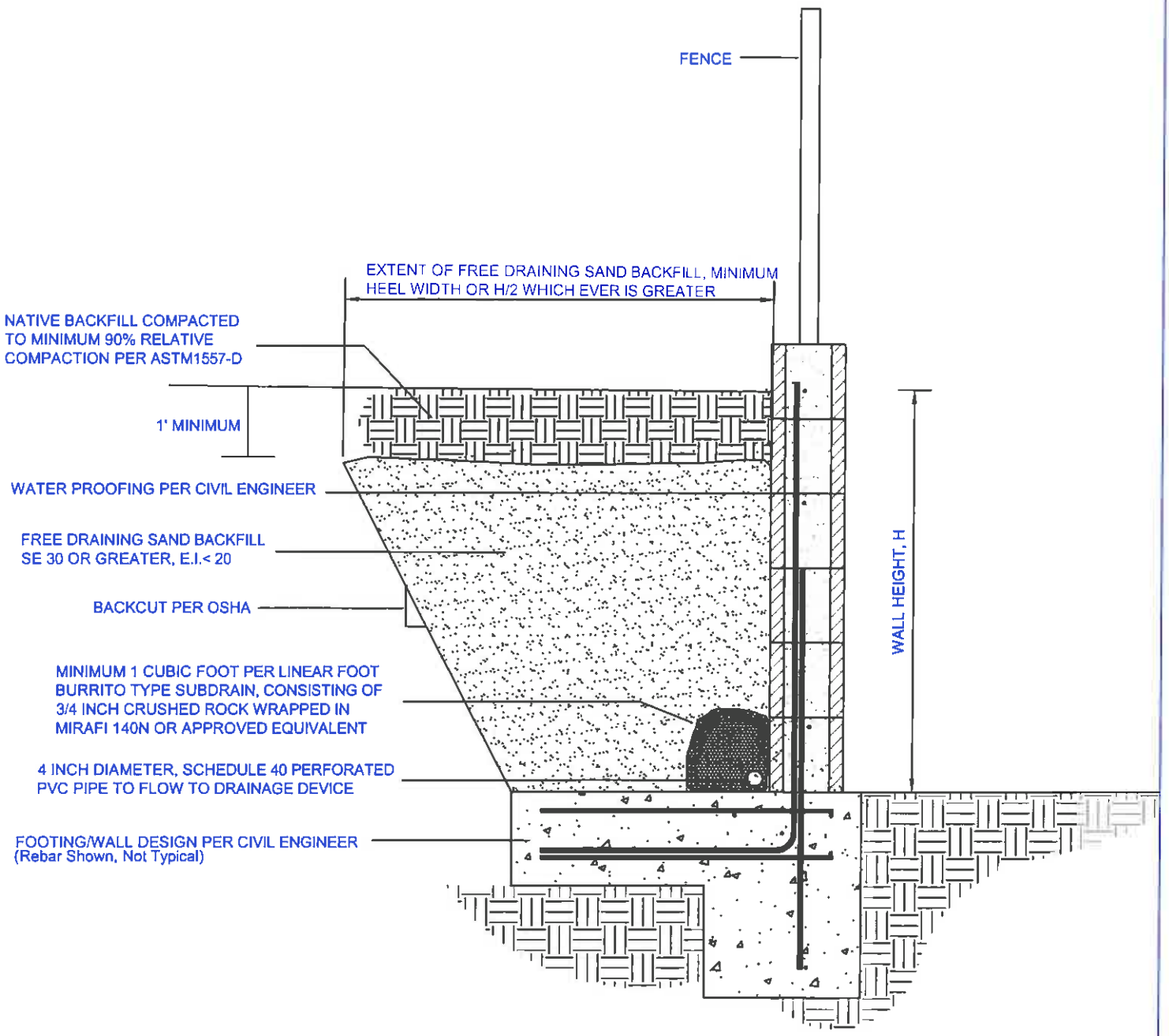
TABLE 6
Lateral Earth Pressures

CONDITIONS	EQUIVALENT FLUID WEIGHT (pcf)	
	Level Backfill	2:1 Backfill Sloping Upwards
Active	40	55
At-Rest	60	73
Passive	250	—

Embedded structural walls should be designed for lateral earth pressures exerted on them. The magnitude of these pressures depends on the amount of deformation that the wall can yield under load. If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at-rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance. The passive earth pressure values assumes sufficient slope setback (see previous section).

The equivalent fluid pressure values assume free-draining conditions. The backfill soils (having an expansion index less than 30 per U.B.C. 18-I-B) should be compacted to at least 90 percent relative compaction (based on ASTM Test Methods D2922 and D3017). The walls should be constructed and backfilled as soon as possible after backcut excavation. Prolonged exposure of backcut slopes may result in some localized slope instability. If conditions other than those assumed above are anticipated, the equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical engineer.

Surcharge loading effects from the adjacent structures should be evaluated by the geotechnical and structural engineers. All retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. The outlet pipe should be sloped to drain to a suitable outlet. Typical wall drainage design is illustrated on Figure 3. It should be noted that the recommended subdrain does not provide protection against seepage through the face of the wall and/or efflorescence. Efflorescence is generally a white crystalline powder (discoloration) that results when water, which contains soluble salts, migrates over a period of time through the face of a retaining wall and evaporates. If such seepage or efflorescence is undesirable, retaining walls should be waterproofed to reduce this potential.



For Informational Purposes Only

LGC INLAND

FIGURE 3
RETAINING WALL DETAIL

Project Name	Oak Creek Canyon
Project No.	I11-2439-10
Geol./ Eng.	SER/LDC
Scale	NOT TO SCALE
Date	January 2012

For sliding resistance, the friction coefficient of 0.35 may be used at the concrete and soil interface. Wall footings should be designed in accordance with structural considerations. The passive resistance value may be increased by one-third when considering loads of short duration such as wind or seismic loads.

Foundations for retaining walls in properly compacted fill should be embedded at least 24 inches below lowest adjacent grade. At this depth, an allowable bearing capacity of 2,000 psf may be assumed.

All excavations should be made in accordance with Cal/OSHA. Excavation safety is the sole responsibility of the contractor.

4.4 Structural Setbacks

Structural setbacks, in addition to those required per the UBC, are not required due to geologic or geotechnical conditions within the site. Building setbacks from slopes, property lines, etc. should conform to 2010 CBC requirements.

4.5 Pavement Recommendations

Based on an assumed R-value of 30 and Traffic Indices (TI's) of 5.0, 6.5, 7.0, 8.0, 8.5, 9.0 and 10.0, we recommend the following minimum pavement sections (Table 7). These recommendations should be confirmed by additional testing at the completion of grading. Final pavement sections should be confirmed by the project civil engineer based upon the project traffic index, the City of Wildomar, and the County of Riverside minimum requirements.

TABLE 7
Recommended Minimum Pavement Sections

	Access Road or Minor Street	*Collector or Industrial Cul-de-Sac*	*Industrial Collector or Street/ Secondary Highway*	*Secondary Arterial*	*Major Arterial*	*Urban Arterial*	*Expressway*
Assumed Traffic Index	5.0	6.5	7.0	8.0	8.5	9.0	10.0
Design R-value	30	30	30	30	30	30	30
AC Thickness (inches)	3.0	3.5	4.25	4.75	5.25	5.5	6.25
AB Thickness (inches)	6.0	10.0	9.0	11.0	12.0	13.0	15.0

The aggregate base material should conform to the specifications for Class 2 Aggregate Base (Caltrans) or Crushed Aggregate Base (Standard Specifications for Public Works Construction). The base material should be compacted to achieve a minimum relative compaction of 95 percent. The subgrade should achieve a minimum relative compaction of 95 percent through the upper 12 inches. Base and subgrade materials should be moisture-conditioned to a relatively uniform moisture content at or slightly over optimum. The R-value should be obtained during the concluding stages of grading, and the final pavement section will then be designed accordingly. TI's for the streets within the subject project site should be obtained from the City, County or calculated by a traffic engineer. The above recommendations are considered applicable if complete removals of the compressible materials are performed in the pavement areas.

4.6 Corrosivity to Concrete and Metal

The National Association of Corrosion Engineers (NACE) defines corrosion as "a deterioration of a substance or its properties because of a reaction with its environment". From a geotechnical viewpoint, the "environment" is the prevailing foundation soils and the "substances" are the reinforced concrete foundations or various buried metallic elements such as rebars, piles, pipes, etc., which are in direct contact with or within close vicinity of the foundation soil.

In general, soil environments that are detrimental to concrete have high concentrations of soluble sulfates and/or pH values of less than 5.5. ACI 318R-05 Table 4.3.1, provides specific guidelines for the concrete mix design when the soluble sulfate content of the soils exceeds 0.1 percent by weight or 1,000 ppm. The minimum amount of chloride ions in the soil environment that are corrosive to steel, either in the form of reinforcement protected by concrete cover, or plain steel substructures such as steel pipes or piles, is 500 ppm per California Test 532.

Based on testing performed during this investigation within the project site, the onsite soils are classified as having a negligible sulfate exposure condition in accordance with Table 19-A-4 of U.B.C., 1997. Therefore, concrete in contact with onsite soils should be designed in accordance with Table 19-A-4 for the negligible category. It is also our opinion that onsite soils should be considered moderately corrosive to buried metals.

Despite the minimum recommendation above, LGC is not a corrosion-engineering firm. Therefore, we recommend that you consult with a competent corrosion engineer and conduct additional testing (if required) to evaluate the actual corrosion potential of the site and to provide recommendations to reduce the corrosion potential with respect to the proposed improvements. The recommendations of the corrosion engineer may supercede the above requirements.

4.7 Nonstructural Concrete Flatwork

Concrete flatwork (such as walkways, bicycle trails, etc.) has a high potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete should be designed in accordance with the minimum guidelines outlined in Table 8. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints, but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

TABLE 8
Nonstructural Concrete Flatwork for Very Low to Low Expansion Potential

	PRIVATE SIDEWALKS	*PRIVATE DRIVES*	*PATIOS/ ENTRYWAYS*	*CITY SIDEWALK CURB AND GUTTERS*
Minimum Thickness (in.)	4 (nominal)	4 (full)	4 (full)	City/Agency Standard
Presaturation	Presoak to at least 12 inches at optimum moisture content	Presoak to at least 12 inches at optimum moisture content	Presoak to at least 12 inches at optimum moisture content	City/Agency Standard
Reinforcement	—	No. 3 at 24 inches on centers	No. 3 at 24 inches on centers	City/Agency Standard
Thickened Edge (in.)	—	8 x 8	—	City/Agency Standard
Crack Control Joints	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard

4.8 Control of Surface Water and Drainage Control

Positive drainage of surface water away from structures is very important. No water should be allowed to pond adjacent to buildings. Positive drainage may be accomplished by providing drainage away from buildings at a gradient of at least 2 percent for a distance of at least 5 feet, and further maintained by a swale or drainage path at a gradient of at least 1 percent. Where necessary, drainage paths may be shortened by use of area drains and collector pipes.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Over watering must be avoided.

4.9 Slope Landscaping and Maintenance

Adequate slope and pad drainage facilities are essential in the design of the finish grading for the subject site. The overall stability of graded slopes should not be adversely affected provided all drainage provisions are properly constructed and maintained thereafter and provided all engineered slopes are landscaped with a deep rooted, drought tolerant and maintenance free plant species, as recommended by the project landscape architect.

4.10 Onsite Stormwater Detention System Recommendations

Results of the preliminary percolation tests indicate that the near surface existing soils in the areas tested exhibit acceptable percolation rates for the construction of detention systems for onsite disposal of storm water. However, additional percolation testing may be required if locations change and during post grading where final design elevations are exposed for verification.

4.11 Future Plan Reviews and Construction Observation and Testing

This report presents a geological and geotechnical review of the 40-scale (Tentative Tract Map). Throughout the design of the project, geological and geotechnical issues may become apparent and should be considered in the design, feasibility, and construction of the project. Future plan reviews are necessary to ensure that recommendations and conclusions from LGC Inland, Inc. feasibility and preliminary studies have been incorporated into the plans. Modifications to the plan may arise from our review therefore our review should be performed as soon as practical. Such reviews should include, but are not limited to:

- Rough Grading Plans
- Bridge Plans
- Foundation Plans
- Retaining Wall Plans
- Storm Drain/Sewer/Water Plans
- Proposed School Sites, Commercial Components, and Recreational Facilities.

Plans should be forwarded to the project geotechnical engineer and/or engineering geologist for review and comments, as deemed necessary.

The recommendations provided in this report are based on limited subsurface observations and geotechnical analysis. The interpolated subsurface conditions should be checked in the field during construction by a representative of LGC.

Construction observation and testing should also be performed by the geotechnical consultant during future grading, excavations, backfill of utility trenches, preparation of pavement subgrade and placement of aggregate base, foundation or retaining wall construction or when an unusual soil condition is encountered at the site. Grading plans, foundation plans, and final project drawings should be reviewed by this office prior to construction.

5.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and submitted for laboratory testing, the observations made and the in-situ field testing performed are believed representative of the entire project; however, soil and geologic conditions revealed by excavation may be different than our preliminary findings. If this occurs, the changed conditions must be evaluated by the project soils engineer and geologist and design(s) adjusted as required or alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

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APPENDIX A

REFERENCES

APPENDIX A

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VSL Engineering, 2012, Preliminary Site Plan, 80-scale, 3-sheets.

Aerial Photograph Interpretation Table

DATE	FLIGHT NUMBER	SCALE
3-1-2011	Google Earth	n/a
3-2-99	C135-40-184, 185	1" = 2000'
9-11-97	C116-40-197, 198	1" = 2000'
10-4-95	135, 136	1" = 2000'
1-30-95	C104-40-93, 94	1" = 2000'
5-14-93	091-8-32, 33	1" = 3000'
2-15-77	RIV 7-07, 08	1" = 4150'
1-28-62	129	1" = 2000'

APPENDIX B

FIELD EXPLORATION

APPENDIX B

Field Exploration

B-1 ***General***

A reconnaissance of the site was carried out by LGC's personnel. The locations of the exploratory excavations were chosen to obtain subsurface information needed to achieve the objective for this investigation.

A visual survey was conducted to verify that the proposed excavations would not encounter any subsurface utility lines. No underground lines were encountered during the field exploratory program.

B-2 ***Excavation, Drilling and Sampling***

The subsurface exploration program for this project was performed on December 7, 8, and 19, 2011, and consisted of the excavation of twenty-four (24) test pits, TP-1 through TP-24 to a maximum depth of 17 feet below the existing grade. The approximate locations of the test pits are shown on the Geotechnical Map, Plates 1 through 3.

Test Pits TP-1 through TP-21 were excavated using a Cat 330C Excavator with a 30-inch bucket. Test Pits TP-22 through TP-24 were excavated using a tractor-mounted backhoe with a 24 inch wide bucket. The test pits were excavated and sampled for laboratory testing.

Bulk samples also were collected during the course of excavating by taking spoils. The bulk samples were selected for classification and testing purposes and may represent a mixture of soils within the noted depths. Recovered samples were bagged and returned to the laboratory for further classification and testing.

B-3 ***Miscellaneous***

The test pit logs describe the earth materials encountered, sampling method used, and field and laboratory tests performed. The logs also show the boring number, date of completion, and the name of the logger and drilling subcontractor. A geologist logged the test pits in accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2488-93. The boundaries between soil types shown on the logs are approximate and the transition between different soil layers may be gradual. The logs of the test pits are presented on the following pages.

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 1
Project Number: I11-2439-10	Elevation: 1740	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-1.5': Clayey SAND, reddish brown, moist, loose to medium dense, slightly porous, abundant rootlets and krotovina **CRETACEOUS GABBRO** B. 1.5-6.5': GABBRO; brown, dry to damp, hard, fine to medium grained, becomes less weathered with depth, massive	Kgb	SC	Bag-1 0-1.5'		

GRAPHICAL REPRESENTATION: NORTH WALL	SCALE 1" = 5'	SURFACE SLOPE 4° S	TREND E-W

Total Depth: 6.5'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 2	
Project Number: I11-2439-10	Elevation:	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-7-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
1. Joint E-W 55° N 2. Joint 320° 53° N	**TOPSOIL** A. 0-1': Silty SAND, brown, damp, loose, moderately porous, abundant rootlets **CRETACEOUS GABBRO** B. 1-9': GABBRO; brown, dry to damp, hard, fine to medium grained, scattered krotovina, slightly weathered C. 9-14.5': Becomes very hard (slow digging)	Kgb	SM	Bag-1 2-4'		

GRAPHICAL REPRESENTATION: NW WALL	SCALE 1" = 5'	SURFACE SLOPE 15-20° SE	TREND 320°

Total Depth: 14.5'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 3	
Project Number: I11-2439-10	Elevation: 1753	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-7-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	TOPSOIL A. 0-1.5': Silty SAND, reddish brown, moist, loose to medium dense, slightly clayey, abundant rootlets, slightly porous **CRETACEOUS GABBRO** B. 1.5-5.5': GABBRO; light brown to brown, dry, moderately hard to hard, fine to medium grained, slightly weathered	Kgb	SM			

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: FLAT	TREND 030°

Total Depth: 5.5'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 4	
Project Number: I11-2439-10	Elevation: 1823	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-7-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Joint Set: 1. Joint: 030° - 42° W 2. Joint: 080° - 55° W 2. Joint: 030° - 85° W	**TOPSOIL** A. 0-0.5': Silty SAND, dark brown, moist, loose, abundant rootlets **CRETACEOUS GABBRO** B. 0.5-3.5': GABBRO; light brown to brown, dry, moderately hard to hard, fine to medium grained, moderately fractured in the upper 2-3', some rock fabric 3.5-14': becomes slightly to non-weathered, hard C. Very hard, slow digging	Kgb	SM			

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: 22° NE	TREND 050°

Practical Refusal at 17'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 5
Project Number: I11-2439-10	Elevation: 1732	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-1.5': Silty SAND, red brown, moist, loose, slightly clayey, porous, abundant rootlets		SM	Bag-1 0-2.5'		
		QUATERNARY ALLUVIUM B. 0-2.5': Slightly to Clayey SAND; dark reddish brown, moist loose abundant rootlets, slightly porous	Qal	SM/SC			
		CRETACEOUS GABBRO C. 1.5-6.5': GABBRO; light brown to brown, dry, moderately hard to hard fine to coarse grained. Slightly to moderately weathered, slightly fractured/jointed	Kgb				

GRAPHICAL REPRESENTATION:	SCALE 1" = 5'	SURFACE SLOPE: 26° NE	TREND 055°

Total Depth = 6.5'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON			Logged by: SER	LOG OF TRENCH TP- 6			
Project Number: I11-2439-10			Elevation: 1763	ENGINEERING PROPERTIES			
Equipment: CAT 330C EXCAVATOR			Location/Grid: SEE GEOTECHNICAL MAP				
GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	QUATERNARY OLDER ALLUVIUM A. 0-11': Silty SAND; red brown, moist, medium dense (loose in upper 6-inches), non-porous, scattered rootlets		Qol	SM	Bag-1 0-3'		
	CRETACEOUS GABBRO B. 11-13': GABBRO; brown, dry, hard , slightly weathered		Kgb				
GRAPHICAL REPRESENTATION: E WALL		SCALE 1" = 5'	SURFACE SLOPE: FLAT			TREND 330°	

Total Depth = 13'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON			Logged by: SER	LOG OF TRENCH TP- 7			
Project Number: I11-2439-10			Elevation:	ENGINEERING PROPERTIES			
Equipment: CAT 330C EXCAVATOR			Location/Grid: SEE GEOTECHNICAL MAP				
GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	QUATERNARY OLDER ALLUVIUM A. 0-3.5': Silty SAND; reddish brown, moist, medium dense, non-porous, scattered rootlets B. 3.5-6': becomes dense, scattered rock up to 12" in diameter, increase in moisture		Qol	SM	Bag-1 0-3'		
GRAPHICAL REPRESENTATION: E WALL		SCALE 1" = 5'	SURFACE SLOPE: FLAT			TREND 315°	

Total Depth = 6'
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON		Logged by: SER		LOG OF TRENCH TP- 8			
Project Number: I11-2439-10		Elevation: 1701		ENGINEERING PROPERTIES			
Equipment: CAT 330C EXCAVATOR		Location/Grid: SEE GEOTECHNICAL MAP					
GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	QUATERNARY ALLUVIUM A. 0-5.5': Silty SAND; red brown, moist, loose to medium dense, scattered rock up to 6-inches, scattered rootlets **CRETACEOUS GABBRO** B. 5.5-6.5': GABBRO; brown, dry, hard, fine to medium grained, intensely weathered, (becomes moderately weathered at 6.5')		Qal	SM			
GRAPHICAL REPRESENTATION: W WALL		SCALE 1" = 5'	SURFACE SLOPE: 5°S			TREND E-W	

Total Depth = 6.5'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 9
Project Number: I11-2439-10	Elevation: 1690	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		QUATERNARY ALLUVIUM A. 0-5.5': Variable Silty SAND to Poorly Sorted SAND mix; red brown to light brown, moist, loose to medium dense, abundant roots/tree roots up to 4" in diameter, scattered cobble	Qal	SM-SP			
		CRETACEOUS GABBRO B. 5.5-6.5': GABBRO; brown, dry to damp, moderately hard, intensely weathered, friable (becomes moderately weathered at 6.5')	Kgb				

GRAPHICAL REPRESENTATION: W WALL	SCALE 1" = 5'	SURFACE SLOPE: FLAT	TREND 315°

Total Depth = 6.5'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 10	
Project Number: I11-2439-10	Elevation: 1723	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-7-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-1.5': Clayey SAND; reddish brown, moist, loose to medium dense, scattered rootlets **CRETACEOUS GABBRO** B. 1.5-3.0': GABBRO; reddish brown to brown, damp to moist, soft to moderately hard, intensely weathered, highly fractured/pegmatitic, heterogeneous localized weathering C. 3-6': becomes moderately weathered, hard	Kgb	SC			

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: 5° N	TREND 345°

Total Depth = 6
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 11	
Project Number: I11-2439-10	Elevation: 1742	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-7-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
1. Joint: N-S 68 ° E	**TOPSOIL** A. 0-1.5': Clayey SAND; red brown, moist, loose to medium dense, scattered rootlets **CRETACEOUS GABBRO** B. 1.5-3.0': GABBRO; reddish brown to brown, damp, moderately hard, intensely weathered, C. 3-10': gray brown, slightly weathered	Kgb	SC			

GRAPHICAL REPRESENTATION: W WALL	SCALE 1" = 5'	SURFACE SLOPE: 8-10 ° N	TREND 330 °

Total Depth = 10
No Groundwater Encountered
Backfilled: 12-7-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 12	
Project Number: I11-2439-10	Elevation: 1747	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-1.5': Clayey SAND; red brown, moist, loose to medium dense, scattered rootlets **CRETACEOUS GABBRO** B. 1.5-16': GABBRO; reddish brown to brown, dry, moderately hard to hard, moderately weathered, slightly fractured/oxidized C. 16-17': becomes very hard, slow digging, non-weathered	Kgb	SC			

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: FLAT	TREND 005°

Total Depth = 17'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 13
Project Number: I11-2439-10	Elevation: 1747	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-8-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Joint Set 1. 030 ° 32NW 2. 085 85 ° N 3. 025 72 ° W	**TOPSOIL** A. 0-1.5': Silty SAND; dark red brown, moist, loose, abundant rootlets **CRETACEOUS GABBRO** B. 1-3': GABBRO; reddish brown to brown, dry, moderately hard, intensely weathered, highly fractured C. 1-6.5': PEGMATITE; white to deep red brown, dry hard, moderately fractured D. 3-16': GABBRO; becomes hard, slightly weathered E. 16-17': becomes very hard – slow digging	Kgb	SM	Bag 1 2-4'		

GRAPHICAL REPRESENTATION: W WALL	SCALE 1" = 5'	SURFACE SLOPE: 15-18 ° to N	TREND 020 °

Practical Refusal at 17'
No Groundwater Encountered
Backfilled: 12-8-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 14	
Project Number: I11-2439-10	Elevation: 1725	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-1': Clayey SAND; red brown, moist, loose, blocky, scattered fine gravel and rootlets **CRETACEOUS GABBRO** B. 1-4': GABBRO; red brown, damp, moderately hard, intensely weathered C. 4-5': becomes gray brown, hard, less weathered	Kgb	SC	Bag 1 0-2'		

GRAPHICAL REPRESENTATION: S WALL	SCALE 1" = 5'	SURFACE SLOPE: LEVEL	TREND 085°

Total Depth: 5'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON			Logged by: SER	LOG OF TRENCH TP- 15			
Project Number: I11-2439-10			Elevation: 1720	ENGINEERING PROPERTIES			
Equipment: CAT 330C EXCAVATOR			Location/Grid: SEE GEOTECHNICAL MAP				
GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		QUATERNARY ALLUVIUM A. 0-1': Clayey SAND; red brown, moist, loose, blocky, scattered fine gravel and rootlets	Qal	SM			
		CRETACEOUS GABBRO B. 2.5-6': GABBRO; brown, damp, moderately hard to hard, slightly to moderately weathered, very fine to medium grained	Kgb				
GRAPHICAL REPRESENTATION: N WALL		SCALE 1" = 5'	SURFACE SLOPE: 5-10° EAST			TREND 280°	

Total Depth: 6'
No Groundwater Encountered
Backfilled: 12-8-2011

Project Name: MDMG – OAK CREEK CANYON			Logged by: SER	LOG OF TRENCH TP- 16			
Project Number: I11-2439-10			Elevation: 1717	ENGINEERING PROPERTIES			
Equipment: CAT 330C EXCAVATOR			Location/Grid: SEE GEOTECHNICAL MAP				
GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		QUATERNARY OLDER ALLUVIUM A. 0-1': Clayey SAND; red brown, moist, loose to medium dense, scattered rootlets, slightly porous B. 1-5': becomes medium dense, non-porous	Qoal	SC	Bag 1 @ 2-4'		
GRAPHICAL REPRESENTATION: E WALL		SCALE 1" = 5'	SURFACE SLOPE: LEVEL			TREND 350°	

Total Depth: 5'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 17
Project Number: I11-2439-10	Elevation: 1747	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-8-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	ARTIFICIAL FILL, UNDOCUMENTED A. 0-13': Silty SAND; brown, dry, loose, scattered rootlets, abundant rock up to 4-5' in diameter	Afu	SM			
	CRETACEOUS GABBRO B. 13-15': GABBRO; reddish brown to brown, damp, hard, moderately weathered, very fine to medium grained	Kgb				

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: 5-10° to NE	TREND 020°

Total Depth: 15'
No Groundwater Encountered
Backfilled: 12-8-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 18
Project Number: I11-2439-10	Elevation: 1737	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-2': Silty SAND; red brown to dark brown, dry to moist, loose, slightly blocky, scattered rootlets **CRETACEOUS GABBRO** B. 2-6': GABBRO; light brown, dry to damp, hard, moderately weathered, very fine to medium grained, slightly to moderately weathered	Kgb	SM			

GRAPHICAL REPRESENTATION: SE WALL	SCALE 1" = 5'	SURFACE SLOPE: LEVEL	TREND 050°

Total Depth: 6'
No Groundwater Encountered
Backfilled: 12-8-2011

Project Name: MDMG – OAK CREEK CANYON			Logged by: SER	LOG OF TRENCH TP- 19			
Project Number: I11-2439-10			Elevation: 1717	ENGINEERING PROPERTIES			
Equipment: CAT 330C EXCAVATOR			Location/Grid: SEE GEOTECHNICAL MAP				
GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	TOPSOIL A. 0-1': Silty SAND to Poorly graded SAND; red brown to brown, dry to damp, loose, scattered rock up to 8-inches in diameter			SM/SP			
	QUATERNARY OLDER ALLUVIUM B. 1-5': Clayey SAND; dark brown, moist, medium dense		Qoal	SC			
GRAPHICAL REPRESENTATION: NE WALL		SCALE 1" = 5'	SURFACE SLOPE: 5° NW			TREND 320°	

Total Depth: 5'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 20	
Project Number: I11-2439-10	Elevation: 1735	ENGINEERING PROPERTIES	
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-8-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	QUATERNARY OLDER ALLUVIUM	Qoal	SC			
	A. 0-8.5': Clayey SAND; reddish brown to dark brown, moist, medium dense, scattered rootlets and rock (up to 6" in diameter)					
	CRETACEOUS GABBRO	Kgb				
Joint 1. 075 70° N* *approximated	B. 8.5-14': GABBRO; light brown, dry to damp, hard, very fine to medium grained, slightly weathered					
	C. 14-15': becomes non-weathered, very hard [slow digging]					

GRAPHICAL REPRESENTATION: NW WALL	SCALE 1" = 5'	SURFACE SLOPE: 5-10° N	TREND 030°

Practical Refusal @ 15'
No Groundwater Encountered
Backfilled: 12-8-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 21
Project Number: I11-2439-10	Elevation: 1767	ENGINEERING PROPERTIES
Equipment: CAT 330C EXCAVATOR	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-8-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Joint Set 1. 020 85° E 2. 072 65° N		**TOPSOIL** A. 0-2': Clayey SAND; reddish brown to brown, moist, loose to medium dense, blocky, scattered rootlets **CRETACEOUS GABBRO** B. 2-5': GABBRO; reddish brown, dry to damp, moderately hard, fine to coarse grained, moderately to intensely weathered, moderately fractured C. 5-16': becomes brown, hard to very hard D. 16-18': very hard, non-weathered [slow digging]	Kgb	SC			

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: 10-15° W	TREND N-S

Total Depth: 18'
No Groundwater Encountered
Backfilled: 12-8-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 22	
Project Number: I11-2439-10	Elevation: 1753	ENGINEERING PROPERTIES	
Equipment: JD 310 Backhoe	Location/Grid: SEE GEOTECHNICAL MAP		

GEOLOGIC ATTITUDES	DATE: 12-19-2011	DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		TOPSOIL A. 0-1.5': Clayey SAND; red brown, moist, loose, scattered rock up to 6" in diameter, abundant rootlets **CRETACEOUS GABBRO** B. 1.5-3.5': GABBRO; red brown to brown, dry to damp, moderately hard to hard, fine to medium grained, intensely weathered C. 3.5-8': becomes light brown to brown, hard, slightly weathered	Kgb	SC			

GRAPHICAL REPRESENTATION: E WALL	SCALE 1" = 5'	SURFACE SLOPE: 5-8° SW	TREND 045°

Total Depth: 8'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 23
Project Number: I11-2439-10	Elevation: 1793	ENGINEERING PROPERTIES
Equipment: JD 310 Backhoe	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-19-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	TOPSOIL A. 0-1': Silty SAND; reddish brown, moist, loose, fine to coarse grained, abundant rock up to 5" in diameter, abundant rootlets		SM			
Joint Set: 1: 310 78° SW 2: 010 82° W 3: 025 79° W	**CRETACEOUS GABBRO** B. 1-4.5': GABBRO; brown, dry to damp, hard to very hard, fine to medium grained, large corestones at bottom up to 4' in diameter C. 3.5-8': becomes light brown to brown, hard, slightly weathered	Kgb				

GRAPHICAL REPRESENTATION: S WALL	SCALE 1" = 5'	SURFACE SLOPE: LEVEL	TREND 085°

Refusal @ 4.5'
No Groundwater Encountered
Backfilled: 12-19-2011

Project Name: MDMG – OAK CREEK CANYON	Logged by: SER	LOG OF TRENCH TP- 24
Project Number: I11-2439-10	Elevation: 1759	ENGINEERING PROPERTIES
Equipment: JD 310 Backhoe	Location/Grid: SEE GEOTECHNICAL MAP	

GEOLOGIC ATTITUDES	DATE: 12-19-2011 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	TOPSOIL A. 0-1': Silty SAND; dark brown to reddish brown, moist, loose, fine to coarse grained, abundant rock up to 8" in diameter, scattered rootlets **CRETACEOUS GABBRO** B. 1-3.5': GABBRO; reddish brown to brown, dry to damp, hard, fine to medium grained C. 3.5-9': becomes brown, hard to very hard, corestones up to 4-5' in diameter	Kgb	SM			

GRAPHICAL REPRESENTATION: N WALL	SCALE 1" = 5'	SURFACE SLOPE: 10-15° W	TREND E-W

Total Depth: 9'
No Groundwater Encountered
Backfilled: 12-19-2011

APPENDIX C

PERCOLATION TEST RESULTS

Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-1	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [4' Test Pit]	Soil Classification:	Cretaceous Gabbro- SM
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/14/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/13/11	10:20	23:10:00	5-gallons
Stop	12/14/11	9:30		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./inch)
9:33 10:33	60	60	12	5.75	6.25	10
10:33 11:33	60	120	12	7.00	5.00	12
11:33 12:33	60	180	12	7.25	4.75	13
12:33 13:33	60	240	12	8.00	4.00	15
13:33 14:33	60	300	12	8.00	4.00	15
14:33 15:33	60	360	12	8.25	3.75	16

LGC

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Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-2	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [1' Test Pit]	Soil Classification:	Quaternary Alluvium-SM/SP
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/14/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/13/11	10:04	23:21:00	5-gallons
Stop	12/14/11	9:25		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./inch)
9:30 10:30	60	60	12	7.00	5.00	12
10:30 11:30	60	120	12	7.25	4.75	13
11:30 12:30	60	180	12	7.50	4.50	13
12:30 13:30	60	240	12	7.75	4.25	14
13:30 14:30	60	300	12	8.00	4.00	15
14:30 15:30	60	360	12	8.00	4.00	15

LGC

LGC INLAND, INC.

Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-3	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [5' test pit]	Soil Classification:	Cretaceous Gabbro-SC/SM
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/14/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/13/11	10:45	22:50:00	5-gallons
Stop	12/14/11	9:35		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./inch)
9:38 10:38	60	60	12	3.00	9.00	6.7
10:38 11:38	60	120	12	4.25	7.75	7.7
11:38 12:38	60	180	12	4.75	7.25	8.3
12:38 13:38	60	240	12	5.00	7.00	8.6
13:38 14:38	60	300	12	5.25	6.75	8.9
14:38 15:38	60	360	12	5.38	6.62	9.1

LGC

LGC INLAND, INC.

Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-4	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [1' Test Pit]	Soil Classification:	Cretaceous Gabbro-SM
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/15/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/14/11	16:07	17:53:00	5-gallons
Stop	12/15/11	10:00		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./Inch)
10:03 11:03	60	60	12	9.00	3.00	20
11:03 12:03	60	120	12	10.25	1.75	34
12:03 13:03	60	180	12	10.50	1.50	40
13:03 14:03	60	240	12	10.50	1.50	40
14:03 15:03	60	300	12	10.75	1.25	48
15:03 16:03	60	360	12	10.75	1.25	48

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Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-5	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [5' Test Pit]	Soil Classification:	Quaternary Older Alluvium-SC
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/15/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/14/11	16:20	17:45:00	5-gallons
Stop	12/15/11	10:05		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./inch)
10:08 11:08	60	60	12	5.50	6.50	9.2
11:08 12:08	60	120	12	7.50	4.50	13.3
12:08 13:08	60	180	12	8.00	4.00	15.0
13:08 14:08	60	240	12	8.00	4.00	15.0
14:08 15:08	60	300	12	8.25	3.75	16.0
15:08 16:08	60	360	12	8.38	3.63	16.6

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LGC INLAND, INC.

Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-6	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [5' Test Pit]	Soil Classification:	Quaternary Older Alluvium-SC
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/15/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/14/11	16:25	17:45:00	5-gallons
Stop	12/15/11	10:10		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./inch)
10:12 11:12	60	60	12	6.00	6.00	10.0
11:12 12:12	60	120	12	7.75	4.25	14.1
12:12 13:12	60	180	12	8.00	4.00	15.0
13:12 14:12	60	240	12	8.25	3.75	16.0
14:12 15:12	60	300	12	8.38	3.63	16.6
15:12 16:12	60	360	12	8.38	3.63	16.6

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LGC INLAND, INC.

Project:	MDMG-Oak Creek Canyon	Job No.:	I11-2439-21
Test Hole No.:	P-7	Date Excavated:	12/8/2011
Depth of Test Hole:	13 Inches [1' Test Pit]	Soil Classification:	Cretaceous Gabbro-SM/SC
Check for Sandy Soil Criteria By:		Date of Perc Test:	12/14/2011

SANDY SOIL CRITERIA TEST

TRIAL	*TIME*	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
Trial 1					
Trial 2					

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	12/13/11	11:06	22:39:00	5-gallons
Stop	12/14/11	9:45		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Pecolation Rate (min./inch)
9:47 10:47	60	60	12	6.00	6.00	10.0
10:47 11:47	60	120	12	6.63	5.38	11.2
11:47 12:47	60	180	12	7.00	5.00	12.0
12:47 13:47	60	240	12	7.50	4.50	13.3
13:47 14:47	60	300	12	7.75	4.25	14.1
14:47 15:47	60	360	12	7.88	4.13	14.5

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APPENDIX D

LABORATORY TESTING PROCEDURES AND TEST RESULTS

APPENDIX D

Laboratory Testing Procedures and Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Soil Classification: Soils were classified according the Unified Soil Classification System (USCS) in accordance with ASTM Test Methods D2487 and D2488. This system uses relies on the Atterberg Limits and grain size distribution of a soil. The soil classifications (or group symbol) are shown on the laboratory test data, and boring logs.

Moisture and Density Determination Tests: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on relatively undisturbed samples obtained from the test borings and/or trenches. The results of these tests are presented in the boring and/or trench logs. Where applicable, only moisture content was determined from undisturbed or disturbed samples.

Maximum Dry Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of these tests are presented in the table below:

SAMPLE LOCATION	*SAMPLE DESCRIPTION*	*MAXIMUM DRY DENSITY (pcf)*	*OPTIMUM MOISTURE CONTENT (%)*
TP-5 @ 2.5'	Light Olive Brown, Clayey fine to Coarse SAND with Trace Fine Gravel	127.3	9.5

Expansion Index: The expansion potential of selected samples was evaluated by the Expansion Index Test, U.B.C. Standard No. 18-2 and/or ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch-thick by 4-inch-diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the table below:

SAMPLE LOCATION	*SAMPLE DESCRIPTION*	*EXPANSION INDEX*	*EXPANSION POTENTIAL**
TP-1 @ 0-4'	Olive-brown Silty SAND	0	Very Low
TP-5 @ 0-5'	Red-brown Silty SAND	25	Low

* Per Table 18-1-B of 2001 CBC.

Direct Shear: Direct shear tests were performed on selected remolded and/or undisturbed samples with ASTM D 3080. Results of these tests are presented in the table below and on the Direct Shear Plots.

SAMPLE LOCATION	SAMPLE DESCRIPTION	FRICTION ANGLE (degrees)	COHESION (psf)
TP-14 @ 0-2'**	Light Olive Brown, Clayey Fine to Coarse SAND with Trace Fine Gravel	37	235

*Ultimate Values
**Remolded values.

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geotechnical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water-cement ratios. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION	SULFATE CONTENT (ppm)	SULFATE EXPOSURE*
TP-5 @ 2.5'	Light Olive Brown, Clayey Fine to Coarse SAND with Trace Fine Gravel	0.001	Negligible

* Per Table No. 19-A-4 of 2001 CBC.

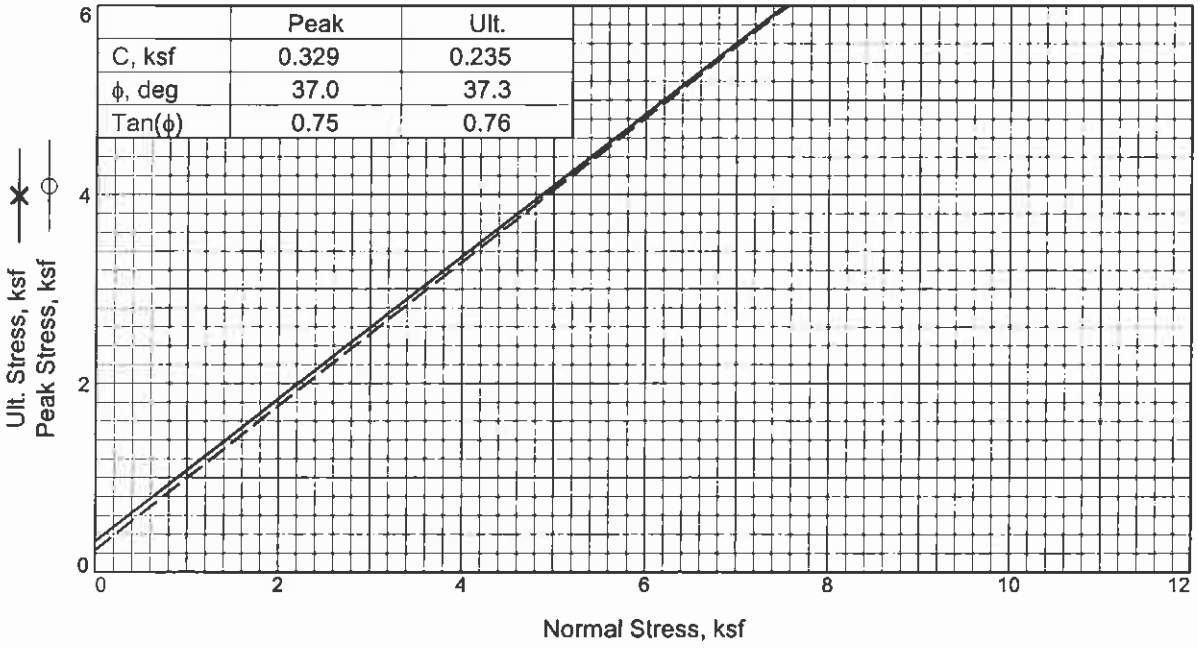
Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed with CTM 643. The results are presented in the table below:

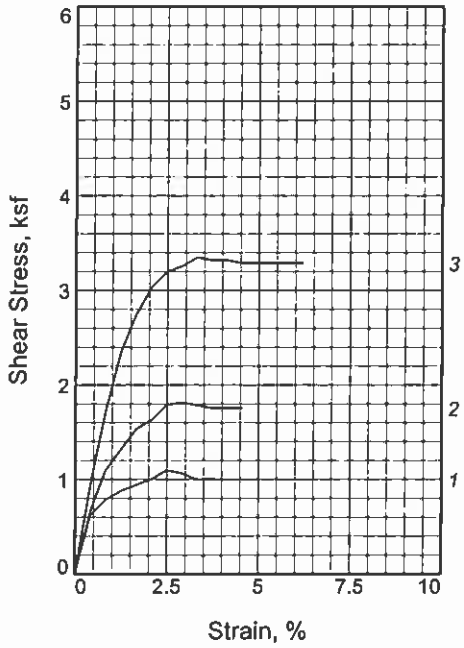
SAMPLE LOCATION	SAMPLE DESCRIPTION	pH	MINIMUM RESISTIVITY (ohm-cm)
TP-5 @ 2.5'	Light Olive Brown, Clayey Fine to Coarse SAND with Trace Fine Gravel	7.7	6,000

Chloride Content: Chloride content was tested with CTM 422. The results are presented below:

SAMPLE LOCATION	SAMPLE DESCRIPTION	CHLORIDE CONTENT (ppm)
TP-5 @ 2.5'	Light Olive Brown, Clayey Fine to Coarse SAND with Trace Fine Gravel	0

	Peak	Ult.
C, ksf	0.329	0.235
ϕ, deg	37.0	37.3
Tan(ϕ)	0.75	0.76





Sample No.		1	2	3
Initial	Water Content, %	13.3	13.3	13.3
	Dry Density, pcf	114.8	114.8	114.8
	Saturation, %	79.9	79.9	79.9
	Void Ratio	0.4416	0.4416	0.4416
	Diameter, in.	2.420	2.420	2.420
	Height, in.	1.000	1.000	1.000
At Test	Water Content, %	15.1	15.1	15.1
	Dry Density, pcf	114.8	114.8	114.8
	Saturation, %	90.3	90.3	90.3
	Void Ratio	0.4416	0.4416	0.4416
	Diameter, in.	2.420	2.420	2.420
	Height, in.	1.000	1.000	1.000
Normal Stress, ksf		1.000	2.000	4.000
Peak Stress, ksf		1.096	1.816	3.350
Strain, %		2.5	2.9	3.3
Ult. Stress, ksf		1.002	1.753	3.287
Strain, %		3.3	3.7	4.5
Strain rate, in./min.		0.033	0.033	0.033

Sample Type: Remolded Shear
Description: Light olive Brown, Clayey Fine to Coarse Sand with Trace Fine Gravel

Assumed Specific Gravity= 2.65
Remarks:

Client: MDMG

Project: MDMG Golden Hills

Source of Sample: TP-14 **Depth:** 0-2
Sample Number: Bag-1
Proj. No.: 1112439 **Date Sampled:**

LGC INLAND

ASTM D3080

Tested By: T. Nevills

APPENDIX E

SLOPE STABILITY ANALYSES

APPENDIX E

SLOPE STABILITY ANALYSES

1.0 Approach

- After a review of the preliminary design, cross-section A-A' was considered representative and critical with regards to slope stability.
- Slope stability analyses were conducted using the computer program GSTABL7 with STEDwin (Version2.0). The Modified Bishop's Method was used to analyze rotational failure modes. A coefficient of horizontal acceleration of 0.15g was used for pseudostatic stability analyses.
- Surficial stability analyses were also performed on cut slopes not steeper than 1½ :1(h:v) inclination. The results are attached in this appendix.

2.0 Design Shear Strength

Laboratory direct shear test data (attached in Appendix D), and our experience in the project area formed the basis of the shear design parameters that were used in the slope stability analyses. Design shear strength and density parameters used in the slope stability analyses are shown in Table 1.

TABLE 1
Shear Strength Parameters for Slope Stability Analyses

MATERIAL	LABORATORY SHEAR STRENGTHS (Ultimate)		DESIGN SHEAR STRENGTHS (Ultimate)		Saturated Bulk Density (pcf)
	Cohesion (psf)	Frictional Angle (Degrees))	Cohesion (psf)	Frictional Angle (Degrees)	
Cretaceous Gabbro, Kgb	235	37	200	36	140

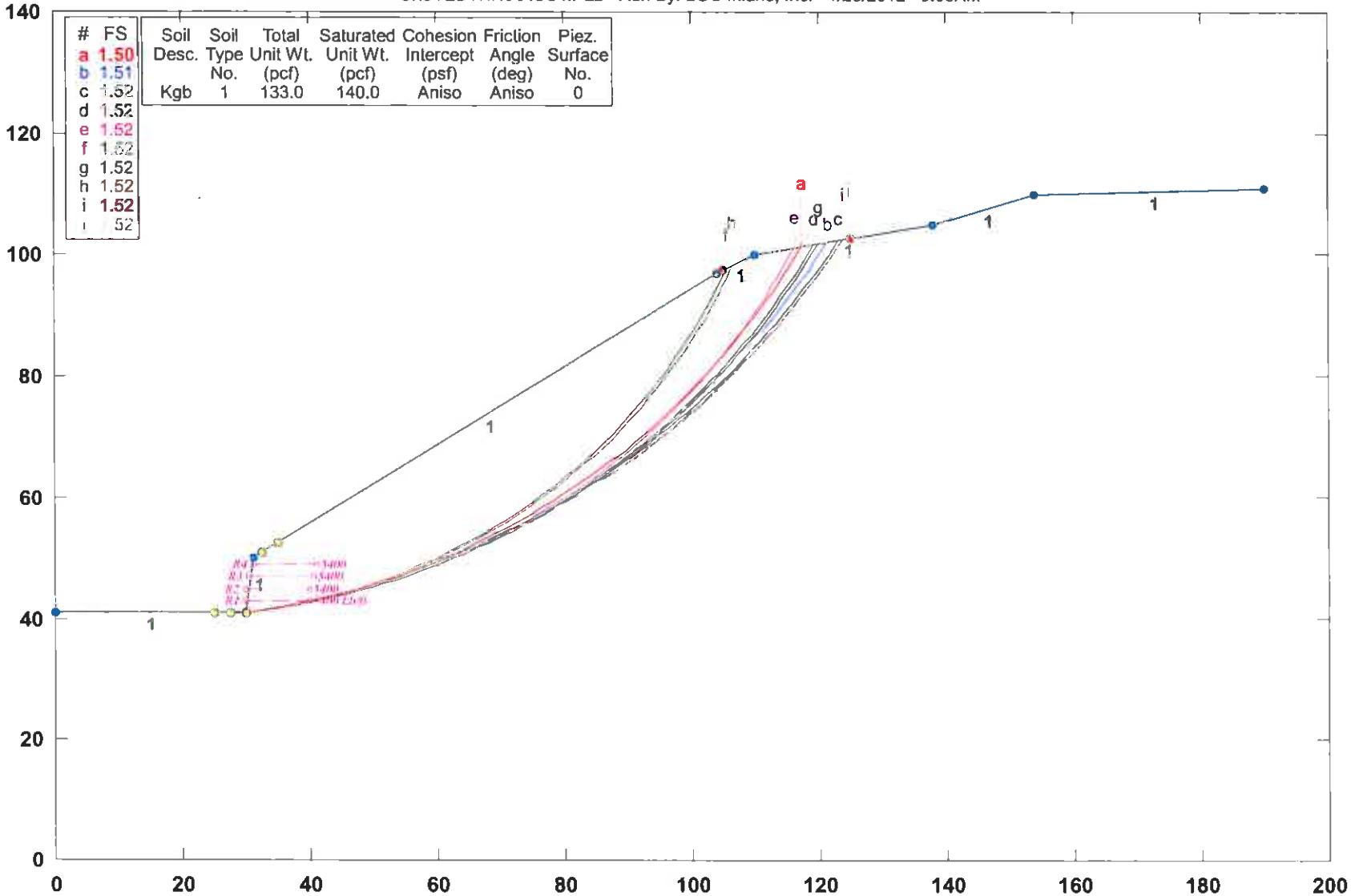
3.0 Presentation of Analyses and Results

A summary of the stability analyses is presented in Table 2 and the slope stability analyses output are presented in the following pages.

TABLE 2
Summary of Slope Stability Analyses

NO	CROSS-SECTION	REFERENCE	CONDITION	FACTOR OF SAFETY	REMARKS
1	A-A'	AA Cut	Highest 1.5:1 (h:v) Cut Slope, Static	1.50	Modified Bishop's Method
2	A-A'	AA Cut Pseudostatic	Pseudostatic for the above	1.13	Modified Bishop's Method

C:\STEDWIN\AACUT.PL2 Run By: LGC Inland, Inc. 1/23/2012 9:08AM



GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
  ** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **
            (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
*******************************************************************************
 Analysis Run Date:        1/23/2012
 Time of Run:              9:08AM
 Run By:                   LGC Inland, Inc.
 Input Data Filename:      C:aacut.
 Output Filename:          C:aacut.OUT
 Unit System:              English
 Plotted Output Filename:  C:aacut.PLT
 PROBLEM DESCRIPTION:
 BOUNDARY COORDINATES
     7 Top   Boundaries
     7 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1          0.00      41.00      30.00      41.00        1
     2         30.00      41.00      31.00      50.00        1
     3         31.00      50.00     104.00      97.00        1
     4        104.00      97.00     110.00     100.00        1
     5        110.00     100.00     138.00     105.00        1
     6        138.00     105.00     154.00     110.00        1
     7        154.00     110.00     190.00     111.00        1
 Default Y-Origin = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  1 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
   1   133.0    140.0     200.0     36.0    0.00       0.0      0
ANISOTROPIC STRENGTH PARAMETERS
     1 soil type(s)
 Soil Type  1 Is Anisotropic
 Number Of Direction Ranges Specified =  3
 Direction    Counterclockwise     Cohesion     Friction
   Range       Direction Limit    Intercept       Angle
    No.            (deg)            (psf)         (deg)
     1             48.0             200.00         36.00
     2             50.0             200.00         36.00
     3             90.0             200.00         36.00
 ANISOTROPIC SOIL NOTES:
    (1) An input value of 0.01 for C and/or Phi will cause Aniso
        C and/or Phi to be ignored in that range.
    (2) An input value of 0.02 for Phi will set both Phi and
        C equal to zero, with no water weight in the tension crack.
    (3) An input value of 0.03 for Phi will set both Phi and
        C equal to zero, with water weight in the tension crack.
REINFORCING LAYER(S)
     4 REINFORCING LAYER(S) SPECIFIED
 REINFORCING LAYER NO.   1
   2 POINTS DEFINE THIS LAYER
      POINT     X-COORD   Y-COORD   FORCE   INCLINATION
       NO.                                    FACTOR
        1        30.00     43.00   5400.00     0.000
        2        40.00     43.00   5400.00     0.000
 REINFORCING LAYER NO.   2
   2 POINTS DEFINE THIS LAYER
```

POINT NO.	X-COORD	Y-COORD	FORCE	INCLINATION FACTOR
1	30.00	45.00	5400.00	0.000
2	40.00	45.00	5400.00	0.000

REINFORCING LAYER NO. 3
2 POINTS DEFINE THIS LAYER

POINT NO.	X-COORD	Y-COORD	FORCE	INCLINATION FACTOR
1	30.50	47.00	5400.00	0.000
2	40.50	47.00	5400.00	0.000

REINFORCING LAYER NO. 4
2 POINTS DEFINE THIS LAYER

POINT NO.	X-COORD	Y-COORD	FORCE	INCLINATION FACTOR
1	31.00	49.00	5400.00	0.000
2	41.00	49.00	5400.00	0.000

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
2500 Trial Surfaces Have Been Generated.
500 Surface(s) Initiate(s) From Each Of 5 Points Equally Spaced
Along The Ground Surface Between X = 25.00(ft)
and X = 35.00(ft)
Each Surface Terminates Between X = 105.00(ft)
and X = 125.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
2.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Evaluated = 2500
Statistical Data On All Valid FS Values:
FS Max = 2.831 FS Min = 1.504 FS Ave = 1.975
Standard Deviation = 0.228 Coefficient of Variation = 11.55 %
Failure Surface Specified By 56 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.32
3	33.95	41.66
4	35.91	42.04
5	37.87	42.46
6	39.82	42.90
7	41.76	43.38
8	43.69	43.88
9	45.62	44.42
10	47.54	45.00
11	49.44	45.60
12	51.34	46.24
13	53.22	46.90
14	55.10	47.60
15	56.96	48.33
16	58.81	49.09
17	60.65	49.88
18	62.47	50.70
19	64.28	51.55
20	66.08	52.43
21	67.86	53.34
22	69.62	54.28
23	71.37	55.25
24	73.11	56.25
25	74.82	57.27
26	76.52	58.33
27	78.20	59.41
28	79.87	60.52
29	81.51	61.66

30	83.14	62.83
31	84.74	64.02
32	86.33	65.24
33	87.90	66.48
34	89.44	67.75
35	90.96	69.05
36	92.47	70.37
37	93.95	71.71
38	95.40	73.08
39	96.84	74.47
40	98.25	75.89
41	99.64	77.33
42	101.00	78.80
43	102.34	80.28
44	103.65	81.79
45	104.94	83.32
46	106.21	84.87
47	107.44	86.44
48	108.65	88.03
49	109.84	89.64
50	111.00	91.27
51	112.13	92.92
52	113.23	94.59
53	114.31	96.28
54	115.35	97.98
55	116.37	99.70
56	117.28	101.30

Circle Center At X = 12.07 ; Y = 160.29 ; and Radius = 120.62

Factor of Safety

*** 1.504 ***

Individual data on the 58 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	587.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.0	1177.5	0.0	0.0	0.	0.	0.0	0.0	0.0
3	2.0	2559.8	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.0	2787.9	0.0	0.0	0.	0.	0.0	0.0	0.0
5	2.0	3004.3	0.0	0.0	0.	0.	0.0	0.0	0.0
6	2.0	3208.7	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.9	3401.0	0.0	0.0	0.	0.	0.0	0.0	0.0
8	1.9	3581.1	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.9	3749.0	0.0	0.0	0.	0.	0.0	0.0	0.0
10	1.9	3904.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.9	4047.5	0.0	0.0	0.	0.	0.0	0.0	0.0
12	1.9	4178.2	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.9	4296.5	0.0	0.0	0.	0.	0.0	0.0	0.0
14	1.9	4402.3	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.9	4495.7	0.0	0.0	0.	0.	0.0	0.0	0.0
16	1.9	4576.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	1.8	4645.8	0.0	0.0	0.	0.	0.0	0.0	0.0
18	1.8	4702.5	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.8	4747.2	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.8	4780.0	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.8	4801.1	0.0	0.0	0.	0.	0.0	0.0	0.0
22	1.8	4810.6	0.0	0.0	0.	0.	0.0	0.0	0.0
23	1.7	4808.8	0.0	0.0	0.	0.	0.0	0.0	0.0
24	1.7	4795.7	0.0	0.0	0.	0.	0.0	0.0	0.0
25	1.7	4771.8	0.0	0.0	0.	0.	0.0	0.0	0.0
26	1.7	4737.2	0.0	0.0	0.	0.	0.0	0.0	0.0
27	1.7	4692.3	0.0	0.0	0.	0.	0.0	0.0	0.0
28	1.7	4637.2	0.0	0.0	0.	0.	0.0	0.0	0.0
29	1.6	4572.3	0.0	0.0	0.	0.	0.0	0.0	0.0
30	1.6	4497.9	0.0	0.0	0.	0.	0.0	0.0	0.0
31	1.6	4414.4	0.0	0.0	0.	0.	0.0	0.0	0.0
32	1.6	4322.0	0.0	0.0	0.	0.	0.0	0.0	0.0

33	1.6	4221.3	0.0	0.0	0.	0.	0.0	0.0	0.0
34	1.5	4112.5	0.0	0.0	0.	0.	0.0	0.0	0.0
35	1.5	3996.1	0.0	0.0	0.	0.	0.0	0.0	0.0
36	1.5	3872.5	0.0	0.0	0.	0.	0.0	0.0	0.0
37	1.5	3742.1	0.0	0.0	0.	0.	0.0	0.0	0.0
38	1.5	3605.3	0.0	0.0	0.	0.	0.0	0.0	0.0
39	1.4	3462.6	0.0	0.0	0.	0.	0.0	0.0	0.0
40	1.4	3314.5	0.0	0.0	0.	0.	0.0	0.0	0.0
41	1.4	3161.4	0.0	0.0	0.	0.	0.0	0.0	0.0
42	1.4	3003.9	0.0	0.0	0.	0.	0.0	0.0	0.0
43	1.3	2842.4	0.0	0.0	0.	0.	0.0	0.0	0.0
44	1.3	2677.4	0.0	0.0	0.	0.	0.0	0.0	0.0
45	0.3	686.3	0.0	0.0	0.	0.	0.0	0.0	0.0
46	0.9	1814.7	0.0	0.0	0.	0.	0.0	0.0	0.0
47	1.3	2301.0	0.0	0.0	0.	0.	0.0	0.0	0.0
48	1.2	2099.9	0.0	0.0	0.	0.	0.0	0.0	0.0
49	1.2	1899.2	0.0	0.0	0.	0.	0.0	0.0	0.0
50	1.2	1699.7	0.0	0.0	0.	0.	0.0	0.0	0.0
51	0.2	217.9	0.0	0.0	0.	0.	0.0	0.0	0.0
52	1.0	1262.5	0.0	0.0	0.	0.	0.0	0.0	0.0
53	1.1	1230.2	0.0	0.0	0.	0.	0.0	0.0	0.0
54	1.1	986.2	0.0	0.0	0.	0.	0.0	0.0	0.0
55	1.1	749.2	0.0	0.0	0.	0.	0.0	0.0	0.0
56	1.0	519.9	0.0	0.0	0.	0.	0.0	0.0	0.0
57	1.0	298.8	0.0	0.0	0.	0.	0.0	0.0	0.0
58	0.9	86.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.97	41.33
3	33.94	41.68
4	35.91	42.06
5	37.86	42.47
6	39.81	42.91
7	41.76	43.39
8	43.69	43.89
9	45.62	44.42
10	47.54	44.98
11	49.45	45.57
12	51.35	46.19
13	53.25	46.84
14	55.13	47.52
15	57.00	48.23
16	58.86	48.96
17	60.71	49.72
18	62.54	50.52
19	64.37	51.34
20	66.18	52.19
21	67.98	53.06
22	69.76	53.96
23	71.53	54.90
24	73.29	55.85
25	75.03	56.84
26	76.75	57.85
27	78.46	58.89
28	80.16	59.95
29	81.83	61.04
30	83.49	62.15
31	85.14	63.29
32	86.76	64.46
33	88.37	65.65
34	89.96	66.87
35	91.53	68.11
36	93.08	69.37
37	94.61	70.66
38	96.12	71.97

39	97.61	73.30
40	99.08	74.65
41	100.53	76.03
42	101.96	77.43
43	103.36	78.86
44	104.75	80.30
45	106.11	81.76
46	107.45	83.25
47	108.77	84.76
48	110.06	86.28
49	111.33	87.83
50	112.57	89.39
51	113.79	90.98
52	114.99	92.58
53	116.16	94.20
54	117.31	95.84
55	118.43	97.49
56	119.53	99.17
57	120.60	100.85
58	121.31	102.02

Circle Center At X = 10.04 ; Y = 169.71 ; and Radius = 130.24

Factor of Safety

*** 1.512 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.97	41.33
3	33.94	41.68
4	35.91	42.07
5	37.86	42.48
6	39.81	42.92
7	41.76	43.39
8	43.69	43.89
9	45.62	44.42
10	47.54	44.98
11	49.46	45.56
12	51.36	46.17
13	53.25	46.81
14	55.14	47.48
15	57.01	48.18
16	58.88	48.91
17	60.73	49.66
18	62.57	50.44
19	64.40	51.25
20	66.22	52.08
21	68.02	52.94
22	69.82	53.83
23	71.60	54.74
24	73.36	55.69
25	75.11	56.65
26	76.85	57.64
27	78.57	58.66
28	80.27	59.71
29	81.96	60.78
30	83.64	61.87
31	85.30	62.99
32	86.94	64.13
33	88.56	65.30
34	90.17	66.49
35	91.76	67.71
36	93.33	68.94
37	94.88	70.21
38	96.41	71.49
39	97.93	72.80
40	99.42	74.13
41	100.89	75.48

42	102.35	76.85
43	103.78	78.25
44	105.20	79.66
45	106.59	81.10
46	107.96	82.55
47	109.30	84.03
48	110.63	85.53
49	111.93	87.05
50	113.22	88.58
51	114.47	90.14
52	115.71	91.71
53	116.92	93.30
54	118.11	94.91
55	119.27	96.54
56	120.41	98.18
57	121.53	99.84
58	122.62	101.52
59	123.14	102.35

Circle Center At X = 9.08 ; Y = 174.15 ; and Radius = 134.78

Factor of Safety

*** 1.517 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.29
3	33.96	41.60
4	35.92	41.95
5	37.89	42.33
6	39.84	42.75
7	41.79	43.19
8	43.74	43.67
9	45.67	44.18
10	47.59	44.73
11	49.51	45.30
12	51.42	45.91
13	53.31	46.54
14	55.20	47.21
15	57.07	47.91
16	58.93	48.64
17	60.78	49.40
18	62.62	50.20
19	64.44	51.02
20	66.25	51.87
21	68.05	52.75
22	69.83	53.66
23	71.59	54.61
24	73.34	55.58
25	75.07	56.57
26	76.79	57.60
27	78.49	58.66
28	80.17	59.74
29	81.83	60.85
30	83.47	61.99
31	85.10	63.16
32	86.71	64.35
33	88.29	65.57
34	89.86	66.81
35	91.40	68.08
36	92.92	69.38
37	94.43	70.70
38	95.90	72.05
39	97.36	73.42
40	98.80	74.81
41	100.21	76.23
42	101.59	77.67
43	102.96	79.13

44	104.29	80.62
45	105.61	82.13
46	106.90	83.66
47	108.16	85.21
48	109.40	86.78
49	110.61	88.37
50	111.79	89.98
51	112.95	91.61
52	114.08	93.26
53	115.19	94.93
54	116.26	96.62
55	117.31	98.32
56	118.33	100.04
57	119.24	101.65

Circle Center At X = 13.87 ; Y = 160.73 ; and Radius = 120.81

Factor of Safety

*** 1.517 ***

Failure Surface Specified By 56 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.26
3	33.96	41.55
4	35.94	41.88
5	37.90	42.24
6	39.86	42.64
7	41.82	43.07
8	43.76	43.54
9	45.70	44.04
10	47.62	44.58
11	49.54	45.15
12	51.45	45.75
13	53.34	46.39
14	55.22	47.07
15	57.09	47.77
16	58.95	48.51
17	60.80	49.29
18	62.63	50.09
19	64.44	50.93
20	66.24	51.80
21	68.03	52.71
22	69.79	53.64
23	71.54	54.61
24	73.28	55.61
25	74.99	56.64
26	76.69	57.70
27	78.37	58.79
28	80.02	59.91
29	81.66	61.06
30	83.27	62.24
31	84.87	63.44
32	86.44	64.68
33	87.99	65.94
34	89.52	67.24
35	91.02	68.56
36	92.50	69.90
37	93.96	71.27
38	95.39	72.67
39	96.79	74.09
40	98.17	75.54
41	99.53	77.01
42	100.85	78.51
43	102.15	80.03
44	103.42	81.57
45	104.67	83.14
46	105.88	84.73
47	107.07	86.34

48	108.23	87.97
49	109.36	89.62
50	110.46	91.29
51	111.53	92.98
52	112.57	94.69
53	113.57	96.42
54	114.55	98.16
55	115.50	99.92
56	116.09	101.09

Circle Center At X = 16.74 ; Y = 151.73 ; and Radius = 111.52

Factor of Safety

*** 1.520 ***

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.28
3	33.96	41.60
4	35.92	41.96
5	37.88	42.37
6	39.83	42.81
7	41.77	43.29
8	43.70	43.82
9	45.62	44.38
10	47.53	44.98
11	49.42	45.63
12	51.30	46.31
13	53.17	47.03
14	55.02	47.79
15	56.85	48.59
16	58.67	49.43
17	60.46	50.31
18	62.24	51.22
19	64.00	52.17
20	65.74	53.16
21	67.46	54.18
22	69.16	55.24
23	70.83	56.33
24	72.49	57.46
25	74.11	58.62
26	75.72	59.82
27	77.29	61.04
28	78.85	62.31
29	80.37	63.60
30	81.87	64.93
31	83.34	66.28
32	84.78	67.67
33	86.19	69.09
34	87.57	70.53
35	88.92	72.01
36	90.24	73.51
37	91.53	75.04
38	92.79	76.60
39	94.01	78.18
40	95.20	79.79
41	96.36	81.42
42	97.48	83.07
43	98.57	84.75
44	99.62	86.45
45	100.63	88.18
46	101.61	89.92
47	102.56	91.68
48	103.46	93.47
49	104.33	95.27
50	105.16	97.09
51	105.44	97.72

Circle Center At X = 17.66 ; Y = 135.95 ; and Radius = 95.75

Factor of Safety
*** 1.521 ***
Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.28
3	33.96	41.58
4	35.93	41.92
5	37.89	42.29
6	39.85	42.70
7	41.80	43.14
8	43.75	43.60
9	45.69	44.10
10	47.61	44.64
11	49.53	45.20
12	51.44	45.80
13	53.34	46.43
14	55.23	47.09
15	57.11	47.78
16	58.97	48.50
17	60.82	49.25
18	62.66	50.03
19	64.49	50.85
20	66.30	51.69
21	68.10	52.56
22	69.89	53.46
23	71.66	54.40
24	73.41	55.36
25	75.15	56.35
26	76.87	57.37
27	78.57	58.42
28	80.26	59.49
29	81.93	60.59
30	83.58	61.72
31	85.21	62.88
32	86.82	64.07
33	88.41	65.28
34	89.98	66.52
35	91.53	67.78
36	93.06	69.07
37	94.57	70.38
38	96.06	71.72
39	97.52	73.08
40	98.96	74.47
41	100.38	75.88
42	101.77	77.32
43	103.14	78.77
44	104.49	80.25
45	105.81	81.75
46	107.11	83.28
47	108.38	84.82
48	109.62	86.39
49	110.84	87.97
50	112.03	89.58
51	113.20	91.20
52	114.34	92.85
53	115.45	94.51
54	116.53	96.19
55	117.59	97.89
56	118.61	99.61
57	119.61	101.34
58	119.84	101.76

Circle Center At X = 14.46 ; Y = 160.76 ; and Radius = 120.76
Factor of Safety
*** 1.522 ***
Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.27
3	33.96	41.58
4	35.93	41.94
5	37.89	42.33
6	39.84	42.76
7	41.78	43.23
8	43.72	43.75
9	45.64	44.30
10	47.55	44.89
11	49.45	45.53
12	51.33	46.20
13	53.20	46.91
14	55.05	47.66
15	56.89	48.45
16	58.71	49.27
17	60.52	50.13
18	62.30	51.03
19	64.07	51.97
20	65.82	52.94
21	67.55	53.95
22	69.25	55.00
23	70.93	56.08
24	72.59	57.19
25	74.23	58.34
26	75.84	59.52
27	77.43	60.74
28	78.99	61.99
29	80.53	63.27
30	82.04	64.58
31	83.52	65.92
32	84.98	67.30
33	86.40	68.70
34	87.80	70.13
35	89.16	71.60
36	90.50	73.08
37	91.80	74.60
38	93.07	76.14
39	94.31	77.71
40	95.52	79.31
41	96.69	80.93
42	97.83	82.57
43	98.94	84.24
44	100.01	85.93
45	101.05	87.64
46	102.05	89.37
47	103.01	91.12
48	103.94	92.89
49	104.83	94.68
50	105.68	96.49
51	106.46	98.23

Circle Center At X = 17.98 ; Y = 136.75 ; and Radius = 96.50

Factor of Safety

*** 1.522 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.31
3	33.95	41.65
4	35.91	42.02
5	37.87	42.42
6	39.83	42.85
7	41.77	43.31
8	43.71	43.79

9	45.65	44.31
10	47.57	44.85
11	49.49	45.42
12	51.40	46.02
13	53.29	46.65
14	55.18	47.31
15	57.06	47.99
16	58.93	48.71
17	60.79	49.45
18	62.63	50.21
19	64.47	51.01
20	66.29	51.83
21	68.10	52.68
22	69.90	53.56
23	71.68	54.47
24	73.45	55.40
25	75.21	56.35
26	76.95	57.34
27	78.68	58.35
28	80.39	59.38
29	82.09	60.44
30	83.77	61.53
31	85.43	62.64
32	87.08	63.77
33	88.71	64.93
34	90.32	66.11
35	91.91	67.32
36	93.49	68.55
37	95.05	69.81
38	96.59	71.08
39	98.11	72.38
40	99.61	73.71
41	101.09	75.05
42	102.55	76.42
43	103.98	77.81
44	105.40	79.22
45	106.80	80.65
46	108.18	82.10
47	109.53	83.57
48	110.86	85.06
49	112.17	86.58
50	113.46	88.11
51	114.72	89.66
52	115.96	91.23
53	117.18	92.81
54	118.37	94.42
55	119.54	96.04
56	120.68	97.68
57	121.80	99.34
58	122.90	101.01
59	123.82	102.47

Circle Center At X = 10.21 ; Y = 173.56 ; and Radius = 134.03

Factor of Safety

*** 1.523 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.97	41.32
3	33.94	41.67
4	35.91	42.05
5	37.87	42.46
6	39.82	42.89
7	41.76	43.35
8	43.70	43.84
9	45.64	44.36
10	47.56	44.91

11	49.47	45.48
12	51.38	46.09
13	53.28	46.72
14	55.17	47.38
15	57.05	48.06
16	58.92	48.77
17	60.77	49.51
18	62.62	50.28
19	64.46	51.07
20	66.28	51.89
21	68.09	52.74
22	69.89	53.61
23	71.68	54.51
24	73.45	55.43
25	75.21	56.38
26	76.96	57.36
27	78.69	58.36
28	80.41	59.39
29	82.11	60.44
30	83.80	61.51
31	85.47	62.61
32	87.12	63.74
33	88.76	64.88
34	90.38	66.06
35	91.98	67.25
36	93.57	68.47
37	95.14	69.71
38	96.69	70.97
39	98.22	72.26
40	99.73	73.57
41	101.22	74.90
42	102.70	76.25
43	104.15	77.62
44	105.59	79.02
45	107.00	80.43
46	108.39	81.87
47	109.77	83.32
48	111.12	84.80
49	112.45	86.29
50	113.75	87.81
51	115.04	89.34
52	116.30	90.89
53	117.54	92.46
54	118.76	94.05
55	119.95	95.65
56	121.12	97.27
57	122.27	98.91
58	123.39	100.57
59	124.49	102.24
60	124.74	102.63

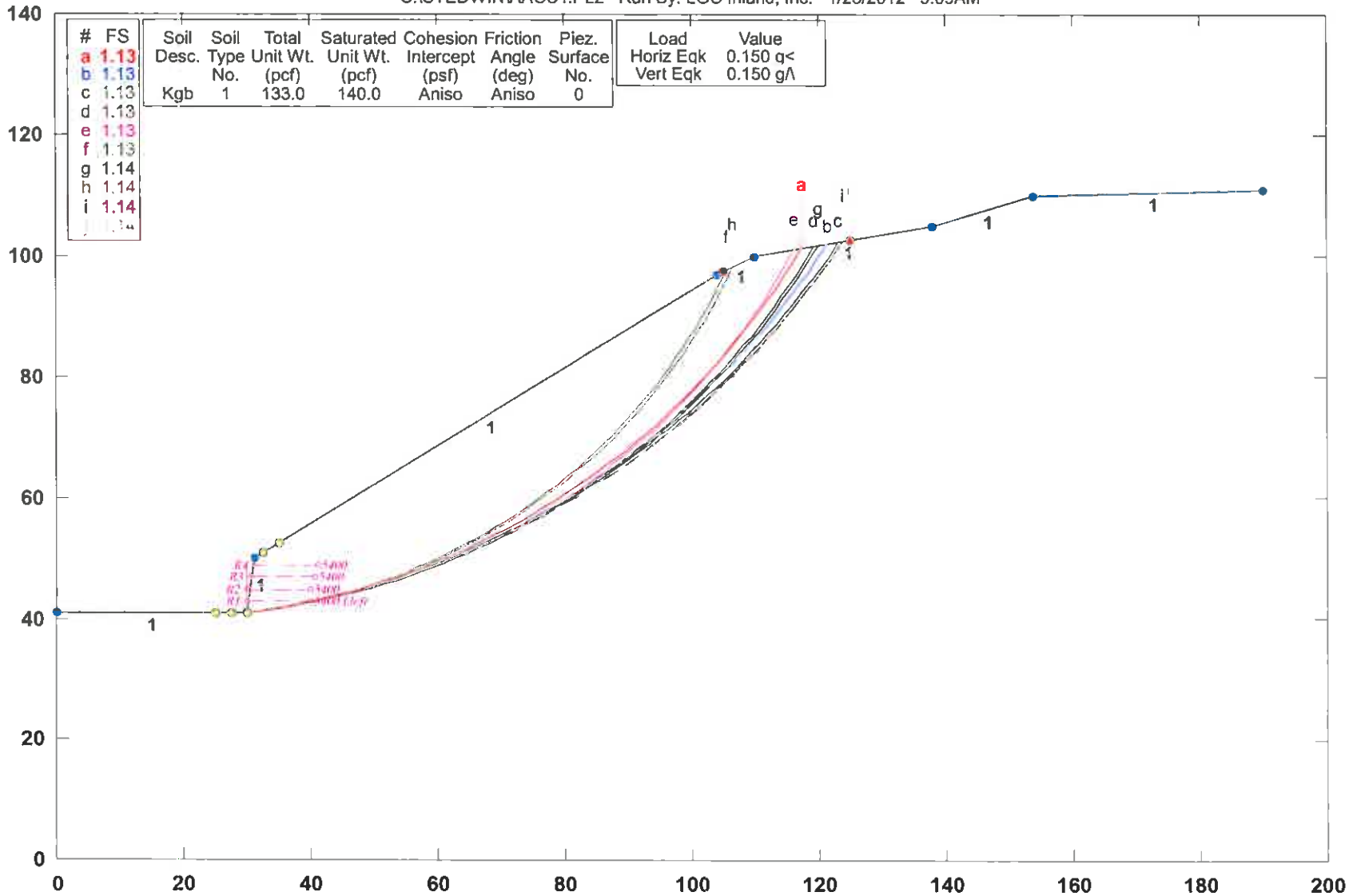
Circle Center At X = 8.98 ; Y = 176.95 ; and Radius = 137.56

Factor of Safety

*** 1.524 ***

**** END OF GSTABL7 OUTPUT ****

C:\STEDWIN\AACUT.PL2 Run By: LGC Inland, Inc. 1/23/2012 9:09AM



GSTABL7 v.2 FSmin=1.13

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

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                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
*******************************************************************************
 Analysis Run Date:        1/23/2012
 Time of Run:              9:09AM
 Run By:                   LGC Inland, Inc.
 Input Data Filename:      C:aacut.
 Output Filename:          C:aacut.OUT
 Unit System:              English
 Plotted Output Filename:  C:aacut.PLT
 PROBLEM DESCRIPTION:
 BOUNDARY COORDINATES
     7 Top   Boundaries
     7 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1         0.00      41.00      30.00      41.00        1
     2        30.00      41.00      31.00      50.00        1
     3        31.00      50.00     104.00      97.00        1
     4       104.00      97.00     110.00     100.00        1
     5       110.00     100.00     138.00     105.00        1
     6       138.00     105.00     154.00     110.00        1
     7       154.00     110.00     190.00     111.00        1
 Default Y-Origin = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  1 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
   1   133.0    140.0     200.0     36.0    0.00       0.0      0
ANISOTROPIC STRENGTH PARAMETERS
     1 soil type(s)
 Soil Type  1 Is Anisotropic
 Number Of Direction Ranges Specified =  3
 Direction    Counterclockwise     Cohesion     Friction
   Range       Direction Limit    Intercept       Angle
    No.            (deg)            (psf)         (deg)
     1              48.0             200.00         36.00
     2              50.0             200.00         36.00
     3              90.0             200.00         36.00
 ANISOTROPIC SOIL NOTES:
    (1) An input value of 0.01 for C and/or Phi will cause Aniso
        C and/or Phi to be ignored in that range.
    (2) An input value of 0.02 for Phi will set both Phi and
        C equal to zero, with no water weight in the tension crack.
    (3) An input value of 0.03 for Phi will set both Phi and
        C equal to zero, with water weight in the tension crack.
 A Horizontal Earthquake Loading Coefficient
 Of0.150 Has Been Assigned
 A Vertical Earthquake Loading Coefficient
 Of0.150 Has Been Assigned
 Cavitation Pressure =    0.0(psf)
REINFORCING LAYER(S)
     4 REINFORCING LAYER(S) SPECIFIED
 REINFORCING LAYER NO.   1
   2 POINTS DEFINE THIS LAYER
      POINT     X-COORD   Y-COORD   FORCE   INCLINATION
```

```
      NO.                                          FACTOR
       1        30.00      43.00   5400.00      0.000
       2        40.00      43.00   5400.00      0.000
REINFORCING LAYER NO.   2
  2 POINTS DEFINE THIS LAYER
     POINT     X-COORD   Y-COORD   FORCE   INCLINATION
      NO.                                      FACTOR
       1        30.00      45.00   5400.00      0.000
       2        40.00      45.00   5400.00      0.000
REINFORCING LAYER NO.   3
  2 POINTS DEFINE THIS LAYER
     POINT     X-COORD   Y-COORD   FORCE   INCLINATION
      NO.                                      FACTOR
       1        30.50      47.00   5400.00      0.000
       2        40.50      47.00   5400.00      0.000
REINFORCING LAYER NO.   4
  2 POINTS DEFINE THIS LAYER
     POINT     X-COORD   Y-COORD   FORCE   INCLINATION
      NO.                                      FACTOR
       1        31.00      49.00   5400.00      0.000
       2        41.00      49.00   5400.00      0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
2500 Trial Surfaces Have Been Generated.
 500 Surface(s) Initiate(s) From Each Of     5 Points Equally Spaced
Along The Ground Surface Between  X =  25.00(ft)
                              and  X =  35.00(ft)
Each Surface Terminates Between   X = 105.00(ft)
                              and   X = 125.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
 2.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Total Number of Trial Surfaces Evaluated =  2500
      Statistical Data On All Valid FS Values:
         FS Max =   2.352   FS Min =   1.128   FS Ave =   1.497
         Standard Deviation =    0.177   Coefficient of Variation =   11.84 %
      Failure Surface Specified By 58 Coordinate Points
        Point      X-Surf      Y-Surf
         No.        (ft)        (ft)
          1         30.00       41.00
          2         31.97       41.33
          3         33.94       41.68
          4         35.91       42.06
          5         37.86       42.47
          6         39.81       42.91
          7         41.76       43.39
          8         43.69       43.89
          9         45.62       44.42
         10         47.54       44.98
         11         49.45       45.57
         12         51.35       46.19
         13         53.25       46.84
         14         55.13       47.52
         15         57.00       48.23
         16         58.86       48.96
         17         60.71       49.72
         18         62.54       50.52
         19         64.37       51.34
         20         66.18       52.19
         21         67.98       53.06
         22         69.76       53.96
         23         71.53       54.90
         24         73.29       55.85
```

25	75.03	56.84
26	76.75	57.85
27	78.46	58.89
28	80.16	59.95
29	81.83	61.04
30	83.49	62.15
31	85.14	63.29
32	86.76	64.46
33	88.37	65.65
34	89.96	66.87
35	91.53	68.11
36	93.08	69.37
37	94.61	70.66
38	96.12	71.97
39	97.61	73.30
40	99.08	74.65
41	100.53	76.03
42	101.96	77.43
43	103.36	78.86
44	104.75	80.30
45	106.11	81.76
46	107.45	83.25
47	108.77	84.76
48	110.06	86.28
49	111.33	87.83
50	112.57	89.39
51	113.79	90.98
52	114.99	92.58
53	116.16	94.20
54	117.31	95.84
55	118.43	97.49
56	119.53	99.17
57	120.60	100.85
58	121.31	102.02

Circle Center At X = 10.04 ; Y = 169.71 ; and Radius = 130.24

Factor of Safety

*** 1.128 ***

Individual data on the 60 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.0	587.1	0.0	0.0	0.	0.	88.1	88.1	0.0
2	1.0	1175.1	0.0	0.0	0.	0.	176.3	176.3	0.0
3	2.0	2555.4	0.0	0.0	0.	0.	383.3	383.3	0.0
4	2.0	2782.7	0.0	0.0	0.	0.	417.4	417.4	0.0
5	2.0	2999.1	0.0	0.0	0.	0.	449.9	449.9	0.0
6	2.0	3204.6	0.0	0.0	0.	0.	480.7	480.7	0.0
7	1.9	3398.9	0.0	0.0	0.	0.	509.8	509.8	0.0
8	1.9	3582.0	0.0	0.0	0.	0.	537.3	537.3	0.0
9	1.9	3753.7	0.0	0.0	0.	0.	563.1	563.1	0.0
10	1.9	3914.2	0.0	0.0	0.	0.	587.1	587.1	0.0
11	1.9	4063.2	0.0	0.0	0.	0.	609.5	609.5	0.0
12	1.9	4200.7	0.0	0.0	0.	0.	630.1	630.1	0.0
13	1.9	4326.8	0.0	0.0	0.	0.	649.0	649.0	0.0
14	1.9	4441.5	0.0	0.0	0.	0.	666.2	666.2	0.0
15	1.9	4544.7	0.0	0.0	0.	0.	681.7	681.7	0.0
16	1.9	4636.6	0.0	0.0	0.	0.	695.5	695.5	0.0
17	1.8	4717.1	0.0	0.0	0.	0.	707.6	707.6	0.0
18	1.8	4786.3	0.0	0.0	0.	0.	717.9	717.9	0.0
19	1.8	4844.4	0.0	0.0	0.	0.	726.7	726.7	0.0
20	1.8	4891.3	0.0	0.0	0.	0.	733.7	733.7	0.0
21	1.8	4927.3	0.0	0.0	0.	0.	739.1	739.1	0.0
22	1.8	4952.4	0.0	0.0	0.	0.	742.9	742.9	0.0
23	1.8	4966.9	0.0	0.0	0.	0.	745.0	745.0	0.0
24	1.8	4970.8	0.0	0.0	0.	0.	745.6	745.6	0.0
25	1.7	4964.4	0.0	0.0	0.	0.	744.7	744.7	0.0

26	1.7	4947.8	0.0	0.0	0.	0.	742.2	742.2	0.0
27	1.7	4921.2	0.0	0.0	0.	0.	738.2	738.2	0.0
28	1.7	4884.9	0.0	0.0	0.	0.	732.7	732.7	0.0
29	1.7	4839.2	0.0	0.0	0.	0.	725.9	725.9	0.0
30	1.7	4784.1	0.0	0.0	0.	0.	717.6	717.6	0.0
31	1.6	4720.1	0.0	0.0	0.	0.	708.0	708.0	0.0
32	1.6	4647.4	0.0	0.0	0.	0.	697.1	697.1	0.0
33	1.6	4566.3	0.0	0.0	0.	0.	685.0	685.0	0.0
34	1.6	4477.1	0.0	0.0	0.	0.	671.6	671.6	0.0
35	1.6	4380.1	0.0	0.0	0.	0.	657.0	657.0	0.0
36	1.6	4275.6	0.0	0.0	0.	0.	641.3	641.3	0.0
37	1.5	4164.0	0.0	0.0	0.	0.	624.6	624.6	0.0
38	1.5	4045.7	0.0	0.0	0.	0.	606.9	606.9	0.0
39	1.5	3920.9	0.0	0.0	0.	0.	588.1	588.1	0.0
40	1.5	3790.1	0.0	0.0	0.	0.	568.5	568.5	0.0
41	1.4	3653.6	0.0	0.0	0.	0.	548.0	548.0	0.0
42	1.4	3511.8	0.0	0.0	0.	0.	526.8	526.8	0.0
43	1.4	3365.2	0.0	0.0	0.	0.	504.8	504.8	0.0
44	0.6	1488.4	0.0	0.0	0.	0.	223.3	223.3	0.0
45	0.7	1720.3	0.0	0.0	0.	0.	258.0	258.0	0.0
46	1.4	3021.7	0.0	0.0	0.	0.	453.3	453.3	0.0
47	1.3	2829.0	0.0	0.0	0.	0.	424.4	424.4	0.0
48	1.3	2634.9	0.0	0.0	0.	0.	395.2	395.2	0.0
49	1.2	2332.1	0.0	0.0	0.	0.	349.8	349.8	0.0
50	0.1	107.6	0.0	0.0	0.	0.	16.1	16.1	0.0
51	1.3	2206.5	0.0	0.0	0.	0.	331.0	331.0	0.0
52	1.2	1944.6	0.0	0.0	0.	0.	291.7	291.7	0.0
53	1.2	1686.9	0.0	0.0	0.	0.	253.0	253.0	0.0
54	1.2	1433.9	0.0	0.0	0.	0.	215.1	215.1	0.0
55	1.2	1186.0	0.0	0.0	0.	0.	177.9	177.9	0.0
56	1.1	943.7	0.0	0.0	0.	0.	141.6	141.6	0.0
57	1.1	707.4	0.0	0.0	0.	0.	106.1	106.1	0.0
58	1.1	477.5	0.0	0.0	0.	0.	71.6	71.6	0.0
59	1.1	254.5	0.0	0.0	0.	0.	38.2	38.2	0.0
60	0.7	49.3	0.0	0.0	0.	0.	7.4	7.4	0.0

Failure Surface Specified By 56 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.32
3	33.95	41.66
4	35.91	42.04
5	37.87	42.46
6	39.82	42.90
7	41.76	43.38
8	43.69	43.88
9	45.62	44.42
10	47.54	45.00
11	49.44	45.60
12	51.34	46.24
13	53.22	46.90
14	55.10	47.60
15	56.96	48.33
16	58.81	49.09
17	60.65	49.88
18	62.47	50.70
19	64.28	51.55
20	66.08	52.43
21	67.86	53.34
22	69.62	54.28
23	71.37	55.25
24	73.11	56.25
25	74.82	57.27
26	76.52	58.33
27	78.20	59.41
28	79.87	60.52
29	81.51	61.66

30	83.14	62.83
31	84.74	64.02
32	86.33	65.24
33	87.90	66.48
34	89.44	67.75
35	90.96	69.05
36	92.47	70.37
37	93.95	71.71
38	95.40	73.08
39	96.84	74.47
40	98.25	75.89
41	99.64	77.33
42	101.00	78.80
43	102.34	80.28
44	103.65	81.79
45	104.94	83.32
46	106.21	84.87
47	107.44	86.44
48	108.65	88.03
49	109.84	89.64
50	111.00	91.27
51	112.13	92.92
52	113.23	94.59
53	114.31	96.28
54	115.35	97.98
55	116.37	99.70
56	117.28	101.30

Circle Center At X = 12.07 ; Y = 160.29 ; and Radius = 120.62

Factor of Safety

*** 1.128 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.97	41.33
3	33.94	41.68
4	35.91	42.07
5	37.86	42.48
6	39.81	42.92
7	41.76	43.39
8	43.69	43.89
9	45.62	44.42
10	47.54	44.98
11	49.46	45.56
12	51.36	46.17
13	53.25	46.81
14	55.14	47.48
15	57.01	48.18
16	58.88	48.91
17	60.73	49.66
18	62.57	50.44
19	64.40	51.25
20	66.22	52.08
21	68.02	52.94
22	69.82	53.83
23	71.60	54.74
24	73.36	55.69
25	75.11	56.65
26	76.85	57.64
27	78.57	58.66
28	80.27	59.71
29	81.96	60.78
30	83.64	61.87
31	85.30	62.99
32	86.94	64.13
33	88.56	65.30
34	90.17	66.49

35	91.76	67.71
36	93.33	68.94
37	94.88	70.21
38	96.41	71.49
39	97.93	72.80
40	99.42	74.13
41	100.89	75.48
42	102.35	76.85
43	103.78	78.25
44	105.20	79.66
45	106.59	81.10
46	107.96	82.55
47	109.30	84.03
48	110.63	85.53
49	111.93	87.05
50	113.22	88.58
51	114.47	90.14
52	115.71	91.71
53	116.92	93.30
54	118.11	94.91
55	119.27	96.54
56	120.41	98.18
57	121.53	99.84
58	122.62	101.52
59	123.14	102.35

Circle Center At X = 9.08 ; Y = 174.15 ; and Radius = 134.78

Factor of Safety

*** 1.129 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.97	41.32
3	33.94	41.67
4	35.91	42.05
5	37.87	42.46
6	39.82	42.89
7	41.76	43.35
8	43.70	43.84
9	45.64	44.36
10	47.56	44.91
11	49.47	45.48
12	51.38	46.09
13	53.28	46.72
14	55.17	47.38
15	57.05	48.06
16	58.92	48.77
17	60.77	49.51
18	62.62	50.28
19	64.46	51.07
20	66.28	51.89
21	68.09	52.74
22	69.89	53.61
23	71.68	54.51
24	73.45	55.43
25	75.21	56.38
26	76.96	57.36
27	78.69	58.36
28	80.41	59.39
29	82.11	60.44
30	83.80	61.51
31	85.47	62.61
32	87.12	63.74
33	88.76	64.88
34	90.38	66.06
35	91.98	67.25
36	93.57	68.47

37	95.14	69.71
38	96.69	70.97
39	98.22	72.26
40	99.73	73.57
41	101.22	74.90
42	102.70	76.25
43	104.15	77.62
44	105.59	79.02
45	107.00	80.43
46	108.39	81.87
47	109.77	83.32
48	111.12	84.80
49	112.45	86.29
50	113.75	87.81
51	115.04	89.34
52	116.30	90.89
53	117.54	92.46
54	118.76	94.05
55	119.95	95.65
56	121.12	97.27
57	122.27	98.91
58	123.39	100.57
59	124.49	102.24
60	124.74	102.63

Circle Center At X = 8.98 ; Y = 176.95 ; and Radius = 137.56

Factor of Safety

*** 1.132 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.31
3	33.95	41.65
4	35.91	42.02
5	37.87	42.42
6	39.83	42.85
7	41.77	43.31
8	43.71	43.79
9	45.65	44.31
10	47.57	44.85
11	49.49	45.42
12	51.40	46.02
13	53.29	46.65
14	55.18	47.31
15	57.06	47.99
16	58.93	48.71
17	60.79	49.45
18	62.63	50.21
19	64.47	51.01
20	66.29	51.83
21	68.10	52.68
22	69.90	53.56
23	71.68	54.47
24	73.45	55.40
25	75.21	56.35
26	76.95	57.34
27	78.68	58.35
28	80.39	59.38
29	82.09	60.44
30	83.77	61.53
31	85.43	62.64
32	87.08	63.77
33	88.71	64.93
34	90.32	66.11
35	91.91	67.32
36	93.49	68.55
37	95.05	69.81

38	96.59	71.08
39	98.11	72.38
40	99.61	73.71
41	101.09	75.05
42	102.55	76.42
43	103.98	77.81
44	105.40	79.22
45	106.80	80.65
46	108.18	82.10
47	109.53	83.57
48	110.86	85.06
49	112.17	86.58
50	113.46	88.11
51	114.72	89.66
52	115.96	91.23
53	117.18	92.81
54	118.37	94.42
55	119.54	96.04
56	120.68	97.68
57	121.80	99.34
58	122.90	101.01
59	123.82	102.47

Circle Center At X = 10.21 ; Y = 173.56 ; and Radius = 134.03

Factor of Safety

*** 1.133 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.29
3	33.96	41.60
4	35.92	41.95
5	37.89	42.33
6	39.84	42.75
7	41.79	43.19
8	43.74	43.67
9	45.67	44.18
10	47.59	44.73
11	49.51	45.30
12	51.42	45.91
13	53.31	46.54
14	55.20	47.21
15	57.07	47.91
16	58.93	48.64
17	60.78	49.40
18	62.62	50.20
19	64.44	51.02
20	66.25	51.87
21	68.05	52.75
22	69.83	53.66
23	71.59	54.61
24	73.34	55.58
25	75.07	56.57
26	76.79	57.60
27	78.49	58.66
28	80.17	59.74
29	81.83	60.85
30	83.47	61.99
31	85.10	63.16
32	86.71	64.35
33	88.29	65.57
34	89.86	66.81
35	91.40	68.08
36	92.92	69.38
37	94.43	70.70
38	95.90	72.05
39	97.36	73.42

40	98.80	74.81
41	100.21	76.23
42	101.59	77.67
43	102.96	79.13
44	104.29	80.62
45	105.61	82.13
46	106.90	83.66
47	108.16	85.21
48	109.40	86.78
49	110.61	88.37
50	111.79	89.98
51	112.95	91.61
52	114.08	93.26
53	115.19	94.93
54	116.26	96.62
55	117.31	98.32
56	118.33	100.04
57	119.24	101.65

Circle Center At X = 13.87 ; Y = 160.73 ; and Radius = 120.81

Factor of Safety

*** 1.135 ***

Failure Surface Specified By 58 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.28
3	33.96	41.58
4	35.93	41.92
5	37.89	42.29
6	39.85	42.70
7	41.80	43.14
8	43.75	43.60
9	45.69	44.10
10	47.61	44.64
11	49.53	45.20
12	51.44	45.80
13	53.34	46.43
14	55.23	47.09
15	57.11	47.78
16	58.97	48.50
17	60.82	49.25
18	62.66	50.03
19	64.49	50.85
20	66.30	51.69
21	68.10	52.56
22	69.89	53.46
23	71.66	54.40
24	73.41	55.36
25	75.15	56.35
26	76.87	57.37
27	78.57	58.42
28	80.26	59.49
29	81.93	60.59
30	83.58	61.72
31	85.21	62.88
32	86.82	64.07
33	88.41	65.28
34	89.98	66.52
35	91.53	67.78
36	93.06	69.07
37	94.57	70.38
38	96.06	71.72
39	97.52	73.08
40	98.96	74.47
41	100.38	75.88
42	101.77	77.32
43	103.14	78.77

44	104.49	80.25
45	105.81	81.75
46	107.11	83.28
47	108.38	84.82
48	109.62	86.39
49	110.84	87.97
50	112.03	89.58
51	113.20	91.20
52	114.34	92.85
53	115.45	94.51
54	116.53	96.19
55	117.59	97.89
56	118.61	99.61
57	119.61	101.34
58	119.84	101.76

Circle Center At X = 14.48 ; Y = 160.76 ; and Radius = 120.76

Factor of Safety

*** 1.137 ***

Failure Surface Specified By 59 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.28
3	33.96	41.58
4	35.93	41.91
5	37.90	42.28
6	39.86	42.67
7	41.81	43.10
8	43.76	43.55
9	45.70	44.04
10	47.63	44.55
11	49.56	45.10
12	51.47	45.68
13	53.38	46.29
14	55.27	46.92
15	57.16	47.59
16	59.03	48.28
17	60.90	49.01
18	62.75	49.76
19	64.59	50.55
20	66.42	51.36
21	68.23	52.20
22	70.03	53.07
23	71.82	53.96
24	73.60	54.89
25	75.35	55.84
26	77.10	56.82
27	78.83	57.82
28	80.54	58.86
29	82.23	59.92
30	83.91	61.01
31	85.58	62.12
32	87.22	63.26
33	88.85	64.42
34	90.45	65.61
35	92.04	66.83
36	93.61	68.06
37	95.16	69.33
38	96.69	70.62
39	98.20	71.93
40	99.69	73.26
41	101.16	74.62
42	102.61	76.00
43	104.03	77.41
44	105.43	78.83
45	106.81	80.28
46	108.17	81.75

47	109.51	83.24
48	110.82	84.75
49	112.10	86.28
50	113.37	87.83
51	114.60	89.40
52	115.82	90.99
53	117.01	92.60
54	118.17	94.23
55	119.31	95.87
56	120.42	97.53
57	121.50	99.21
58	122.56	100.91
59	123.46	102.40

Circle Center At X = 13.66 ; Y = 167.72 ; and Radius = 127.77

Factor of Safety

*** 1.141 ***

Failure Surface Specified By 56 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.26
3	33.96	41.55
4	35.94	41.88
5	37.90	42.24
6	39.86	42.64
7	41.82	43.07
8	43.76	43.54
9	45.70	44.04
10	47.62	44.58
11	49.54	45.15
12	51.45	45.75
13	53.34	46.39
14	55.22	47.07
15	57.09	47.77
16	58.95	48.51
17	60.80	49.29
18	62.63	50.09
19	64.44	50.93
20	66.24	51.80
21	68.03	52.71
22	69.79	53.64
23	71.54	54.61
24	73.28	55.61
25	74.99	56.64
26	76.69	57.70
27	78.37	58.79
28	80.02	59.91
29	81.66	61.06
30	83.27	62.24
31	84.87	63.44
32	86.44	64.68
33	87.99	65.94
34	89.52	67.24
35	91.02	68.56
36	92.50	69.90
37	93.96	71.27
38	95.39	72.67
39	96.79	74.09
40	98.17	75.54
41	99.53	77.01
42	100.85	78.51
43	102.15	80.03
44	103.42	81.57
45	104.67	83.14
46	105.88	84.73
47	107.07	86.34
48	108.23	87.97

49	109.36	89.62
50	110.46	91.29
51	111.53	92.98
52	112.57	94.69
53	113.57	96.42
54	114.55	98.16
55	115.50	99.92
56	116.09	101.09

Circle Center At X = 16.74 ; Y = 151.73 ; and Radius = 111.52

Factor of Safety

*** 1.142 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	41.00
2	31.98	41.26
3	33.96	41.55
4	35.94	41.87
5	37.91	42.22
6	39.87	42.60
7	41.83	43.01
8	43.78	43.45
9	45.72	43.93
10	47.66	44.43
11	49.58	44.97
12	51.50	45.53
13	53.41	46.13
14	55.31	46.76
15	57.20	47.41
16	59.08	48.10
17	60.95	48.81
18	62.80	49.56
19	64.65	50.33
20	66.48	51.13
21	68.30	51.97
22	70.10	52.83
23	71.89	53.72
24	73.67	54.63
25	75.43	55.58
26	77.18	56.55
27	78.91	57.55
28	80.63	58.58
29	82.33	59.64
30	84.01	60.72
31	85.67	61.83
32	87.32	62.96
33	88.95	64.12
34	90.56	65.31
35	92.15	66.52
36	93.72	67.75
37	95.28	69.01
38	96.81	70.30
39	98.32	71.61
40	99.81	72.94
41	101.28	74.30
42	102.73	75.68
43	104.15	77.08
44	105.56	78.51
45	106.94	79.95
46	108.30	81.42
47	109.63	82.91
48	110.94	84.42
49	112.23	85.95
50	113.49	87.51
51	114.73	89.08
52	115.94	90.67
53	117.13	92.28

```
   54        118.29       93.90
   55        119.42       95.55
   56        120.53       97.22
   57        121.62       98.90
   58        122.67      100.59
   59        123.70      102.31
   60        123.79      102.46
Circle Center At X =    14.79 ; Y =   166.50 ; and Radius =   126.42
       Factor of Safety
      ***    1.145   ***
          **** END OF GSTABL7 OUTPUT ****
```

SURFICIAL STABILITY

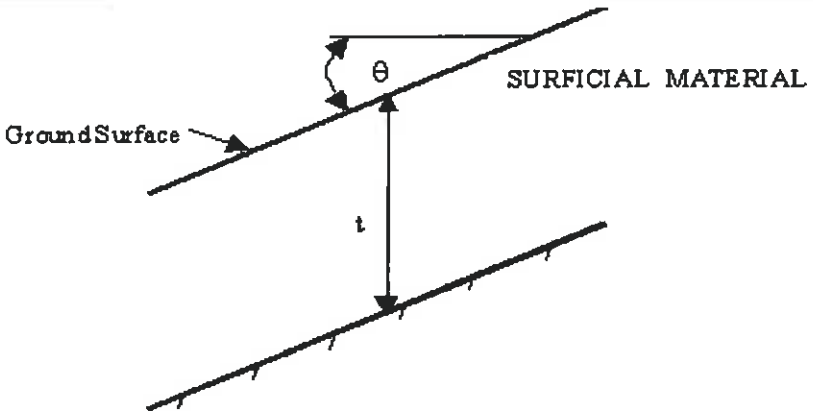
JN: I11-2439-10 CONSULT: LGC
CLIENT: MDMG-Oak Canyon

CALCULATION SHEET # 1

CALCULATE THE SURFICIAL STABILITY OF THE EARTH MATERIAL USING THE INFINITE SLOPE ANALYSIS WITH PARALLEL SEEPAGE. THIS METHOD WAS RECOMMENDED BY THE ASCE AND THE BUILDING AND SAFETY ADVISORY COMMITTEE (8/16/78). MODIFIED FROM SKEMPTON & DeLORY, 1957.

CALCULATION PARAMETERS

EARTH MATERIAL:	Cretaceous Gabbro		
COHESION:	235 psf	SHEAR DIAGRAM:	Direct Shear Plot
PHI ANGLE:	36 degrees	SLOPE ANGLE:	33.7 degrees
DENSITY:	140 pcf	SATURATION DEPTH (t):	4.0 feet

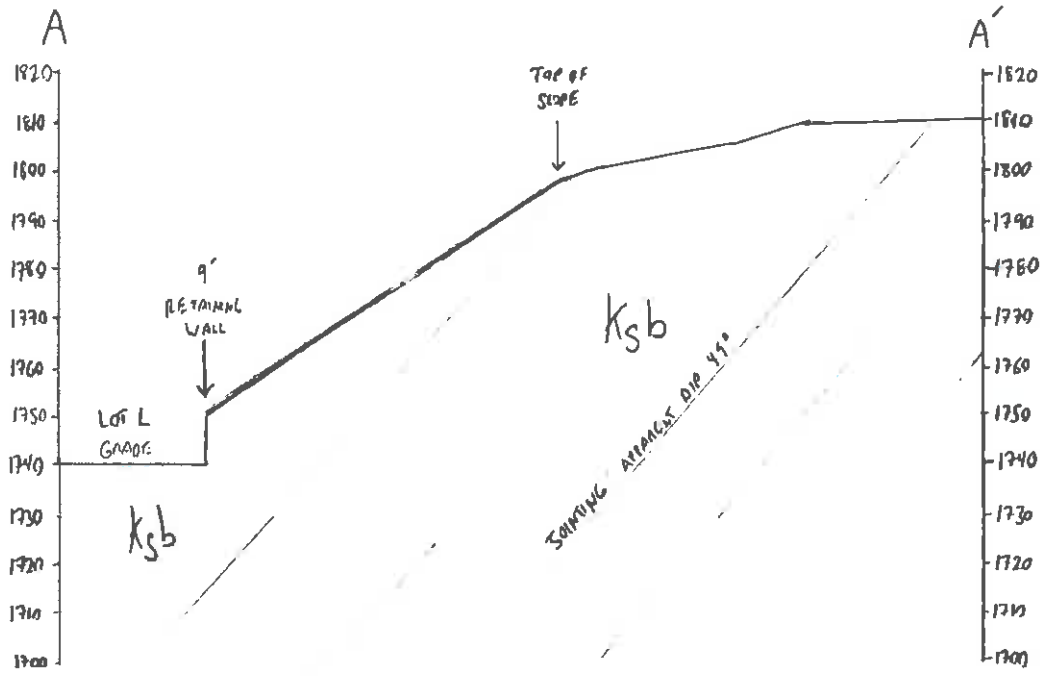


$$FS = \frac{C + (\gamma_{soil} - \gamma_{water}) \bullet t \bullet \cos^2\theta \tan\Phi}{\gamma_{soil} \bullet t \bullet \cos\Phi \sin\Phi}$$

SAFETY FACTOR = 1.51

CONCLUSIONS:

THE CALCULATION INDICATES THAT CRETACEOUS GABBRO CUT SLOPES ARE SURFICIALLY STABLE. (*Lab Cohesion value utilized based on direct sampling)



LEGEND

Design Grade

Cretaceous Gabbro (Kgb)- red brown to gray brown, moderately hard to very hard, fine to medium grained, moderately jointed

LGC INLAND

CROSS SECTION
A-A'

Project Name	Oak Creek Canyon
Project No.	I11-2439-10
Geol./ Eng.	SER/LDC
Scale	40-Scale
Date	January 2012

APPENDIX F

SEISMIC REFRACTION SURVEY

TERRA GEOSCIENCES

SEISMIC REFRACTION SURVEY

OAK CREEK PROJECT

TENTATIVE TRACT NO. 36388

CITY OF WILDOMAR, CALIFORNIA

Project No. 112554-1

December 14, 2011

Prepared for:

LGC Inland, Inc.
41635 Enterprise Circle North
Suite A
Temecula, CA 92590-5657

Consulting Engineering Geology & Geophysics

P.O. Box 1090, Loma Linda, CA 92354 • 909-796-4667

LGC Inland, Inc.
41635 Enterprise Circle North
Suite A
Temecula, CA 92590-5657

Attention: Mr. Chris Josef, Project Engineer

Regarding: Seismic Refraction Survey
Oak Creek Project
Tentative Tract No. 36388
City of Wildomar, California
LGC Inland Project No. I112439

INTRODUCTION

As requested, this firm has performed a geophysical survey using the seismic refraction method along selected portions of the proposed tentative tract as directed by you. The purpose of this investigation was to assess the general seismic velocity characteristics of the underlying earth materials and to aid in evaluating whether high velocity bedrock (non-rippable) are present which could indicate potential excavation difficulties. According to Morton (2003), the site where locally surveyed is underlain by Cretaceous age igneous bedrock described as being a brown-weathering, medium- to very coarse-grained, hornblende gabbro.

The approximate locations of the survey lines are presented on partial copies of the Tentative Tract Map No. 36388, prepared by VSL Engineering, Temecula, California, as presented on the Seismic Line Location Map, Plate 1. As authorized by you, the following services were performed during this study:

- Review of available published and unpublished geologic/geophysical data in our files pertinent to the site.
- Performing a geophysical survey by a State of California licensed Professional Geophysicist; to include three seismic refraction traverses.
- Preparation of this report, presenting our findings and conclusions with respect to the velocity characteristics and the expected excavation potentials of the subsurface earth materials.

Accompanying Maps and Appendices

Plate 1 - Seismic Line Location Map
Appendix A - Layer Velocity Models
Appendix B - Refraction Tomographic Models
Appendix C - Excavation Considerations
Appendix D - References

SEISMIC REFRACTION SURVEY

Methodology

The seismic refraction method consists of measuring (at known points along the surface of the ground) the travel times of compressional waves generated by an impulsive energy source and can be used to estimate the layering, structure, and seismic acoustic velocities of subsurface horizons. Seismic waves travel down and through the soils and rocks, and when the wave encounters a contact between two earth materials having different velocities, some of the wave's energy travels along the contact at the velocity of the lower layer. The fundamental assumption is that each successively deeper layer has a velocity greater than the layer immediately above it. As the wave travels along the contact, some of the wave's energy is refracted toward the surface where it is detected by a series of motion-sensitive transducers (geophones). The arrival time of the seismic wave at the geophone locations can be related to the relative seismic velocities of the subsurface layers in feet per second (fps), which can then be used to aid in interpreting both the depth and type of materials encountered.

Field Procedures

Three seismic refraction survey lines (Seismic Lines S-1 & S-2 both being 125 feet long and Seismic Line S-3 at 200 feet in length) were performed within the subject study area as shown on Plate 1. A 16-pound sledge-hammer was used as the energy source to produce the seismic waves and twenty-four, 14-Hz geophones (spaced at five-foot and eight-foot centers) were employed to detect both the direct and refracted waves. The seismic wave arrivals were digitally recorded in SEG-2 format on a Geometrics StrataVisor™ NZXP model signal enhancement refraction seismograph. Seven shot points were utilized along each spread using forward, reverse, and several intermediate locations in order to obtain high resolution survey data for velocity analysis and depth modeling purposes. The data was acquired using a sampling rate of 0.0625 milliseconds having a record length of 0.064 to 0.10 seconds with no acquisition filters. During acquisition, the seismograph provides both a hard copy and screen display of the seismic wave arrivals, of which are digitally recorded on the in-board seismograph computer. The data on the paper record and/or display screen were used to analyze the arrival time of the primary seismic "P"-waves at each geophone station, in the form of a wiggle trace, or wave travel-time curve, for quality control purposes in the field. Each geophone and shot location was surveyed using a hand level and ruler for topographic correction purposes, with the lowest portion of each survey line being the reference "0" elevation.

Data Reduction

All of the recorded field data was subsequently transferred to our office computer for further processing, analyzing, and printing purposes, using the computer programs **SIPwin** (**S**eismic Refraction Interpretation **P**rogram for **Win**dows) developed by Rimrock Geophysics, Inc. (2003), and **Rayfract™** (Intelligent Resources, Inc., 1996-2011). **SIPwin** is a ray-trace modeling program that evaluates the subsurface using layer

assignments based on time-distance curves and is better suited for layered media, using the "Seismic Refraction Modeling by Computer" method (Scott, 1973). The first step in the modeling procedure is to compute layer velocities by least-squares techniques. Then the program uses the delay-time method to estimate depths to the top of layer-2. A forward modeling routine traces rays from the shot points to each geophone that received a first-arrival ray refracted along the top of layer-2. The travel time of each such ray is compared with the travel time recorded in the field by the seismic system. The program then adjusts the layer-2 depths so as to minimize discrepancies between the computed ray-trace travel times and the first arrival times picked from the seismic waveform record. The process of ray tracing and model adjustment is repeated a total of three times to improve the accuracy of depths to the top of layer-2.

Rayfract™ is seismic refraction tomography software that models subsurface refraction, transmission, and diffraction of acoustic waves which generally indicates the relative structure and velocity distribution of the subsurface using first break energy propagation modeling. An initial 1D gradient model is created using the Delta-t-V method which gives a good initial fit between modeled and picked first breaks. This initial model is then refined automatically with a true 2D WET (Wavepath Eikonal Traveltime) tomographic inversion (Schuster and Quintus-Bosz, 1993). WET tomography models multiple signal propagation paths contributing to one first break, whereas conventional ray tracing tomography is limited to the modeling of just one ray per first break. Both computer programs perform their analysis using exactly the same input data for each line, which includes first-arrival P-waves and line geometry.

SUMMARY OF GEOPHYSICAL INTERPRETATION

To begin our discussion, it is important to consider that the seismic velocities obtained within bedrock materials are influenced by the nature and character of the localized major structural discontinuities (foliation, fracturing, bedding, etc.), creating anisotropic conditions. Anisotropy (direction-dependent properties of materials) can be caused by "micro-cracks," jointing, foliation, layered or interbedded rocks with unequal layer stiffness, small-scale lithologic changes, etc. (Barton, 2007). Velocity anisotropy complicates interpretation and it should be noted that the seismic velocities obtained during this survey may have been influenced by the nature and character of the localized major structural discontinuities within the bedrock underlying the site.

Generally, it is expected that higher (truer) velocities will be obtained when the seismic waves propagate along direction (strike) of the dominant structure, with a damping effect when the seismic waves travel in a perpendicular direction. Such variable directions can result in velocity differentials of between 2% to 40% depending upon the degree of the structural fabric (i.e., weakly-moderately-strongly foliated, respectively). Therefore, the seismic velocities obtained during our field study and as discussed below, should be considered minimum velocities at this time.

The analysis of the data was performed using the two methods as previously discussed. The first method described below is the traditional layer method (**SIPwin**). Using this method, it should be understood that the data obtained represents an average of seismic velocities within any given layer. For example, high seismic velocity boulders/dikes/bedding planes or other local lithologic inconsistencies may be isolated within a low velocity matrix, thus yielding an average medium velocity for that layer. Therefore, in any given layer, a range of velocities could be anticipated, which can also result in a wide range of excavation characteristics.

In general, the site where locally surveyed was noted to be characterized by two to three major subsurface layers with respect to seismic velocities. The following velocity layer summaries have been prepared using the **SIPwin** analysis, with the representative Layer Velocity Models presented within Appendix A, displaying the "weighted average" subsurface velocities in generalized layers.

- **Velocity Layer V1**:

  This uppermost velocity layer (V1) is most likely comprised of topsoil, colluvium, and/or completely-weathered and intensely fractured granitic bedrock materials. This layer has an average weighted velocity of 1,273 to 1,539 fps, which is typical for these types of near-surface materials.

- **Velocity Layer V2**:

  The second layer (V2) yielded seismic velocities of 2,111 to 2,778 fps, indicating the presence of very highly-weathered bedrock materials. These velocities are typical for the near surface weathered zone commonly found in granitic rocks in the southern California region. These velocities may indicate the possibility of buried relatively-fresher large boulders in a very-highly decomposed bedrock matrix and/or homogeneous weathered granitic bedrock with relatively wide spacing of the local joint/fracture system.

- **Velocity Layer V3**:

  The third layer (V3) indicates highly- to moderately-weathered bedrock, with a range of average weighted velocities between 3,644 to 4,637 fps. These relatively higher velocities signify the decreasing effect of bedrock weathering as a function of depth along with the possibility of abundant widely-scattered buried large boulders and dikes within a highly to moderately decomposed bedrock matrix as suggested by the local bedrock outcroppings and structure in the vicinity of the site.

Relatively recent geophysical analytical tools have been developed that better illustrate the general structure and velocity distribution of the subsurface by the use of tomographic inversion modeling. Using the computer program **Rayfract™**, tomographic models were also prepared and analyzed for comparative purposes, as presented within Appendix B. Although no discrete velocity layers or boundaries are created,

these models generally resemble the corresponding **SIPwin** velocities. It can be seen in these models that the seismic velocity (i.e., hardness) of the bedrock gradually increases with depth which is most likely the representative condition of the subsurface materials, along with some lateral variations suggestive of localized fresher corestones. It was also noted that for the most part, the seismic velocities on the Layer Velocity Models (Appendix A) appears to generally correlate with the average of the velocity gradients as shown on the Refraction Tomographic Models (Appendix B).

GENERALIZED RIPPABILITY CHARACTERISTICS OF BEDROCK

A summary of the generalized rippability characteristics of bedrock based on a compilation of rippability performance charts prepared by Caterpillar, Inc. (2004), Caltrans (Stephens, 1978), and Santi (2006), has been provided to aid in evaluating potential excavation difficulties with respect to the seismic velocities obtained along the local areas surveyed. These seismic velocity ranges and rippability potentials have been tabulated below for reference.

TABLE 1- CATERPILLAR RIPPABILITY CHART (D9 Ripper)

Granitic Rock Velocity (feet/sec ±)	Rippability
< 6,800	Rippable
6,800 – 8,000	Moderately Rippable
> 8,000	Non-Rippable

Additionally, we have provided the Caltrans Rippability Chart as presented below within Table 2 for comparison. These values are from published Caltrans studies (Stephens, 1978) that are based on their experience which are more conservative than Caterpillar's rippability charts. It should be noted that the type of bedrock was not defined.

TABLE 2- STANDARD CALTRANS RIPPABILITY CHART

Velocity (feet/sec ±)	Rippability
< 3,500	Easily Ripped
3,500 – 5,000	Moderately Difficult
5,000 – 6,600	Difficult Ripping / Light Blasting
> 6,600	Blasting Required

Table 3 is partially modified from the "Engineering Behavior from Weathering Grade" as presented by Santi (2006), which also provides velocity ranges with respect to rippability potentials, along with other rock engineering properties that are pertinent for this study.

TABLE 3- SUMMARY OF ROCK ENGINEERING PROPERTIES

ENGINEERING PROPERTY:	Slightly Weathered	Moderately Weathered	Highly Weathered	Completely Weathered
Excavatability	Blasting necessary	Blasting to rippable	Generally rippable	Rippable
Slope Stability	½ :1 to 1:1 (H:V)	1:1 (H:V)	1:1 to 1.5:1 (H:V)	1.5:1 to 2:1 (H:V)
Schmidt Hammer Value	51 – 56	37 – 48	12 – 21	5 – 20
Seismic Velocity (fps)	8,200 – 13,125	5,000 – 10,000	3,300 – 6,600	1,650 – 3,300

A summary of the generalized rippability characteristics of granitic bedrock has been provided to aid in evaluating potential excavation difficulties with respect to the seismic velocities obtained along the local areas surveyed. The velocity ranges described below are approximate and assume typical, good-working, heavy excavation equipment, such as single shank or D9R dozer, such as described by Caterpillar, Inc. (2000 and 2004); however, different excavating equipment (i.e., trenching equipment) may not correlate well with these velocity ranges. Trenching operations within granitic bedrock materials with seismic velocities generally greater than 3,500 to 4,000±-fps, typically encounter very difficult to non-productable conditions.

The seismic velocity ranges described below are considered approximate and assume typical, good-working, heavy excavation equipment, such as a D9R/D9T dozer, such as described by Caterpillar, Inc. (2000 and 2004); however, different excavating equipment (i.e., trenching equipment) may not correlate well with these velocity ranges.

- ***Rippable Condition (0 - 4,000 ft/sec)***:

  This velocity range indicates rippable materials which may consist of alluvial-type deposits and decomposed granitic bedrock, with random hardrock floaters. These materials typically break down into silty sands (depending on parent lithologic materials), whereas floaters will require special disposal. Some areas containing numerous hardrock floaters may present utility trench problems. Large floaters exposed at or near finished grade may present problems for footing or infrastructure trenching.

- ***Marginally Rippable Condition (4,000 - 7,000 ft/sec)***:

  This range of seismic velocities indicates materials which may consist of moderately weathered bedrock and/or large areas of fresh bedrock materials separated by weathered fractured zones. These bedrock materials are generally rippable with difficulty by a Caterpillar D9R or equivalent. Excavations may produce material that will partially break down into a coarse, silty to clean sand, with a high percentage of very coarse sand to pebble-sized material depending on the parent bedrock lithology. Less fractured or weathered materials will probably require blasting to facilitate removal.

- **Non-Rippable Condition (7,000 ft/sec or greater)**:

  This velocity range includes non-rippable material consisting primarily of moderately fractured bedrock at lower velocities and only slightly fractured or unfractured rock at higher velocities. Materials in this velocity range may be marginally rippable, depending upon the degree of fracturing and the skill and experience of the operator. Tooth penetration is often the key to ripping success, regardless of seismic velocity. If the fractures and joints do not allow tooth penetration, the material may not be ripped effectively; however, pre-blasting or "popping" may induce sufficient fracturing to permit tooth entry. In their natural state, materials with these velocities are generally not desirable for building pad grade, due to difficulty in footing and utility trench excavation. Blasting will most likely produce oversized material, requiring special disposal.

GEOLOGIC & EARTHWORK CONSIDERATIONS

To evaluate whether a particular bedrock material can be ripped or excavated, this geophysical survey should be used in conjunction with the geologic and/or geotechnical report and/or information gathered for the subject project which may describe the physical properties of the bedrock. The physical characteristics of bedrock materials that favor ripping generally include the presence of fractures, faults, and other structural discontinuities, weathering effects, brittleness or crystalline structure, stratification or lamination, large grain size, moisture permeated clay, and low compressive strength. If the bedrock is foliated and/or fractured at depth, this structure could aid in excavation production.

Unfavorable bedrock conditions can include such characteristics as massive and homogeneous formations, non-crystalline structure, absence of planes of weakness, fine-grained materials, and formations of clay origin where moisture makes the material plastic. Use of these physical bedrock conditions and characteristics along with the subsurface seismic velocities as presented within this report should aid in properly evaluating the type of equipment necessary and the production levels that can be anticipated.

A summary of excavation considerations has been included within Appendix C in order to provide you and your client with a better understanding of the complexities of excavation in bedrock materials. These concepts should be understood so that proper planning and excavation techniques can be employed by the selected grading contractor. For purposes of the discussion in this report with respect to the expected bedrock rippability characteristics, we are assuming that a D9R dozer will be used as a minimum. Smaller excavating equipment will most likely result in slower production rates and possible refusal within relatively lower velocity bedrock materials. The decision for blasting of the bedrock materials for facilitating the excavation is sometimes made based upon economic production reasons and not solely on the rippability (velocity/hardness) characteristics of the bedrock.

SUMMARY OF FINDINGS AND CONCLUSIONS

The raw field data was considered to be of very good quality which had only minor amounts of ambient "noise" that was introduced by nearby vehicular traffic along Bundy Canyon Road. Effort was made to time our survey shots when there was a window of little to no vehicular traffic when possible, thereby minimizing such "noise." Therefore, analysis of the data and picking of the primary "P"-wave arrivals was performed with little difficulty with very minor interpolation of the data being necessary. Based on the results of our comparative seismic analyses of both computer programs **SIPwin** and **Rayfract™**, the seismic refraction survey line models appear to generally coincide with one another, with some minor variances due to the methods that these programs process and integrate the input data. The anticipated excavation potentials of the velocity layers encountered locally during our survey are as follows:

- **Velocity Layer V1**:

  No excavating difficulties are expected to be encountered within the uppermost, low-velocity layer V1 (average weighted velocities of 1,273 to 1,539 fps). This layer is expected to be comprised of topsoil, colluvium, and/or completely-weathered and intensely fractured granitic bedrock materials.

- **Velocity Layer V2**:

  The second layer V2 is believed to consist of very highly-weathered granitic bedrock materials (average weighted velocities of 2,111 to 2,778 fps) and is expected to excavate with no major difficulties. Isolated floaters (i.e., boulders, corestones, dikes, etc.) are expected to be present within this layer and could produce somewhat difficult conditions locally.

- **Velocity Layer V3**:

  The third layer V3 is believed to consist of highly- to moderately-weathered bedrock. Excavation difficulties within this deeper velocity layer (average weighted velocities of 3,644 to 4,637 fps) could be anticipated. Hard excavating areas consisting of localized higher velocity boulders and/or dikes would most likely be encountered. Although not anticipated, some minor local blasting, rock breaking, or other excavation methods may be necessary to achieve desired grade (expected to be more likely in the placement of infrastructure).

Using the rock classification from Santi (2006) as presented within Table 3, seismic wave velocities of less than 7,000 fps generally indicate weak rocks (including weathered materials), which would include velocity layers V1 through V3 and is noted to be generally within the threshold for conventional ripping. Based on the tomographic models and typical excavation characteristics observed within granitic bedrock of the southern California region, anticipation of gradual increasing hardness with depth along with lateral variations (generally due to the presence of buried corestones), should be anticipated within the project study area.

CLOSURE

The field survey was performed by the undersigned on December 6 through 8, 2011 using "state of the art" geophysical equipment and techniques along selected portions of the subject study area as directed by you. The seismic data was further evaluated using recently developed tomographic inversion techniques to provide a more thorough analysis and understanding of the subsurface structural conditions. It should be noted that our data was obtained along only three specific locations therefore other areas in the local vicinity beyond the limits of our seismic lines may contain different velocity layers and depths not encountered during our field survey. Estimates of layer velocity boundaries as presented in this report are generally considered to be within 10± percent of the total depth of the contact. In summary, the results of this survey are to be considered as an aid to assessing the rippability and excavation potentials of the bedrock locally. This information should be carefully reviewed by the grading contractor and representative "test" excavations with the proposed type of excavation equipment for the proposed construction should be considered, so that they may be correlated with the data presented within this report.

Client should understand that when using the theoretical geophysical principles and techniques discussed in this report, sources of error are possible in both the data obtained and in the interpretation and that the results of this survey may not represent actual subsurface conditions. These are all factors beyond **Terra Geosciences** control and no guarantees as to the results of this survey can be made. We make no warranty, either expressed or implied. If the client does not understand the limitations of this geophysical survey, additional input should be sought from the consultant.

Respectfully submitted,
TERRA GEOSCIENCES

Donn C. Schwartzkopf
Principal Geophysicist
PGP 1002

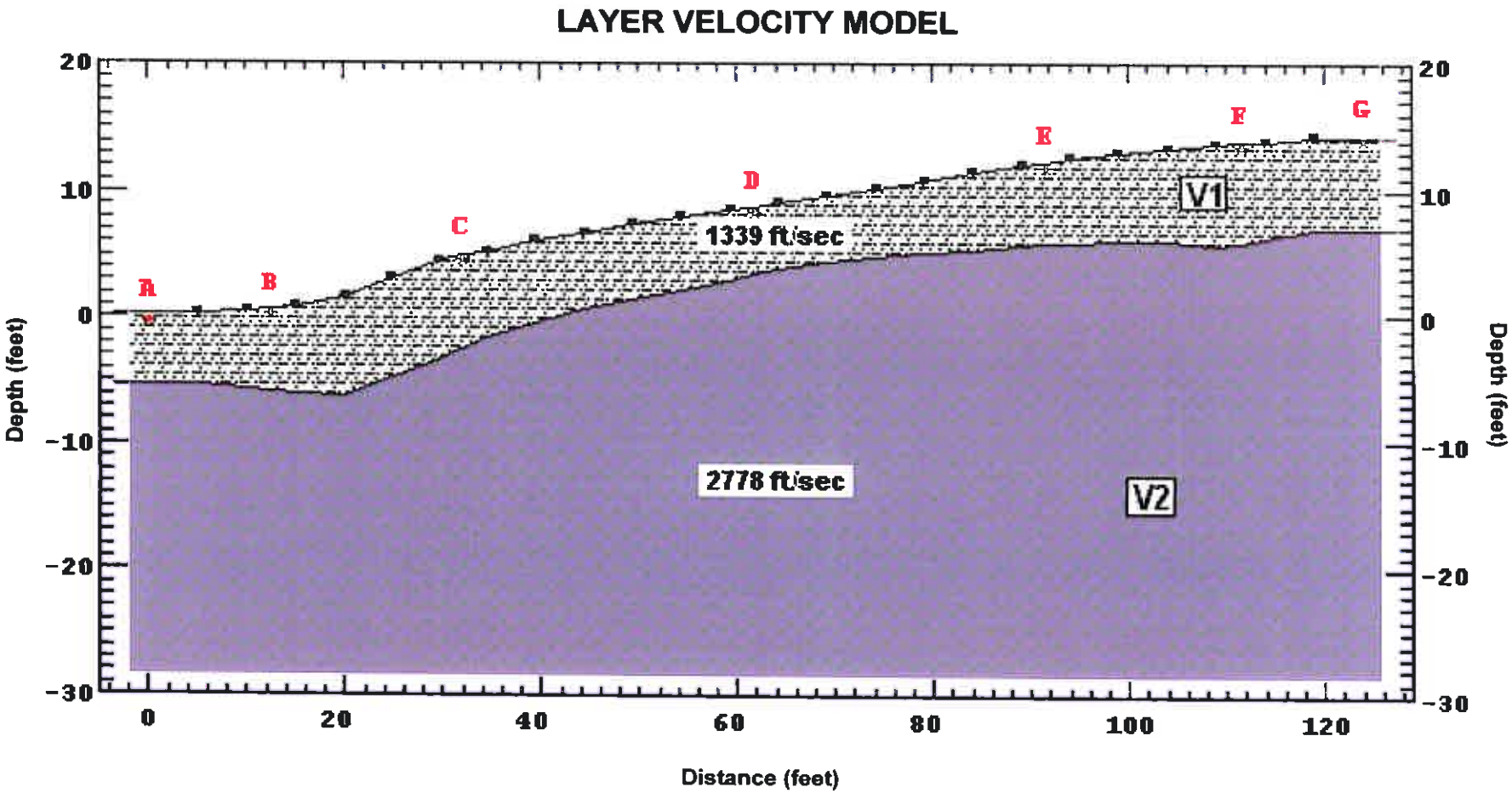
PROFESSIONAL GEOPHYSICIST
DONN C. SCHWARTZKOPF
No. 1002
STATE OF CALIFORNIA

APPENDIX A

LAYER VELOCITY MODELS

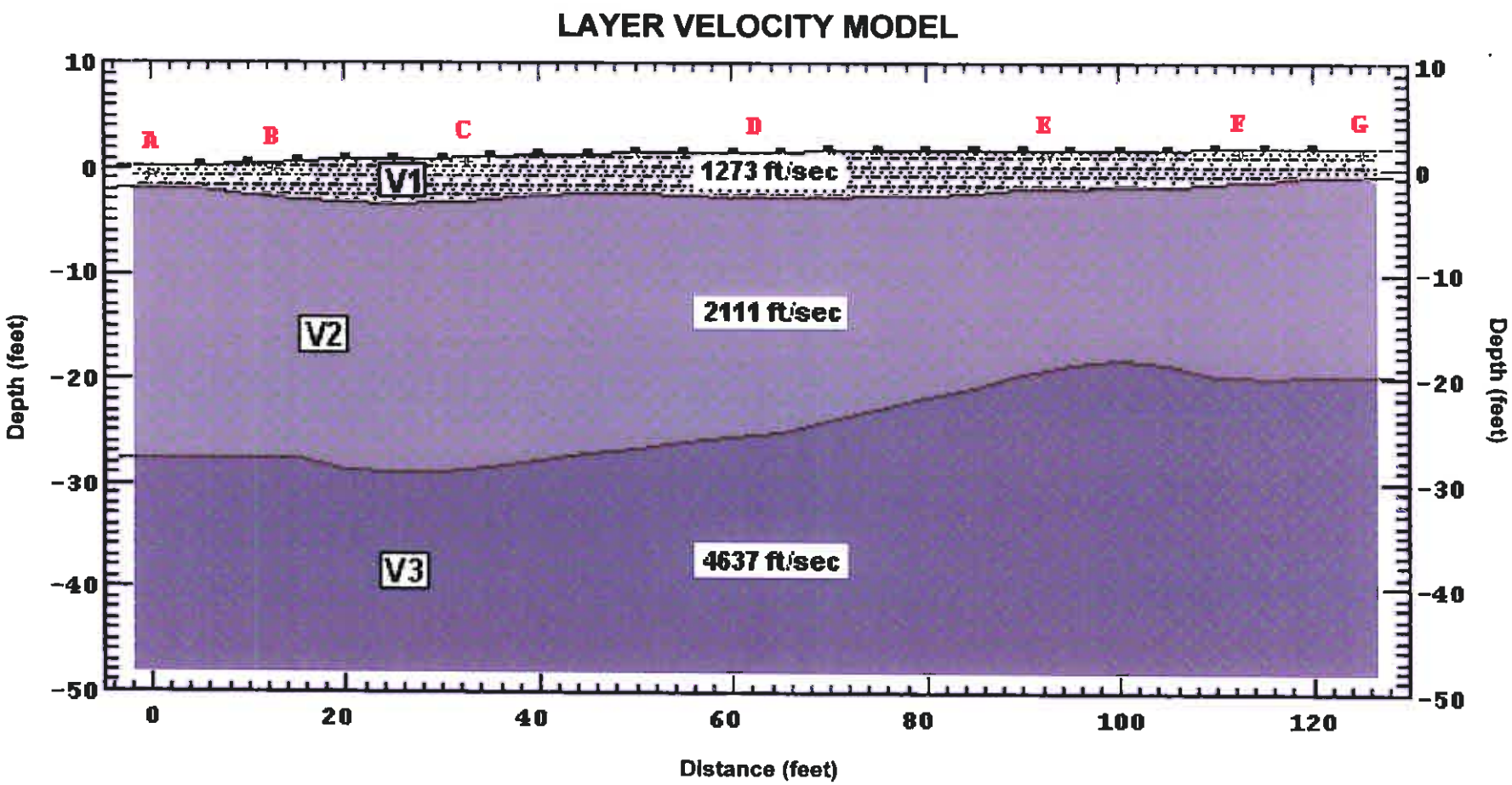
SEISMIC LINE S-1

South 55° East →



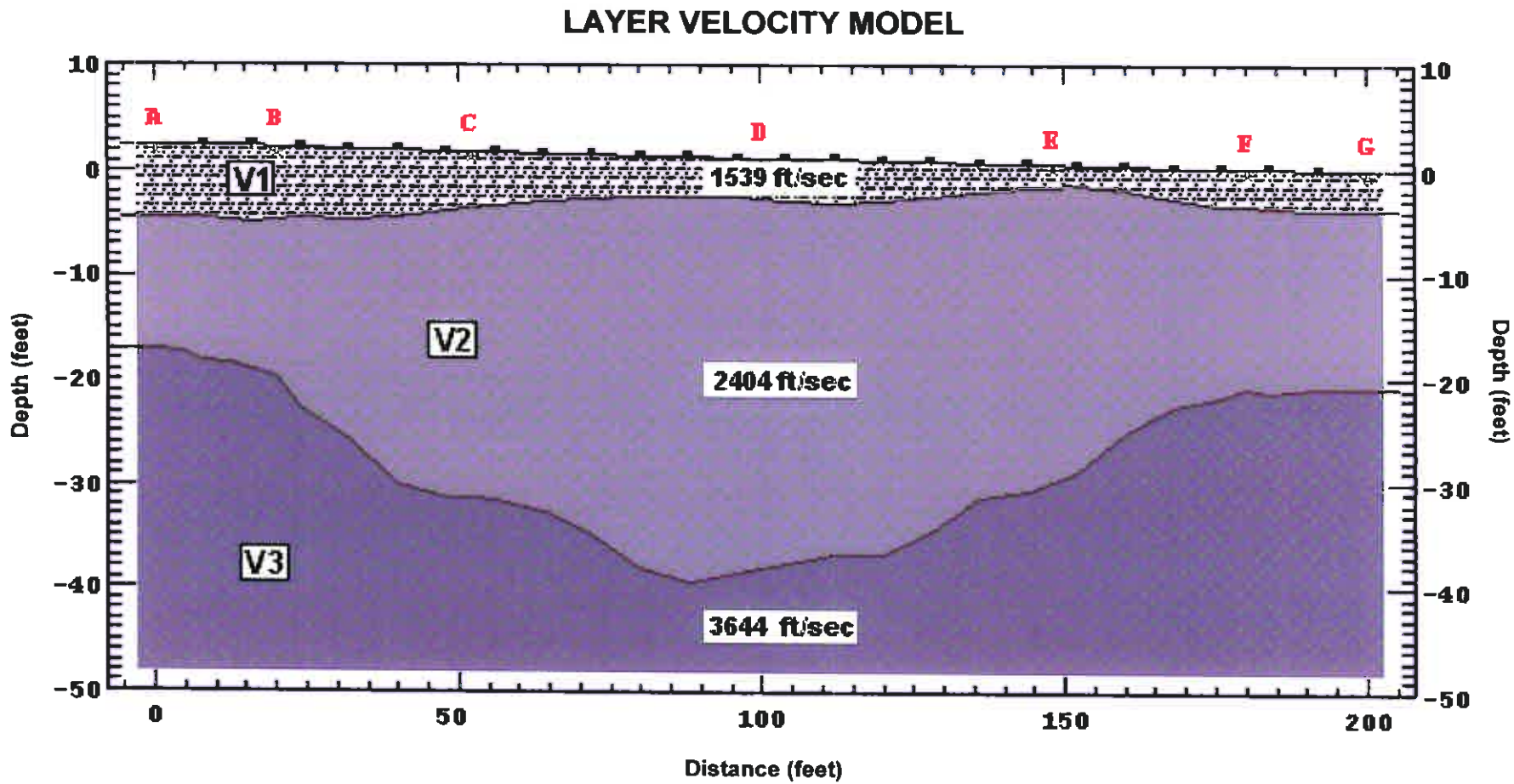
SEISMIC LINE S-2

North 50° East →



SEISMIC LINE S-3

South 80° East →



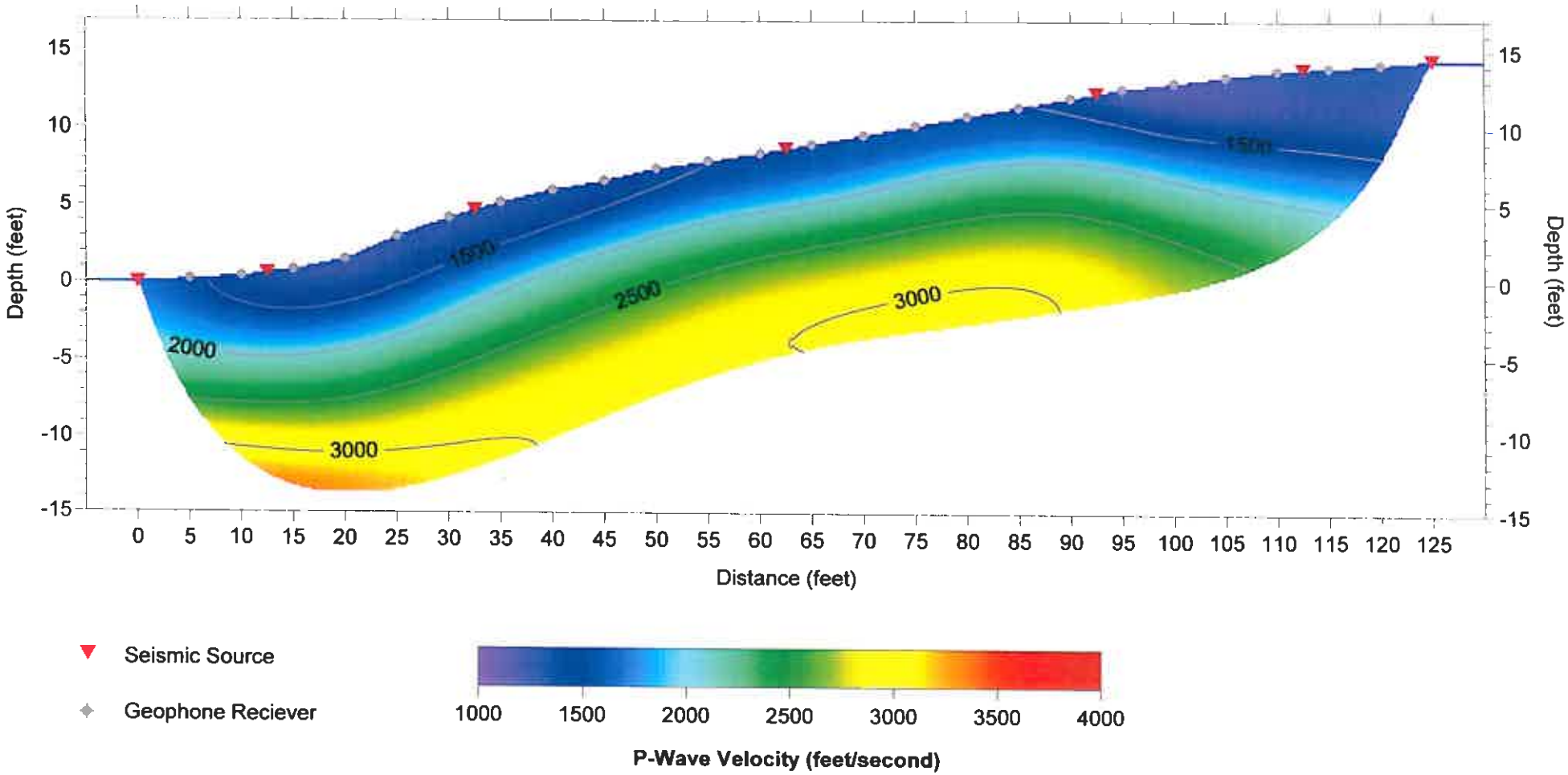
APPENDIX B

REFRACTION TOMOGRAPHIC MODELS

SEISMIC LINE S-1

South 55° East →

REFRACTION TOMOGRAPHIC MODEL



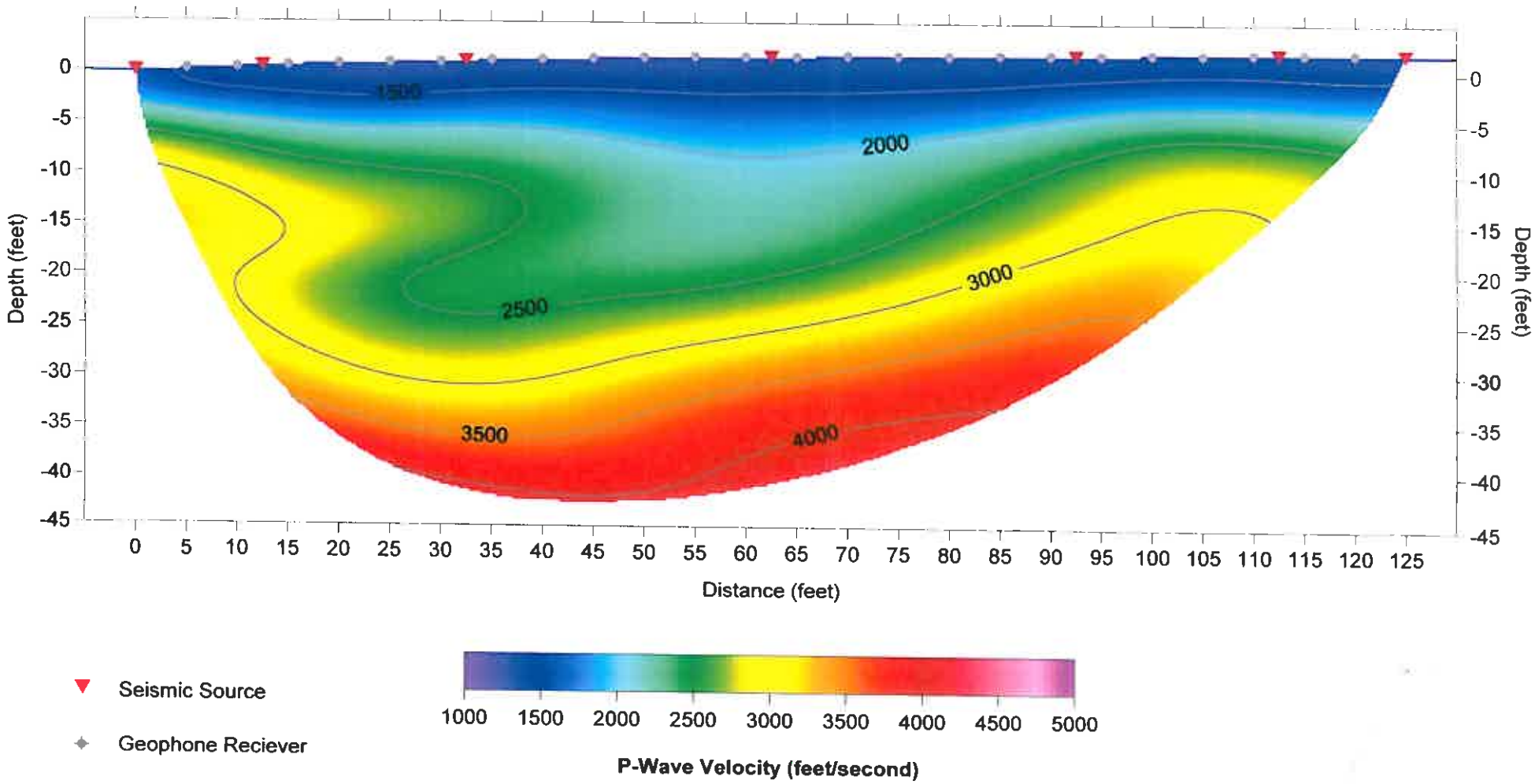
NOTE: Vertical Exaggeration 1.5X

RMS error 1.4 %, Rayfract Version 3.20

SEISMIC LINE S-2

North 50° East →

REFRACTION TOMOGRAPHIC MODEL

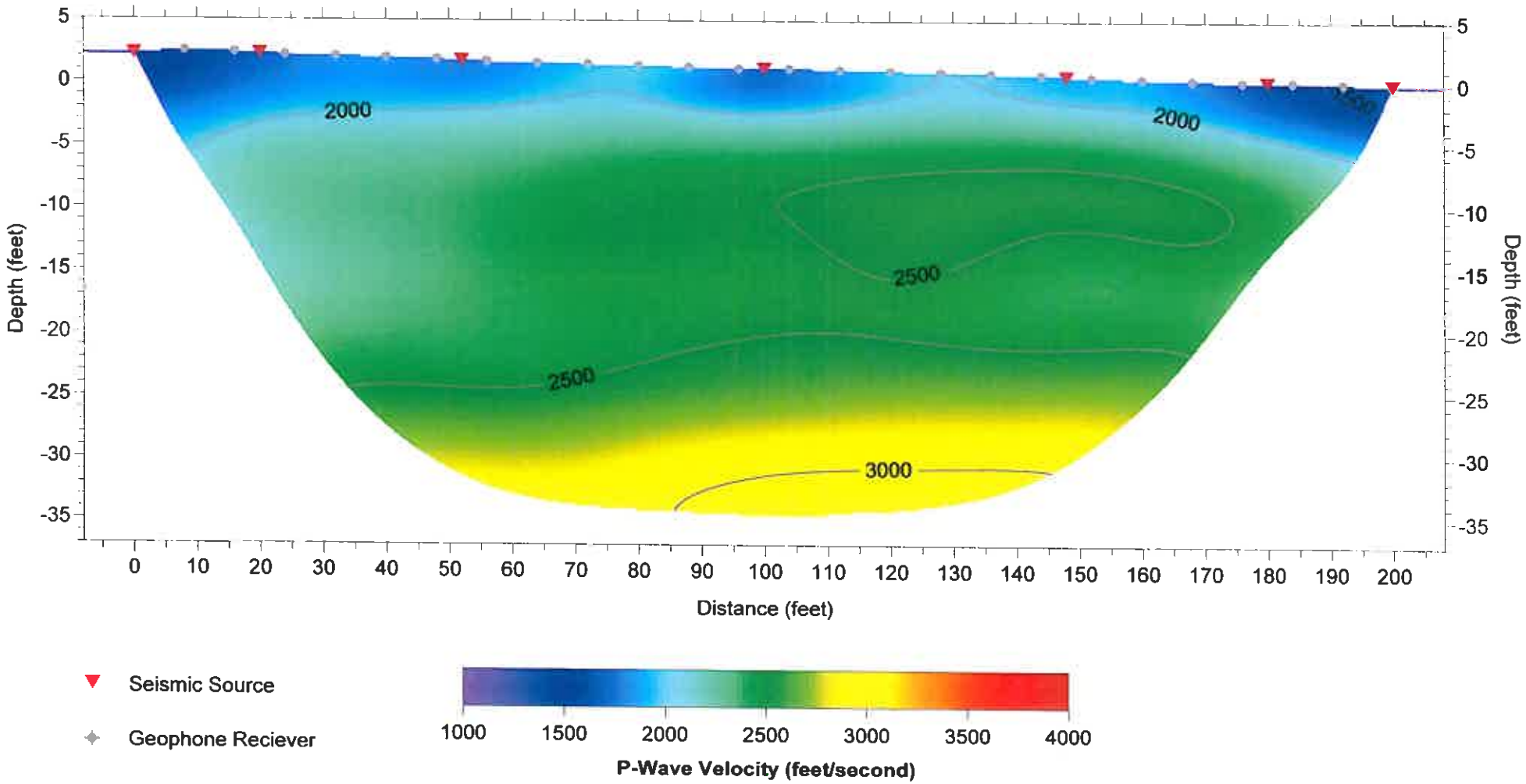


RMS error 1.1 %,Rayfract Version 3.20

SEISMIC LINE S-3

South 80° East →

REFRACTION TOMOGRAPHIC MODEL



NOTE: Vertical Exaggeration 2X

RMS error 1.5 %, Rayfract Version 3.20

APPENDIX C

EXCAVATION CONSIDERATIONS

EXCAVATION CONSIDERATIONS

These excavation considerations have been included to provide the client with a brief overall summary of the general complexity of hard bedrock excavation. It is considered the clients responsibility to insure that the grading contractor they select is both properly licensed and qualified, with experience in hard-bedrock ripping processes. To evaluate whether a particular bedrock material can be ripped, this geophysical survey should be used in conjunction with the geologic or geotechnical report prepared for the project which describes the physical properties of the bedrock. The physical characteristics of bedrock materials that favor ripping generally include the presence of fractures, faults and other structural discontinuities, weathering effects, brittleness or crystalline structure, stratification of lamination, large grain size, moisture permeated clay, and low compressive strength. Unfavorable conditions can include such characteristics as massive and homogeneous formations, non-crystalline structure, absence of planes of weakness, fine-grained materials, and formations of clay origin where moisture makes the material plastic.

When assessing the potential rippability of the underlying bedrock of a given site, the above geologic characteristics along with the estimated seismic velocities can then be used to evaluate what type of equipment may be appropriate for the proposed grading. When selecting the proper ripping equipment there are three primary factors to consider, which are:

- **Down Pressure available at the tip, which determines the ripper penetration that can be attained and maintained,**
- **Tractor flywheel horsepower, which determines whether the tractor can advance the tip, and,**
- **Tractor gross-weight, which determines whether the tractor will have sufficient traction to use the horsepower.**

In addition to selecting the appropriate tractor, selection of the proper ripper design is also important. There are basically three designs, being radial, parallelogram, and adjustable parallelogram, of which the contractor should be aware of when selecting the appropriate design to be used for the project. The penetration depth will depend upon the down-pressure and penetration angle, as well as the length of the shank tips (short, intermediate, and long).

Also important in the excavation process is the ripping technique used as well as the skill of the individual tractor operator. These techniques include the use of one or more ripping teeth, up- and down-hill ripping, and the direction of ripping with respect to the geologic structure of the bedrock locally. The use of two tractors (one to push the first tractor-ripper) can extend the range of materials that can be ripped. The second tractor can also be used to supply additional down-pressure on the ripper. Consideration of light blasting can also facilitate the ripper penetration and reduce the cost of moving highly consolidated rock formations.

All of the combined factors above should be considered by both the client and the grading contractor, to insure that the proper selection of equipment and ripping techniques are used for the proposed grading.

APPENDIX D

REFERENCES

REFERENCES

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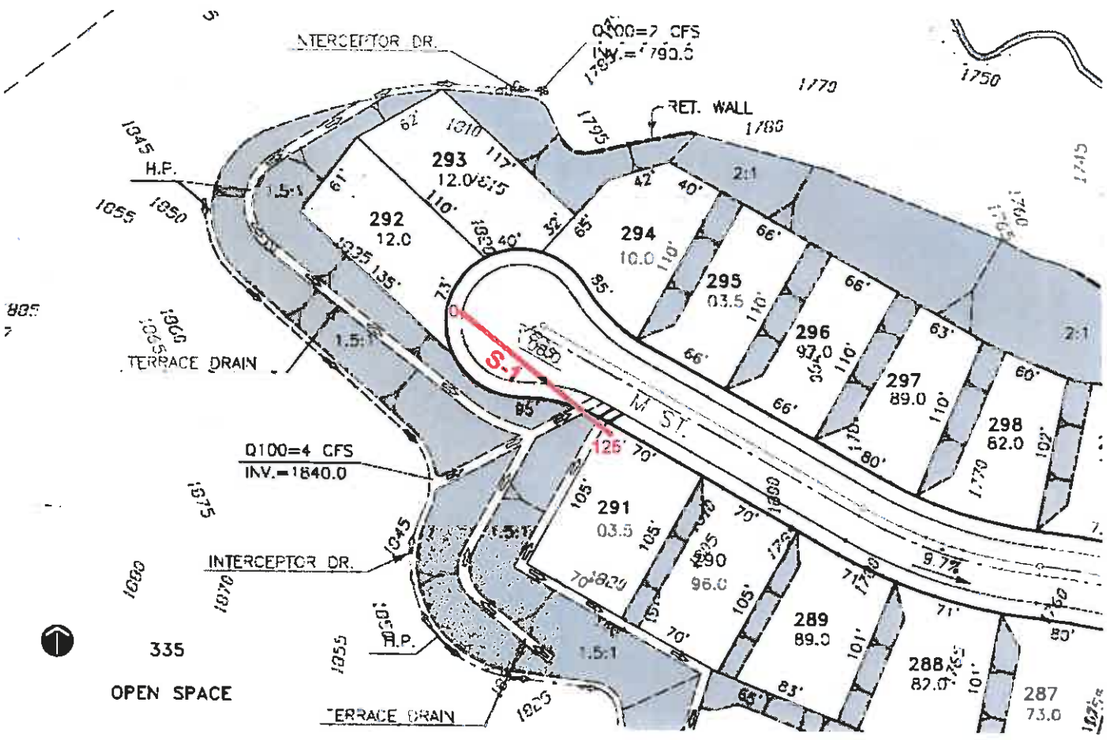
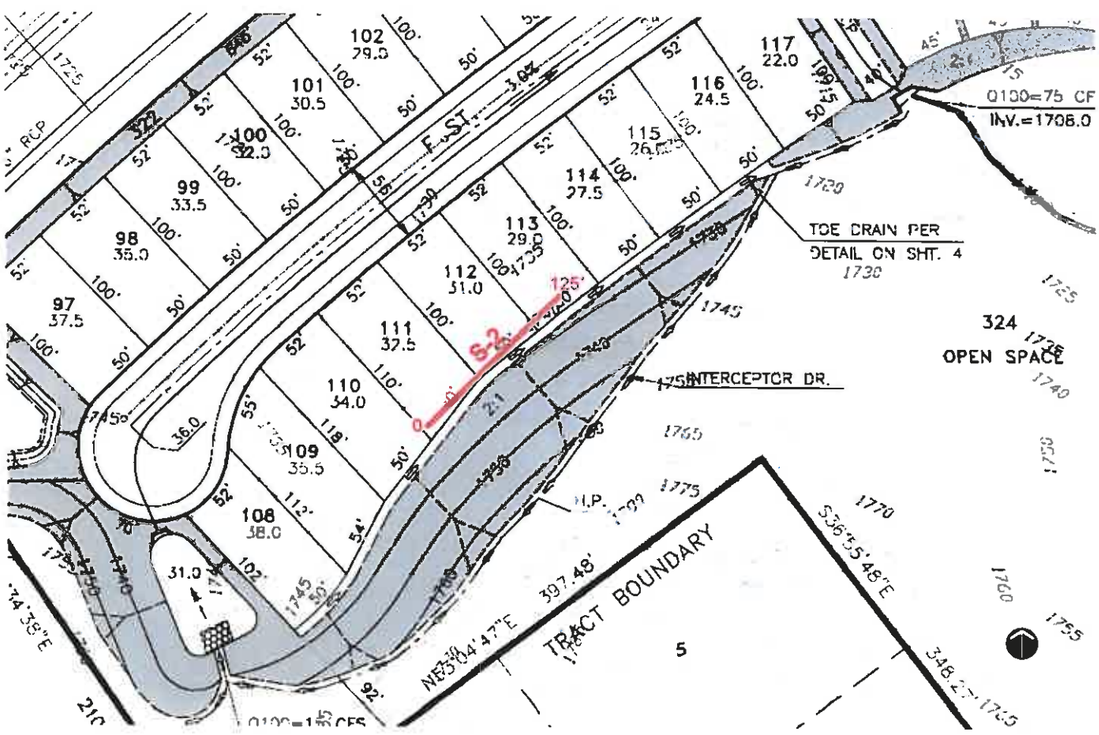
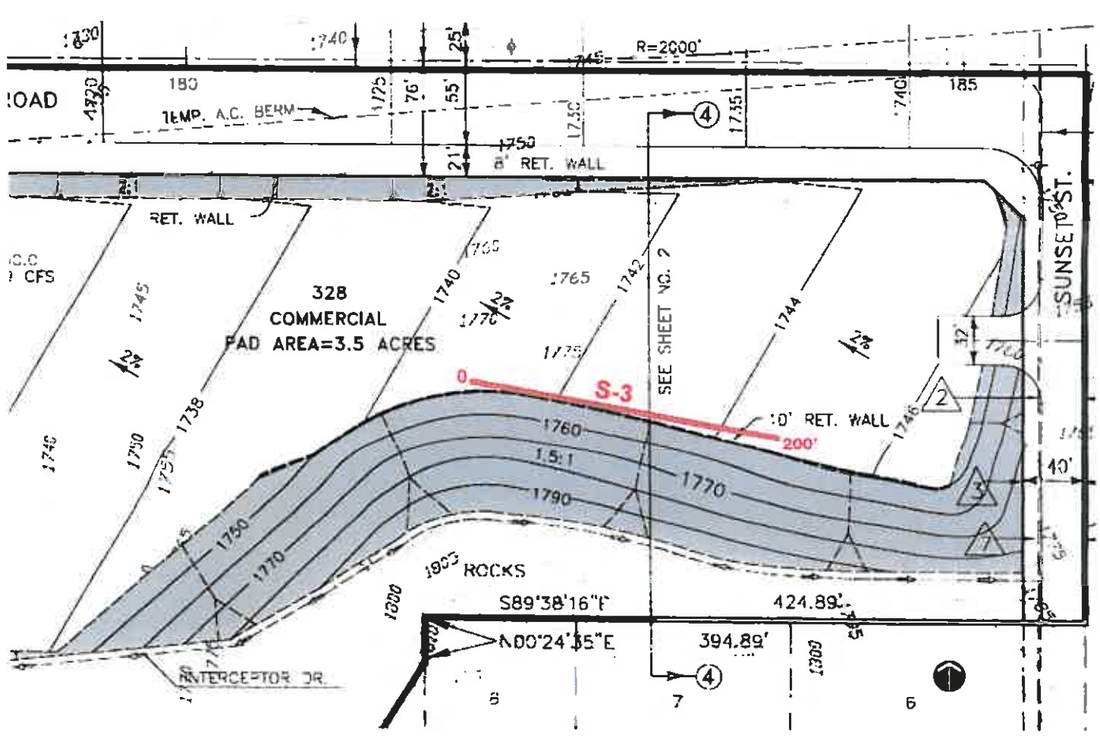
SEISMIC LINE LOCATION MAP







APPENDIX G

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

APPENDIX G

LGC INLAND, INC.

General Earthwork and Grading Specifications

1.0 General

1.1 ***Intent:*** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 ***The Geotechnical Consultant of Record:*** Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 ***The Earthwork Contractor:*** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork

contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 ***Clearing and Grubbing:*** Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 10 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

2.2 ***Processing:*** Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 ***Overexcavation:*** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 ***Benching:*** Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 ***Evaluation/Acceptance of Fill Areas:*** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 *Fill Material*

3.1 ***General:*** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 ***Oversize:*** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 ***Import:*** If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 *Fill Placement and Compaction*

4.1 ***Fill Layers:*** Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 ***Fill Moisture Conditioning:*** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 ***Compaction of Fill:*** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 ***Compaction of Fill Slopes:*** In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 ***Compaction Testing:*** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 ***Frequency of Compaction Testing:*** Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one (1) test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 ***Compaction Test Locations:*** The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two (2) grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 ***Subdrain Installation***

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 ***Excavation***

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the

slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 ***Trench Backfills***

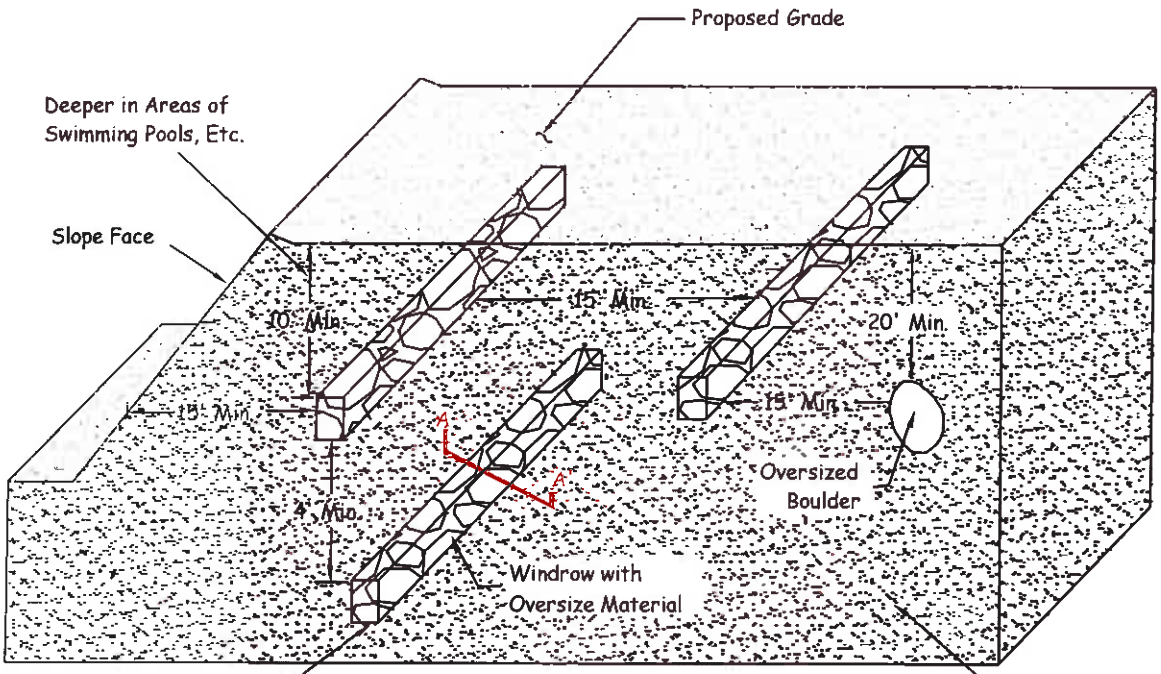
7.1 The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

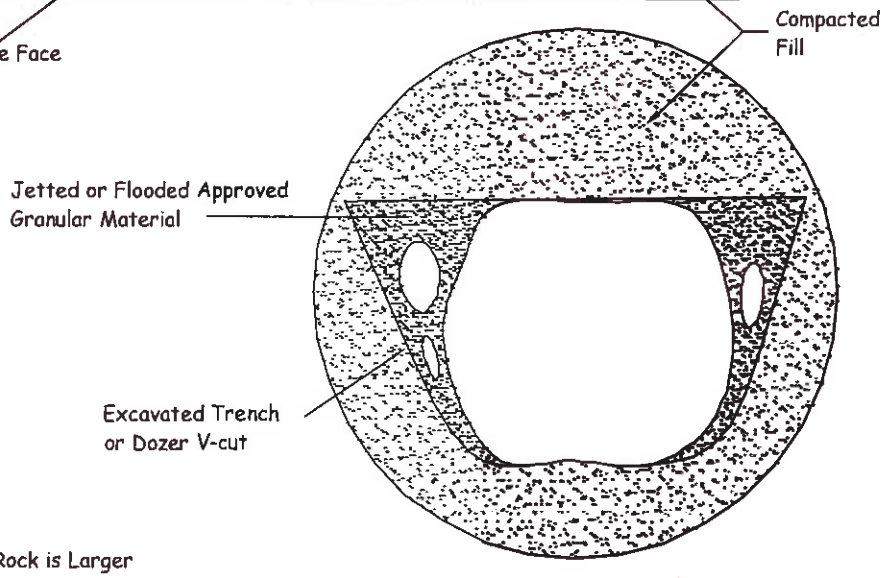
7.2 All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

7.3 The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one (1) test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.





Note: Oversize Rock is Larger than 8" in Maximum Dimension.

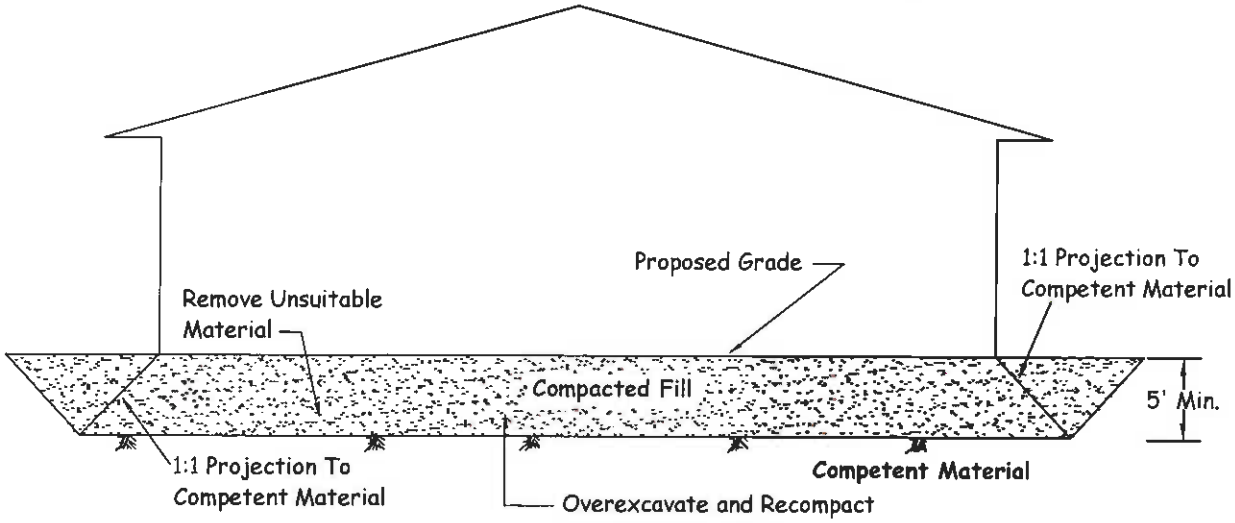
Section A-A'

LGC

OVERSIZE ROCK DISPOSAL DETAIL

11/26/02

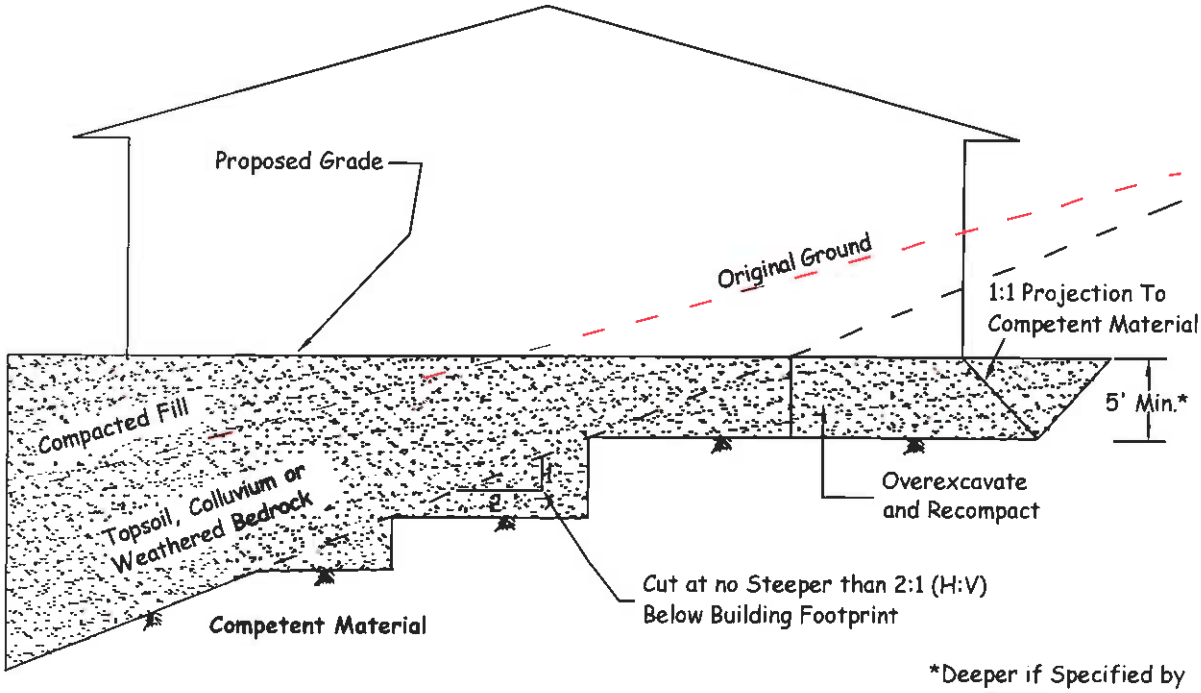
Cut Lot
(Exposing Unsuitable Soils at Design Grade)



Note 1: Removal Bottom Should be Graded With Minimum 2 % Fall Towards Street or Other Suitable Area (as Determined by Soils Engineer) to Avoid Ponding Below Building

Note 2: Where Design Cut Lots are Excavated Entirely Into Competent Material, Overexcavation May Still be Required for Hard-Rock Conditions or for Materials With Variable Expansion Characteristics.

Cut/Fill Transition Lot

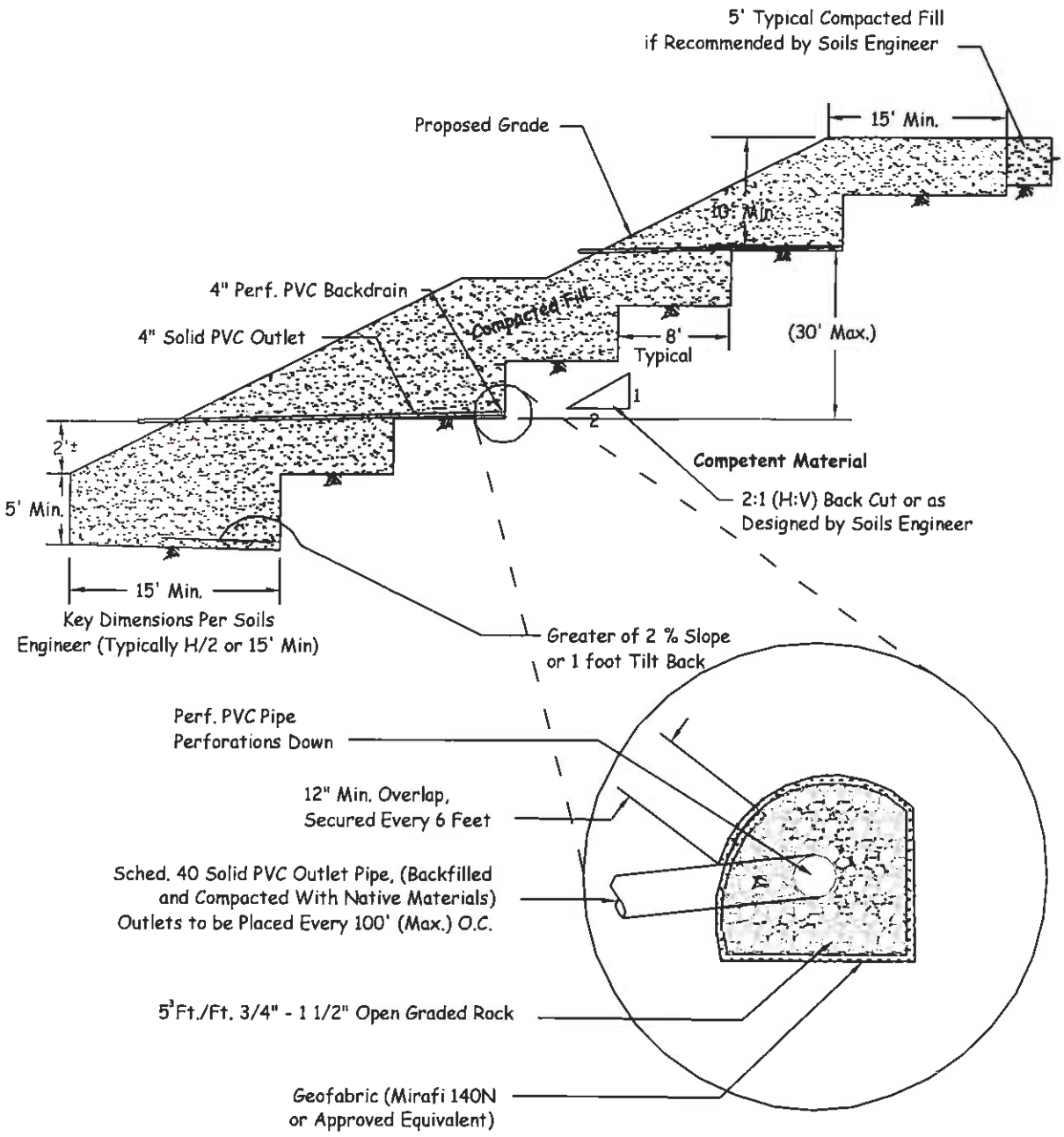


*Deeper if Specified by Soils Engineer

LGC

CUT AND TRANSITION LOT OVEREXCAVATION DETAIL

11/26/02



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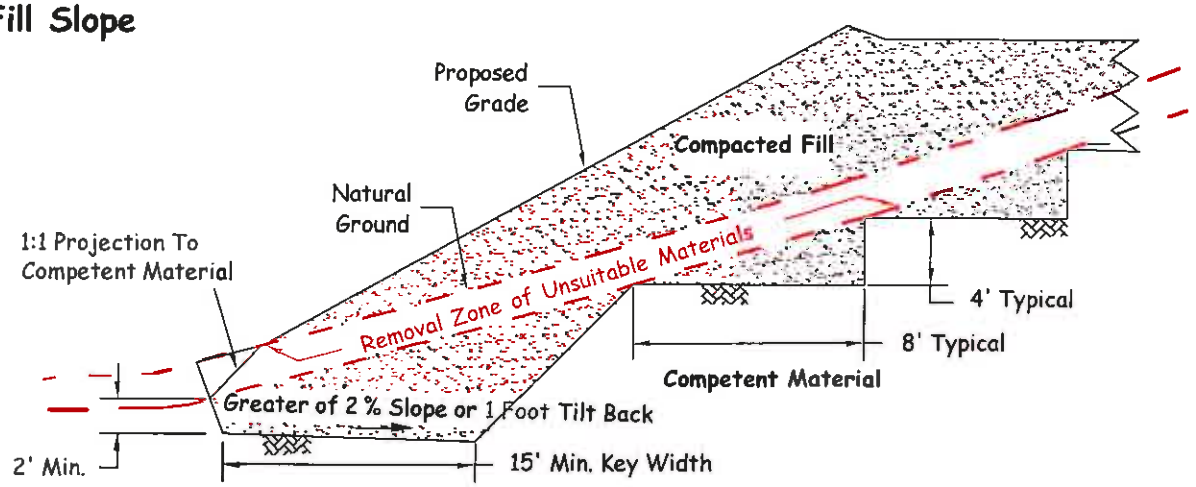
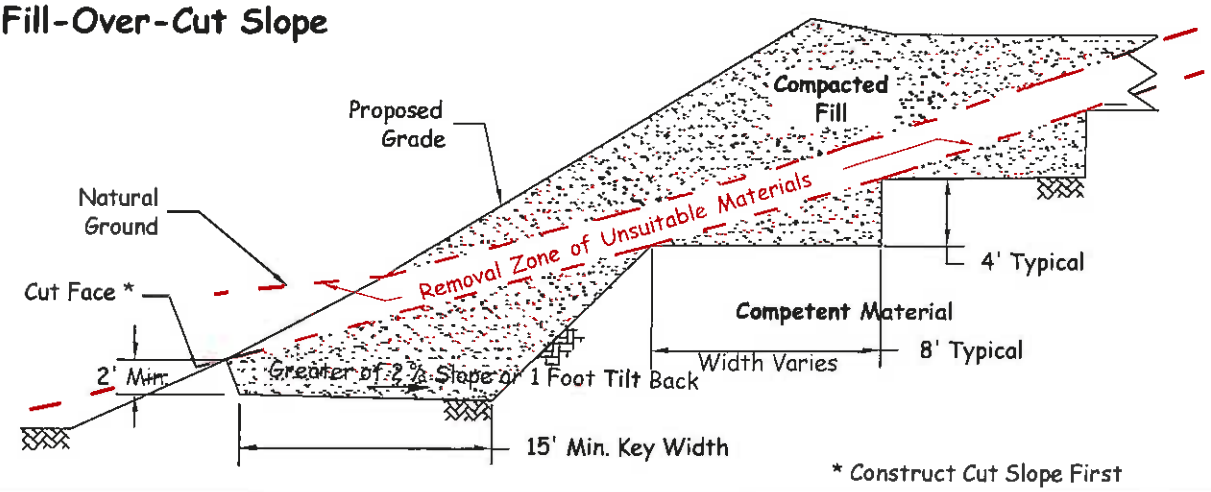
TYPICAL STABILIZATION FILL DETAIL

11/26/02

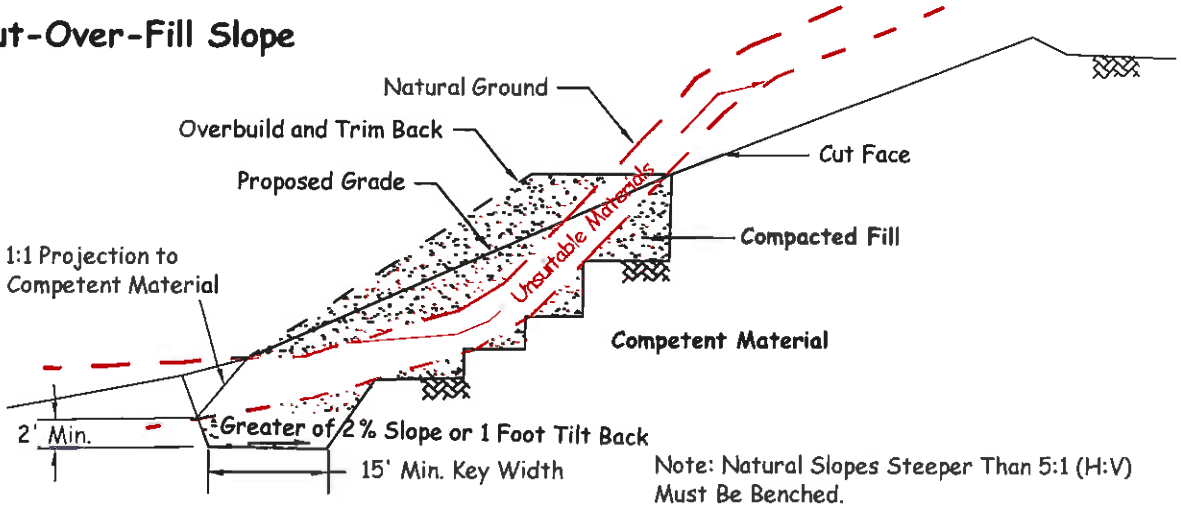
Fill Slope



Fill-Over-Cut Slope



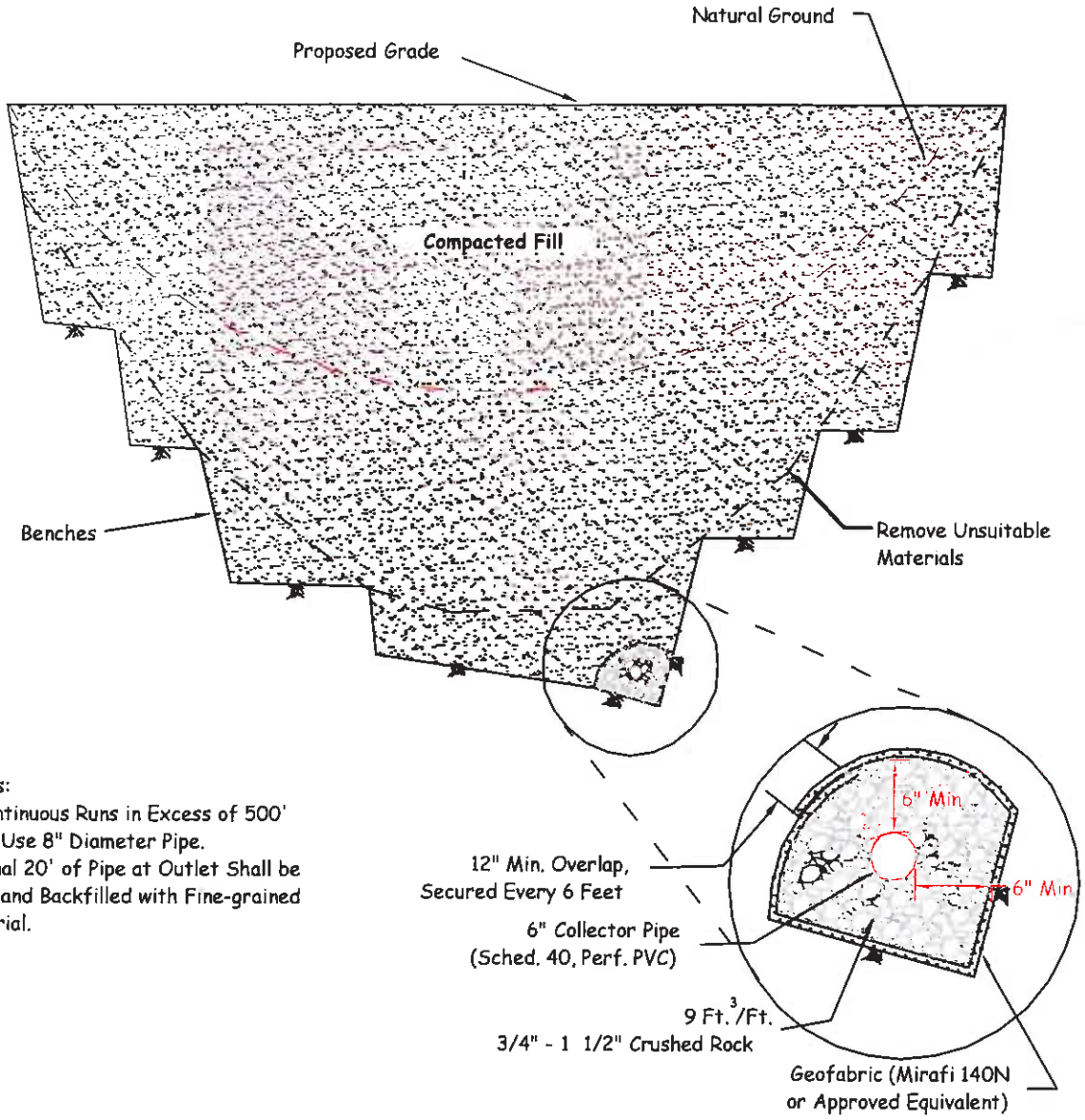
Cut-Over-Fill Slope



LGC

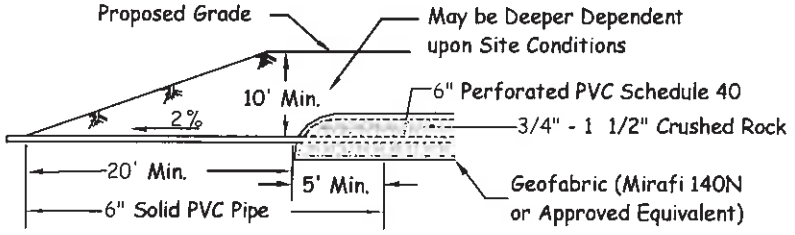
KEYING AND BENCHING

11/26/02



Notes:
1) Continuous Runs in Excess of 500' Shall Use 8" Diameter Pipe.
2) Final 20' of Pipe at Outlet Shall be Solid and Backfilled with Fine-grained Material.

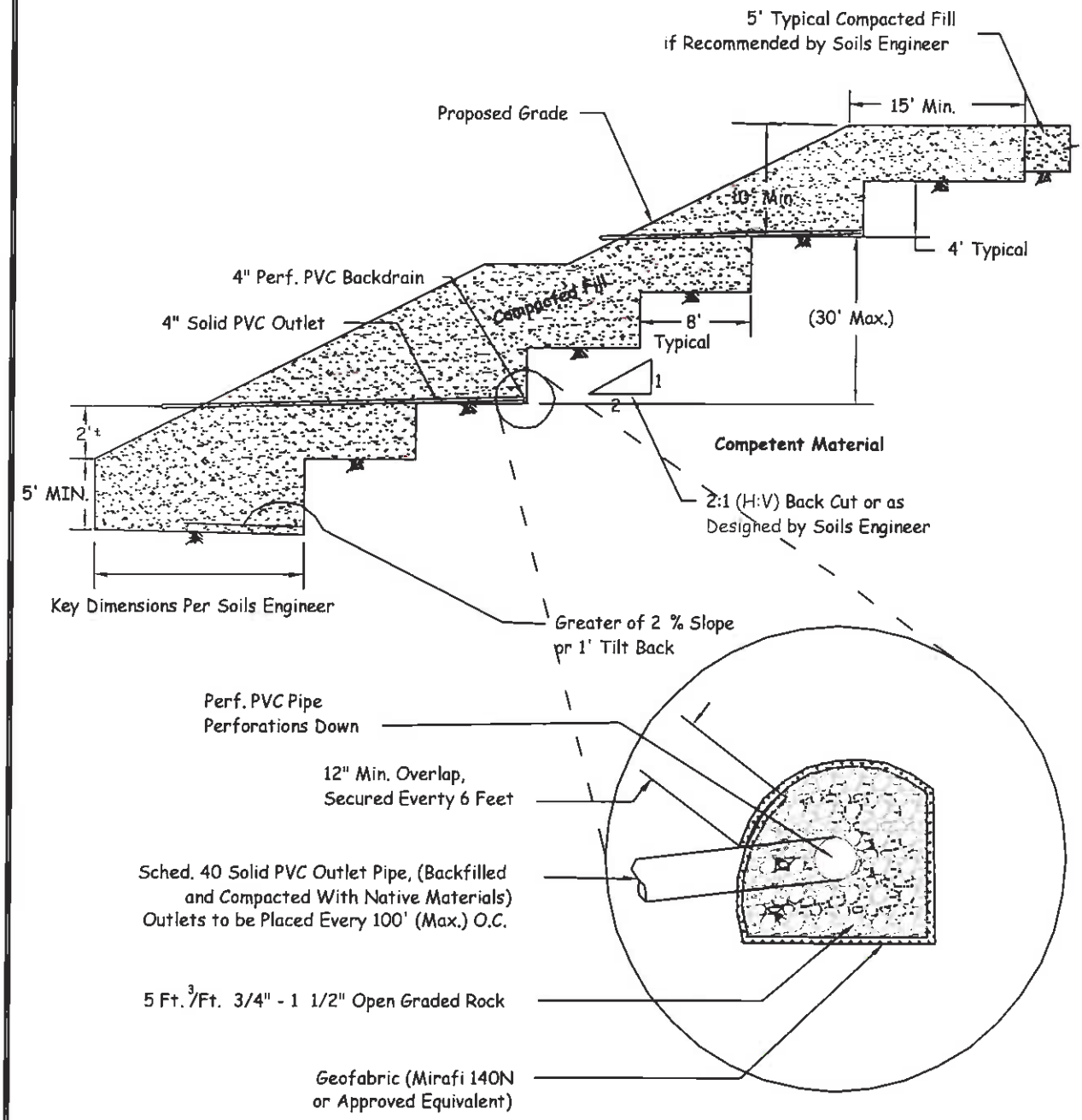
Proposed Outlet Detail



LGC

CANYON SUBDRAINS

11/26/02



LGC

TYPICAL BUTTRESS DETAIL

11/26/02