Attachment D

Geotechnical Report for EMSA and CMSA

FINAL REPORT

GEOTECHNICAL EVALUATIONS AND DESIGN RECOMMENDATIONS

EAST AND CENTRAL MATERIALS STORAGE AREAS
Permanente Quarry Reclamation Plan Update
Santa Clara County, California

Submitted To: Lehigh Southwest Cement Company
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1.0 INTRODUCTION

Golder Associates Inc. (Golder) is submitting this report addressing the results of slope stability analyses completed for the East Materials Storage Area (EMSA) and Central Materials Storage Area (CMSA) located at the Permanente Quarry (Quarry) near Cupertino, California (Figure 1). The Quarry mines limestone primarily for the production of cement and aggregate. Limestone that is of suitable grade is used for cement production. Unsuitable rock materials (waste rock) excavated from the Quarry are placed in permanent stockpiles that are referred to as storage areas. Waste rock materials include low-grade limestone and non-limestone rock materials. The EMSA/CMSA is a primary storage area for these materials. A companion report entitled "Geotechnical Evaluations and Design Recommendations, Permanente Quarry Reclamation Plan Update, Santa Clara County, California. May 2010." provides a description of the Quarry area and the overall Reclamation Project.

This report addresses the combined EMSA and CMSA which are contiguous, overlapping materials storage areas (Figure 2). The EMSA was previously evaluated as a stand-alone unit and a report was provided to Santa Clara County in April 2009. Since that time, the EMSA has been re-configured into the CMSA and the EMSA, and the April 2009 report has been updated to reflect the proposed grading plan for the combined EMSA/CMSA. Supplemental slope stability evaluations were completed to verify that the proposed reclamation of EMSA/CMSA complies with the applicable slope stability-related provisions of the Surface Mining and Reclamation Act (SMARA).

The Central Materials Storage Area (CMSA) is an overburden storage area located immediately west of the East Materials Storage Area (Figure 2). The CMSA includes approximately 52 acres of overburden storage area and ranges in elevation from approximately 775 feet amsl to 1270 feet amsl. The EMSA is that area of the rockfill that lies east of the CMSA below elevation 775 amsl. The CMSA will accept overburden materials during Phase 1 of the project and subsequently will be reclaimed according to the proposed Amendment. The CMSA's eastern edge connects to the flat pad at the west end of the EMSA. This connection results in an approximately 11-acre overlap of the CMSA on the top of the EMSA's western edge. The majority of the overlap covers the flat pad at the western edge of the EMSA and is designed to minimize any interference with reclamation activities in the EMSA. For the purposes of this report, the contiguous storage units are hereafter referred to as the EMSA/CMSA.

The EMSA/CMSA will reach a maximum elevation of 1270 feet mean sea level (msl) at the west end. Overall slope angles will be 2.6(H):1.0(V) or flatter. Following reclamation, the slopes will be comprised of 2H:1V inter-bench slopes which are comprised of 25-foot wide bench spaced at 40-foot vertical intervals. As discussed in Section 4, the final EMSA/CMSA slopes will be stable under static and seismic loading conditions provided Golder's construction recommendations are implemented as discussed in Section 5.

2.0 GEOLOGIC SETTING

2.1 Site Geology

The following information regarding the geologic setting of the EMSA/CMSA and immediate surrounding area has been excerpted from Foruria (2004) who has performed detailed geologic mapping of the Quarry.

Cement-grade limestone and aggregate are extracted from the intricately folded and faulted limestones and metabasalts (greenstones) in the Quarry. These rocks are part of the Permanente Terrain of the Jurassic-Cretaceous age Franciscan Assemblage. The Franciscan Assemblage represents a subduction zone assemblage of highly deformed, variably metamorphosed, marine sedimentary rocks with oceanic crust-related submarine basalt (greenstone), chert, and limestone. This limestone-metabasalt assemblage reaches a minimum total thickness of approximately 1,100 feet and is moderately inclined to the southeast.

All major stratigraphic horizons within the Franciscan rocks of the Quarry are separated by low-angle faults forming a structurally imbricated thrust stack of layered and folded rock units. The Franciscan rocks are tectonically juxtaposed against an overlying section of undated, continentally-derived graywackes, shales, and argillites. The deformed thrust stack is a gently folded, northeast-trending, southeast dipping sequence in the eastern area of the Quarry pit and transitions southwestward to a series of en-echelon, northwest-trending, southeast-plunging, anticlinal and synclinal folds in the western area of the pit, and beyond. High angle, brittle faults crosscut the Franciscan rocks, dissecting the rocks along prominent north-south and northwest-southeast orientations. A major through-going regional fault, the northwest strand of the Berrocal fault, crosses through the western end of the Quarry. Figure 3 shows the major faults in the site vicinity.

The Santa Clara Formation overlies a portion of the Franciscan Complex rocks in the north-central portion of the EMSA/CMSA (Figure 4). The Santa Clara Formation is a continental fluvial and alluvial deposit that is composed of unconsolidated to slightly consolidated conglomerate, sandstone, siltstone, and claystone (Vanderhurst, 1981). The age of the Santa Clara Formation ranges from late Tertiary to Pleistocene. Uplift of the Coast Ranges during this time resulted in increased erosion of the mountains and deposition of the Santa Clara Formation. The contact between the Franciscan rocks and Santa Clara Formation is considered to be unconformable, with the Santa Clara Formation deposited on an eroded Franciscan terrain (Rogers and Armstrong, 1973).

Subsequent uplift of the nearby foothills along the Monte Vista fault, which lies along the margin of the valley floor to the east of the site, has resulted in deformation of the Santa Clara Formation. In addition, faulting within the uplifted geologic terrane between the Monte Vista and Berrocal faults has juxtaposed the Santa Clara formation in fault contact with older Franciscan rocks in the western portion of the

EMSA/CMSA (Figure 4). To the east of the unnamed fault, the deformed Santa Clara formation overlies the Franciscan with south-southwest trending dips of up to 50 degrees (Rogers and Armstrong, 1973). A large erosional window east of the unnamed fault in the EMSA/CMSA exposes greenstone, greywacke and limestone of the Franciscan Assemblage.

2.2 Regional Structure

The San Andreas Fault zone is located approximately 2 miles southwest of the North Quarry. The Sargent-Berrocal Fault Zone (SBFZ), part of the Santa Cruz Mountains front-range thrust fault system, parallels the San Andreas to the east and forms the eastern-most structural boundary to the Permanente Terrain.

Near the Quarry, the SBFZ consists of two northwest-trending, sub-parallel faults, namely the northeastern-most Monta Vista Fault Zone and the southwestern-most Berrocal Fault Zone (Sorg and McLaughlin, 1975). The Monta Vista Fault Zone is located approximately 1 mile to the northeast of the Quarry. A strand of the Berrocal Fault Zone lies beneath the Permanente Cement Plant area to the south of the EMSA/CMSA, and extends west to other portions of the Quarry (Matheson, 1982; Sorg and McLaughlin, 1975).

2.3 Seismic Hazards

The Permanente Quarry is located within the San Francisco Bay Area, which is a region characterized by relatively high seismicity. SMARA does not specify a minimum seismic design event that should be used for slope stability analyses. However, SMARA does specify that the final slopes shall be flatter than the critical gradient, which is defined at the maximum stable slope inclination of a unsupported slope under the most adverse conditions (i.e. seismic loading) that it will likely experience, as determined by current engineering technology. Accordingly, Golder evaluated potential seismic impacts within the EMSA/CMSA resulting from an earthquake event associated with 10 percent probability of exceedance (POE) in a 50-year period.

Using the California Geological Survey (CGS) earthquake data base (Ground Motions for User Selected Site, Probabilistic Seismic Hazards Assessment (http://www.consrv.ca.gov/cgs/rghm/pshamap/pshamap.asp), and Golder estimates that design peak ground accelerations is approximately 0.6g for the Quarry.

3.0 SITE GEOTECHNICAL INVESTIGATIONS

3.1 Previous Site Investigations

A number of geotechnical studies have been completed to address slope stability in other areas of the Site, including the North Quarry (Call and Nicolas, Inc., or CNI) and the WMSA (The Mines Group, Inc., or MGI; and Golder, 2008), that have relevance to the stability evaluation of the EMSA/CMSA. These studies are summarized below.

3.1.1 Call and Nicolas

CNI performed a number of geotechnical evaluations of slope stability issues in the North Quarryin the early 1980's. This work was reviewed for basic geotechnical data for the Franciscan Assemblage rocks and also waste rock materials. The material shear strength data is summarized below:

- **Franciscan Melange**
  - Unit weight = 162 pcf
  - Cohesion = 2,150 psf
  - Internal friction angle = 20.1°
- **Franciscan Greenstone**
  - Unit weight = 175 pcf
  - Cohesion = 1,000 psf
  - Internal friction angle = 31.3°
- **Waste Fill**
  - Unit weight = 125 pcf
  - Cohesion = 144 psf
  - Internal friction angle = 38°

CNI also estimated the mean minus one standard deviation shear strengths in their 2003 report, provided estimates of the shear strength of good quality and poor quality greenstone, and estimate the shear strengths for other geologic materials.

3.1.2 The MINES Group, Inc.

The Mines Group, Inc. (MGI) reviewed the reclamation design for one portion of waste fill located at the northwest corner of the West Materials Storage Area (WMSA) and developed conceptual drainage and sediment control design for the remainder of the waste fill facility in 2001 (MGI, 2001). An evaluation of the slope stability was performed with the following model inputs and design criteria:

- **Material Shear Strengths**: all materials were modeled with Mohr-Coulomb criteria with the following strength parameters:
  - Waste Rock: cohesion (c') = 0 psf; internal friction (φ') = 36°;
  - Fine Waste: c' = 50 psf; φ' = 26°;

- Colluvial Soil: c' = 500 psf; φ' = 28°; and
- Greenstone Bedrock: c' = 1,882 psf; φ' = 27°

Development of the above strengths by MGI were based on the physical observed characteristics of the materials and review of past stability studies.

- **Groundwater Level**: for slope stability modeling purposes, MGI conservatively assumed the Greenstone Bedrock and most of Colluvial Soil contained groundwater and that the precipitation at the site supported a perched water table above the Colluvial Soil/Greenstone interface that eventually discharged to the surface contributing to the flow in Permanente Creek.
- **Stability Criteria**: MGI used a minimum design static factor of safety of 1.3 and a minimum pseudo-static (or seismic) factor of safety (FOS) of 1.0 as the stability design criteria. For pseudo-static analyses, a seismic coefficient of 0.15 g was used.

Based upon the stability analyses performed with the above inputs and assumptions, MGI concluded that the designed 3H:1V overall slopes of the WMSA were expected to be stable under both static and seismic loading. MGI also indicated the presence of fine-grained waste does not appear to control the stability of the waste rock slopes, even when placed within 10 feet horizontally of the final reclaimed slope face.

3.1.3 Golder Associates - WMSA Stability Review

Golder (2008) reviewed the stability of the reclamation design for the WMSA and used the following material strength properties based on review of previous stability evaluations for the North Quarry and the WMSA and a subsurface investigation by Golder to characterize the foundation conditions at the WMSA:

- Coarse Waste Rock: cohesion (c') = 0 psf; internal friction (φ') = 35°;
- WMSA Foundation Soil: c' = 200 psf; φ' = 30°;
- Greenstone Bedrock: c' = 1,440 psf; φ' = 23°; and
- Limestone Bedrock: c' = 12,500 psf; φ' = 30°

This stability evaluation uses the same strengths summarized above with the exception of the "Foundation Soil", which was characterized based on the subsurface investigation performed for the EMSA/CMSA discussed in the following section.

3.2 Golder Investigations

Golder completed investigations of the EMSA/CMSA to supplement the existing data for the Permanente Quarry consisting of the following:

- Aerial Photograph review and reconnaissance-level mapping;
- Subsurface drilling; and
- Geotechnical Laboratory Testing.

The following sections provide additional detail on these investigations.

3.2.1 Surface Mapping/Aerial Photography Review

Golder performed a review of aerial photographs and reconnaissance level mapping of the EMSA/CMSA to define areas of cut and fill, map surficial deposits where present, and to field check the bedrock geology.

A review of aerial photographs dating back to 1939 was performed to identify areas of cut and fill associated with the development of the EMSA/CMSA and to map surficial deposits. Large areas of the southern and southeastern portion of the EMSA/CMSA have been excavated to create flat building pads for existing and former structures associated with former industrial operations (Figure 5). Other areas have been previously used for disposal of waste rock materials, and for stockpiling of aggregate products.

The central and northern areas of the site consist of native soils and rock exposed at the surface except for access road construction. In this area several colluvial-filled drainages were mapped (shown where estimated to be greater than approximately five to six feet thick). Southeast of the site, Permanente creek parallels the southeast margin of the site, and is mapping as containing alluvium and artificial fill related to development of the railroads right-of-way and the main access road to the facility.

Exposures of bedrock are generally poor in the EMSA/CMSA due to surface weathering and soil formation and heavy vegetation in native areas. Occasional, highly weathered outcrops are exposed in the larger cutslope. In general, with minor modifications, the bedrock geology conforms with that previously mapped by regional investigators (Rogers and Armstrong, 1973; Sorg and McLaughlin, 1975; Vanderhurst, 1981).

3.2.2 Subsurface Drilling

Five hollow stem auger borings (EMSA-1 through -5) were drilled in the EMSA/CMSA with a CME 75 drilling rig (see Figure 4 for borehole locations). The borings were drilled at locations where the proposed waste rock fill will have greater thickness and steeper slopes. The borings were drilled under the supervision of a Golder geologist and logged and sampled using Golder's procedures and methods that follow industry standards (see Appendix A for summary boring logs).

The sampling sequence included the use of a Shelby tube pushed at the beginning of each borehole, if the material was suitable, followed by driven Standard Penetration Test (SPT) samples at approximate five-foot depth intervals. All boreholes were advanced until refusal or a depth of 45 feet. Refusal for the driven sampler (> 50 blows) was common below approximately 15 to 30 feet. Auger refusal was reached at depths starting at about 32 feet below ground surface (bgs). Groundwater was not encountered during drilling. Borings were backfilled with cuttings to the ground surface. The geotechnical samples were sent to Cooper Testing Laboratory in Mountain View, California for laboratory testing.

3.2.3 Earth Materials

The following section describes the general geologic character of the surficial materials and bedrock units encountered in the field investigations.

3.2.3.1 Bedrock Materials

Bedrock materials in the EMSA/CMSA included greenstone, limestone and graywacke (sandstone) within the sheared Franciscan Assemblage rocks, and poorly consolidated sandstone, gravels and siltstone of the Santa Clara Formation. All of the bedrock materials encountered in the EMSA/CMSA were weathered to highly weathered and dry. The Franciscan materials were typically angular to sub-angular, and contained hard, consolidated clasts. Colors ranged from dark reddish brown to gray to green. The Santa Clara formation was typically mottled yellowish brown in color and contained sub-rounded to sub-angular gravels comprised of Franciscan Assemblage rocks.

3.2.3.2 Colluvium

Colluvial deposits were encountered at the surface in some of the EMSA/CMSA borings and were also mapped in the larger natural swales in the area. The colluvial materials encountered were predominantly dark yellowish brown clayey sand with gravel to clayey gravel to gravelly clay. Gravel size was up to 3-inches. In general, the colluvium was dry and loose to very stiff/dense.

3.2.4 Geotechnical Laboratory Testing

Geotechnical testing consisted of grain-size distribution and Atterberg limits completed by Cooper Testing Laboratories located in Mountain View, California. Attempts were made to obtain intact samples of the clayey portion of the waste fill, and the native foundation soil at the base of the waste fill. However, the samples contained abundant gravel and larger rock fragments that were not suitable for use in laboratory shear strength testing.

The samples obtained of the native foundation soils at the EMSA/CMSA ranged from a silty sand and gravel to gravelly and sandy clay. Atterberg limits were completed on the finer portion of the waste materials with Plastic Indices ranging from 14 to 26, but generally between 23 and 26.

In all cases, the Plastic Indices were measured on the finer portion of the soil materials that were sampled. These Atterberg limits results are representative of individual soil samples and not necessarily of all of the soil materials sampled.

The geotechnical characterization of the units encountered is discussed in more detail in Section 4.

4.0 SLOPE STABILITY EVALUATIONS

The purpose of this study was to evaluate the geotechnical aspects of the EMSA/CMSA reclamation for compliance with SMARA and the applicable requirements of Title 14 of the California Code of Regulations (CCR).

4.1 Regulatory Framework

SMARA provides guidance with respect to addressing geotechnical slope stability for both fill slopes and cut slopes. Title 14, Chapter 8, CCR Section 3502(b)(3) indicates that final reclaimed slopes shall be flatter than the critical gradient, which implies that static factors of safety should be greater than 1.0. This section further states "Wherever final slopes approach the critical gradient for the type of material involved, regulatory agencies shall require an engineering analysis of slope stability. Special emphasis on slope stability and design shall be taken when public safety or adjacent property are affected."

For fill slopes, Section 3704 (d) states that fill slopes shall be 2H:1V or flatter. Slopes steeper than 2H:1V must be supported by site-specific geologic and engineering analyses to indicate that the minimum factor of safety is suitable for the proposed end use. For the Permanente Quarry, the proposed end use is undeveloped open space.

The proposed overall slopes for the EMSA/CMSA are between 2.5H:1V and 2.6H:1V with interbench slopes of 2H:1V. Therefore, slope stability analyses are not explicitly required from a SMARA perspective for this project. However, due to the complex geological conditions of the region, the size of the EMSA/CMSA fills, and the regional seismicity, it is Golder's opinion that prudent engineering of the EMSA/CMSA will include slope stability analyses.

For this project, we consider a minimum static factor of safety of 1.2 appropriate for the EMSA/CMSA rock fill. For seismic conditions, permanent seismically-induced displacements of less than 2 to 3 feet under the design earthquake conditions are considered acceptable considering the end use of the project.

4.2 Approach and Assumptions

4.2.1 Methodology

Golder completed static and seismic slope stability analyses to evaluate stability conditions of the proposed reclaimed slopes of the EMSA/CMSA. The computer program SLIDE 5.0 (Rocscience, 2003) was used to calculate the factors-of-safety against potential slope failures. This program uses two-dimensional, limit-equilibrium theory to calculate factors of safety (FOS) for slope stability problems. This program allows both circular and noncircular sliding surfaces to be either defined or generated automatically. Spencer's Method was used for FOS calculations.

Pseudo-static analyses were performed as an initial evaluation of slope performance under earthquake loading. In a pseudo-static limit equilibrium analysis, a lateral force is added to a potential failure mass, with magnitude equal to some fraction of the weight of the slide mass. The fraction is defined in the form of a seismic coefficient, which is typically assumed to be less than the peak ground acceleration and is expressed as a percentage of gravity. Selection of a seismic coefficient for this initial evaluation was based on the recommendations by Seed (1979), i.e., k_s = 0.10 for earthquakes of magnitude 6-1/2 or less, and k_s = 0.15 for earthquakes of magnitude as great as 8-1/4. However, due to the close proximity of significant faults to the site, dynamic deformation analyses were also completed to quantify the magnitude of potential permanent slope deformations.

Pseudo-static analyses presume that the slope deformations are "acceptably small" if the computed pseudo-static FOS is greater than the specified threshold value (i.e. usually between 1.0 and 1.15). The dynamic deformation analyses provide an estimate of the permanent deformations so that they can be confirmed to be "acceptably small."

Dynamic deformation analyses were performed using a predictive model recently developed by Bray and Travasarou (2007). The Bray and Travasarou model is a semi-empirical simplified model for estimating permanent displacements due to earthquake-induced deviatoric deformations. The Bray and Travasarou model also can be implemented within a fully probabilistic framework or be used deterministically to evaluate seismic displacement potential. The following equation is used by Bray and Travasarou (2007) to predict the seismic displacement (D) assuming potential slide mass is a rigid sliding block:

$$\ln(D) = -0.22 - 2.83\ln(k_y) - 0.333(\ln(k_y))^2 + 0.566\ln(k_y)\ln(PGA) + 3.04\ln(PGA) - 0.244(\ln(PGA))^2 + 0.287(M - 7) \pm \varepsilon$$

Where, D = seismic displacement in cm

k_y = yield coefficient

PGA = peak ground acceleration

M = moment magnitude

ε = normally distributed random variable with zero mean and standard deviation σ = 0.67.

4.2.2 Modeling Inputs and Assumptions

4.2.2.1 Model Geometries

Sections E1 and E3 for the EMSA/CMSA (Figure 6) were used as representative critical sections for stability evaluation. These sections were developed based on pre-storage and current topographic maps, and proposed reclamation designs, provided by Lehigh, as well as on subsurface investigations performed by Golder. Although Section E4 (Figure 7) includes waste rock that is greater in overall height, the overall slope is flatter than the other sections due to the presence of a haul road, and therefore, it is not a critical section given the materials within and underlying this section of the EMSA/CMSA.

4.2.2.2 4.1.2.2 Material Properties

The following units were included in the stability modeling of the EMSA/CMSA:

- **Coarse Waste Fill:** For cohesionless rock materials characteristic of the coarse waste at the site, the angle-of-repose of waste fill slopes is often used to approximate the shear strength of a rock material. Based on review of existing topographic maps, the angle-of-repose of the WMSA and EMSA/CMSA fills generally ranges from 34 degrees to 37 degrees, and averages around 35 degrees. Assuming a cohesion value of zero, this corresponds with an internal friction angle of approximately 35 degrees. Accordingly, coarse waste was assigned average strength parameters based on an internal friction angle of 35 degrees and no cohesion. This friction angle is slightly lower than the value of 36 degrees that Mines Group used (MGI, 2001). A moist unit weight of 125 pcf was assumed for stability modeling.
- **Foundation Soils:** According to the subsurface investigation summarized in Section 3, the foundation soils beneath the proposed EMSA/CMSA are generally characterized as "a sandy clay to clayey sand with gravel to a silty or clayey gravel with sand." Based on in-situ strength characterization performed using Standard Penetration Testing (SPT), an internal friction angle of 28 degrees with no cohesion was conservatively used to represent the mean drained strength of the Foundation Soil under the EMSA/CMSA for long-term stability modeling. An average thickness of 10 feet and a moist unit weight of 120 pcf were assumed.
- **Bedrock:** As discussed in Section 3.1.3, a shear strength characterized with a cohesion of 10 psi or 1,440 psf and a friction angle of 23 degrees was used in stability models to represent the Greenstone in Section E1 in accordance with Golder's Geotechnical Evaluations and Design Recommendations for Permanente Quarry Reclamation Plan Update (May 2010) and the Greywacke in Section E3.

The material properties used for stability modeling are summarized in Table 1.

4.2.2.3 Water Level

Available historical data indicate groundwater depths ranging from approximately 40 feet to over 200 feet below ground surface. No groundwater was encountered in any of the Golder borings drilled at the EMSA/CMSA in 2007. Golder conservatively assumed that permanent groundwater is approximately 30 ft to 100 ft below existing ground surface with water levels more shallow at the toe of the proposed waste fill slope. The estimated groundwater depths do not adversely affect the stability of the EMSA/CMSA slopes.

4.2.2.4 Seismic Parameters

Consistent with previous discussions, the waste fill reclamation stability modeling was based on the following seismic parameters:

- Horizontal seismic coefficient of 0.15g;
- Design Moment Magnitude: M_w = 6.8~7.1; and
- Peak horizontal ground acceleration (a_{max}) = 0.6 g (Golder, 2007).

4.3 Static Analyses

4.3.1 Static Stability Conditions of EMSA/CMSA

As shown in Figure 2, the proposed reclamation plan for the EMSA/CMSA has overall slopes no steeper than 2.5H:1V to 2.6H:1V and inter-bench slopes no steeper than 2H:1V. Sections E1 and E3 were developed as a representative section to evaluate the stability of the proposed EMSA/CMSA reclamation slopes. The static stability modeling results are presented in Appendix C. The calculated FOS values against potential multi-bench failure (or global failure) are 1.68 for Section E1 and 1.62 for Section E3, which exceed the minimum static slope stability design criterion. The calculated FOS against potential inter-bench slope failure is approximately 1.40, which also exceeds the acceptable minimum criteria.

4.4 Seismic Analyses

The pseudo-static limit equilibrium analyses for Sections E1 and E3 with the horizontal seismic coefficient of 0.15g are shown in Appendix C (see Appendices C-3 and C-4), which indicate that the minimum FOS against global failure is about 1.16 for Section E1 and 1.03 for Section E3. Seismic displacement analyses (Table 2) were completed for Section E1 and E3. For Section E3, which is the more critical section with respect to seismic slope stability, the computed permanent slope deformations range between 3 inches and 13 inches with an average of approximately 6-inches.

The pseudo-static limit equilibrium analyses on potential inter-bench failure result in a computed minimum FOS of approximately 1.0 to 1.02. Seismic displacement analyses (Table 2) estimate that the potential inter-bench permanent slope deformation could range between 4-inches and 14-inches with an average of 7-inches. The inter-bench seismic displacement is anticipated to be shallow and will be contained with the 25-foot wide benches between lifts.

4.5 Additional Analyses

Additional slope stability analyses were completed to address specific waste storage area construction requirements.

4.5.1 Presence of Fine Waste

The washing of limestone aggregate produces a fine waste material that consists of an unconsolidated saturated clayey silt (ML) and silty clay (CL). The fine waste fill is placed in the middle portion of the waste storage areas in lifts no higher than 8 feet. These lifts are then covered by at least a 25-foot thick lift of coarse waste. The fine waste is maintained at a minimum offset of 50 feet from the final outer slope of the waste storage area.

To evaluate the impact of the fine waste deposit on local slope stability, slope stability analyses were completed. The drained strength of the fine waste was modeled using Mohr-Coulomb shear strength envelope characterized by an internal friction angle of 28 degree with no cohesion. This assumed shear strength is consistent with the results of the soil index laboratory tests and slightly lower than the results from two consolidated undrained (CU) triaxial tests performed on the fine waste material (Appendix B).

The stability modeling results shown in Appendix C-5 indicate that under static conditions, block failures through fine waste will unlikely become critical or controlling failure paths and the local stability of the EMSA/CMSA slope with the fine waste fill is unlikely affected by the presence of the fine waste fill provided the fine wastes remain drained.

Pseudo-static analysis was also performed to evaluate the stability of the EMSA/CMSA with the fine waste fill. Since the fine waste fill mostly consists of clay and silt and could be locally or partially saturated due to its relatively lower permeable nature, a strength reduction of 20 percent was conservatively applied to the peak undrained strength for seismic stability modeling. As shown in Appendix C-5, the calculated minimum pseudo-static FOS against local block failures through Fine Waste is approximately 1.02. Seismic slope displacement analyses (Table 2) indicate that the permanent slope deformation caused by the design earthquake loading is estimated to be between 6 and 24-inches, with a mean displacement of 12-inches, which is within the acceptable displacement criterion.

4.5.2 Subgrade Preparation

The placement of the EMSA/CMSA materials on organic rich topsoil, soft or clayey colluvium, or over saturated soils could result in foundation soil conditions with lower effective shear strengths than assumed in this study. A series of slope stability analyses were completed to determine the extent of foundation improvements that should be completed for the EMSA/CMSA construction.

Based on the results of these analyses, Golder concludes that foundation preparation should be completed on the outer 50 feet of the EMSA/CMSA fill. The foundation preparation should include over-excavation of the upper topsoil, organic debris, and fine grained colluvium with high plasticity index to expose firm bedrock, granular soils or lean clay. In areas where the outer 50 feet of the footprint is founded on a native slope that is steeper than 5H:1V, the topsoil and colluvium over-excavation should be extended to 100 feet from the outer slope. Appendices C-6 through C-9 presents the slope stability analyses.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on previous studies and investigations, laboratory testing, and slope stability analyses completed by Golder, the following conclusions are provided for the EMSA/CMSA:

- The EMSA/CMSA will be reclaimed as undeveloped open space and will not pose a threat to public safety or to adjacent properties.
- The static FOS for global slope stability is exceeds 1.6. The static FOS for the 2H:1V slope between benches is approximately 1.4. These values are considered acceptable for reclamation. Corresponding pseudo-static FOS are equal to or greater than 1.0.
- Permanent, seismically-induced displacements are estimated to be an average of 6-inches or less for the waste rock fill. These displacements could average 12-inches when considering the placement of fine waste material in maximum 8-foot lifts with an offset of 50 feet from the final outer slope face. These computed displacements are considered acceptable for reclamation and the proposed end use of the property as open space.

In summary, the proposed reclaimed EMSA/CMSA slopes are stable under static conditions and have acceptable performance under the design seismic loading conditions.

5.2 Recommendations

Golder recommends implementing the following during construction of the EMSA/CMSA:

- Foundation preparation should be completed prior to fill placement of the outer 50 feet beneath the EMSA/CMSA fill. Foundation preparation should consist of over-excavation of outer 50 feet of topsoil, organic materials (trees, brush, grasses), fine-grained colluvium with a Plastic Index greater than 25, or other unsuitable soils until firm bedrock, granular soils, or clay soils with a Plastic Index less than 25 are exposed. If the exposed foundation surface is inclined at 5H:1V or steeper, the over-excavation distance from the outer slope should be extended from 50 feet to 100 feet. Furthermore, the fill placed on slopes of 5H:1V or steeper should be benched into the slope with individual bench heights of at least 2 feet and up to approximately 5 feet. Figure 8 illustrates the subgrade preparation requirements.
- A qualified California Professional Geologist, Certified Engineering Geologist, or a California Registered Civil Engineer with geotechnical experience should inspect the foundation preparation to ensure all unsuitable materials are removed prior to placement of the outer 50 to 100 feet of EMSA/CMSA fill.
- If seepage or wet zones are observed in the foundation, suitable drainage provisions should be incorporated into the foundation prior to fill placement. Suitable drainage provisions include the placement of a blanket of free-draining sand or gravel over the seepage/wet zone in conjunction with a perforated, polyvinyl (PVC) or high-density polyethylene (HDPE) drain pipe that drains positively toward and daylights at the slope face. The sand or gravel drainage material should be fully covered with a minimum 8-oz/square yard, non-woven, geotextile filter to provide separation from the EMSA/CMSA materials.
- The fine waste materials should be placed in maximum 8-foot thick lifts and offset a minimum of 50 feet from the final slope face. Each lift of fine waste should be covered by a minimum 25-foot thick lift of waste rock.

- Golder should be contacted to review any modifications to EMSA/CMSA fill geometry including increases to the maximum overall slope inclination, maximum inter-bench slope inclination, slope height, or footprint. Such modifications may require further slope stability analyses.

6.0 LIMITATIONS

This report has been prepared for the exclusive use of Lehigh Southwest Cement Company for specific application to the evaluation of the EMSA/CMSA slope reclamation for compliance with SMARA. The findings, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice that exists within the area at the time of the work. No other warranty, expressed or implied, is made.

The analyses and recommendations contained in this report are based on data obtained from the results of previous subsurface explorations by others as well as the explorations and mapping conducted by Golder. The methods used generally indicate subsurface conditions at the time and locations explored and sampled. Boring logs may not reflect strata variations that may exist between all sampling locations. In addition, groundwater conditions can vary with time.

7.0 REFERENCES

Bray, J. D., and Travasarou, T. (2007), "Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements", Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

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Seed, H. B. (1979), "Considerations in the Earthquake-Resistant Design of Earth and Rockfill Dams," Geotechnique, vol. 29, No. 3, pp. 215-263.

Sorg, D.H., and McLaughlin, R.J., 1975. Geologic Map of the Sargent-Berrocal Fault Zone Between Los Gatos and Los Altos Hills, Santa Clara County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-643, scale 1:24,000

United States Department of Agriculture, Forest Service, "Level I Stability Analysis Documentation for Version 2.0," General Technical Report INT-285, April 1992.

United States Department of Agriculture, Forest Service, "Slope Stability Reference Guide for National Forests in the United States, Volume II," EM 7170-13, August 1994.Reference Text.

TABLES

TABLE 1
MATERIAL PROPERTIES FOR STABILITY ANALYSES

Material	Unit Weight, pcf	Drained Strength		Undrained Strength	
		Cohesion c', psf	Friction Angle ϕ', °	Cohesion c, psf	Friction Angle ϕ, °
Coarse Waste Fill[1]	125	0	35	0	35
Foundation Soil – EMSA[2]	120	0	28	0	28
Bedrock[3]	165	1,440	23	1,440	23
Fine Waste Fill[4]	110	0	28	0	18

Notes:

1. Design values assumed based on back analyses and field observations;
2. Design values based on in-situ strength characterization and correlation recommendation in literatures;
3. Design values based on review of past studies (Golder, 2008);
4. Design values based on laboratory testing data and correlation recommendation in literatures.

TABLE 2

Summary of Dynamic Deformation Analysis

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk} g	a_{max} (Reference 1) g
7.1	0.60	0.60

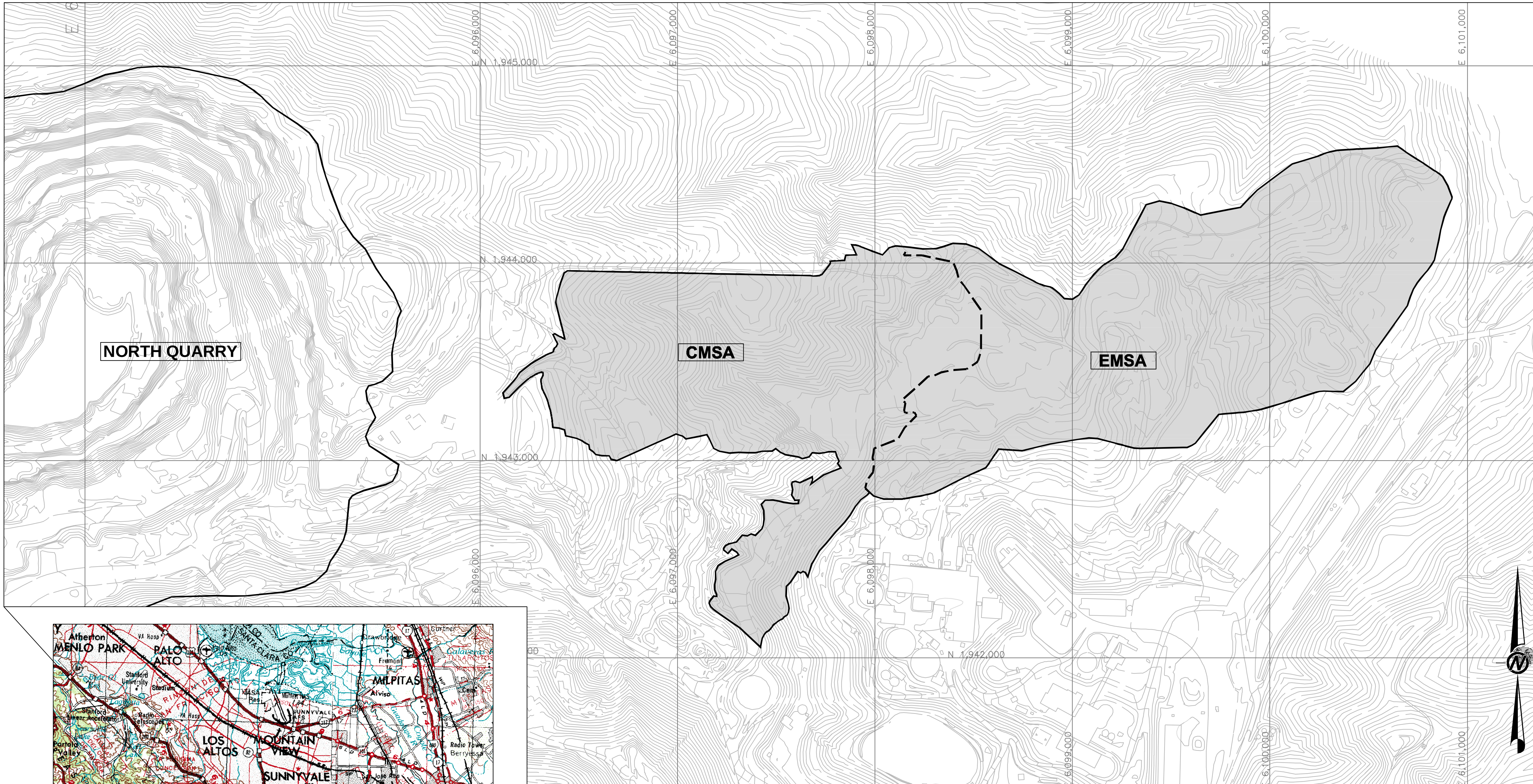
Deformation Calculation (Reference 2)							
SITE	Section	Failure Modes	k_y g	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
					84% Exc.	16% Exc.	50% Exc.
EMSA/CMSA	E1	Inter-Bench	0.16	0.27	3	13	6
	E1	Global Stability	0.22	0.37	2	7	3
	E3	Inter-Bench	0.15	0.25	4	14	7
	E3	Global Stability	0.16	0.27	3	13	6
Fine Waste Layers	Conceptual	Local Block Failure	0.11	0.18	6	24	12

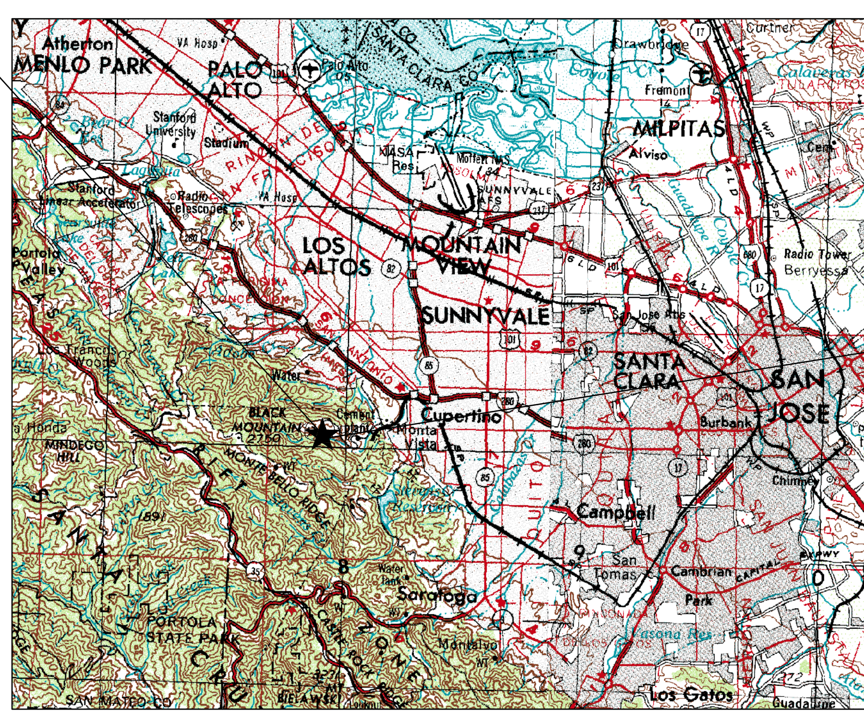
References:

1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displaceme Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections.

FIGURES





MAP OF REGION

LEGEND

★ PROJECT LOCATION

APPROXIMATE LIMIT OF STUDIED AREA

NOTE

1. REGIONAL MAP BASED FROM USGS 250K QUAD MAPS:
   - SAN FRANCISCO, 1980
   - SAN JOSE, 1969

PROJECT

PROPOSED RECLAMATION PLAN
EAST AND CENTRAL MATERIALS STORAGE AREA
LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA

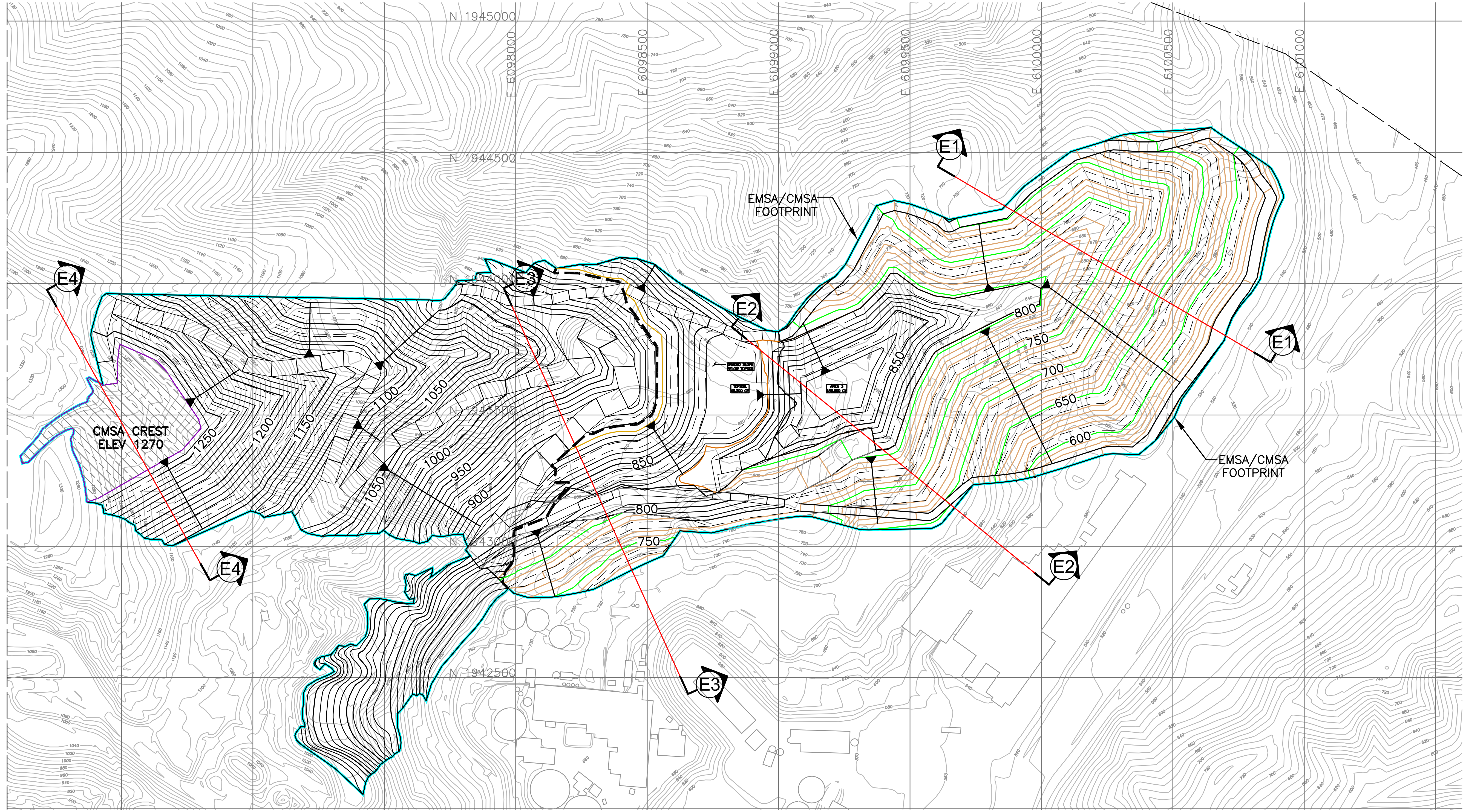
TITLE

SITE LOCATION MAP

Golder Associates
SUNNYVALE, CA

PROJECT No.	063-7109008		FILE No. Figure 1.dwg
DESIGN	PHY	05/10	SCALE AS SHOWN REV. 0
CADD	CJM	05/10	
CHECK	PHY	05/10	**FIGURE 1**
REVIEW	KGH	05/10	

Drawing file: Figure 1.dwg May 21, 2010 – 2:00pm



EAST AND CENTRAL MATERIALS STORAGE AREA SITE PLAN

SCALE: 1"=400'
CONTOUR INTERVAL = 10'

400 0 400 800
SCALE FEET

LEGEND

1550 PREDUMP TOPOGRAPHY AS OF APRIL 2007 (10 FT INTERVAL)

DESIGN TOPOGRAPHY

ADJACENT STRUCTURES AND FACILITIES

E2 SECTION ID

CMSA CREST ELEV. 1270

EMSA/CMSA FOOTPRINT

BOUNDARY BETWEEN EMSA AND CMSA

NOTE

1. PRE-DUMP TOPOGRAPHIC INFORMATION PROVIDED BY HAMMON, JENSEN, WALLEN AND ASSOCIATES. DATE OF TOPOGRAPHY: 4-9-07.

PROJECT	PROPOSED RECLAMATION PLAN EAST AND CENTRAL MATERIALS STORAGE AREA LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA				
TITLE	SITE PLAN EAST AND CENTRAL MATERIALS STORAGE AREA				
Golder Associates SUNNYVALE, CA	PROJECT No.		063-7109	FILE No.	Figure 2.dwg
	DESIGN	PHY	05/10	SCALE AS SHOWN	REV. 0
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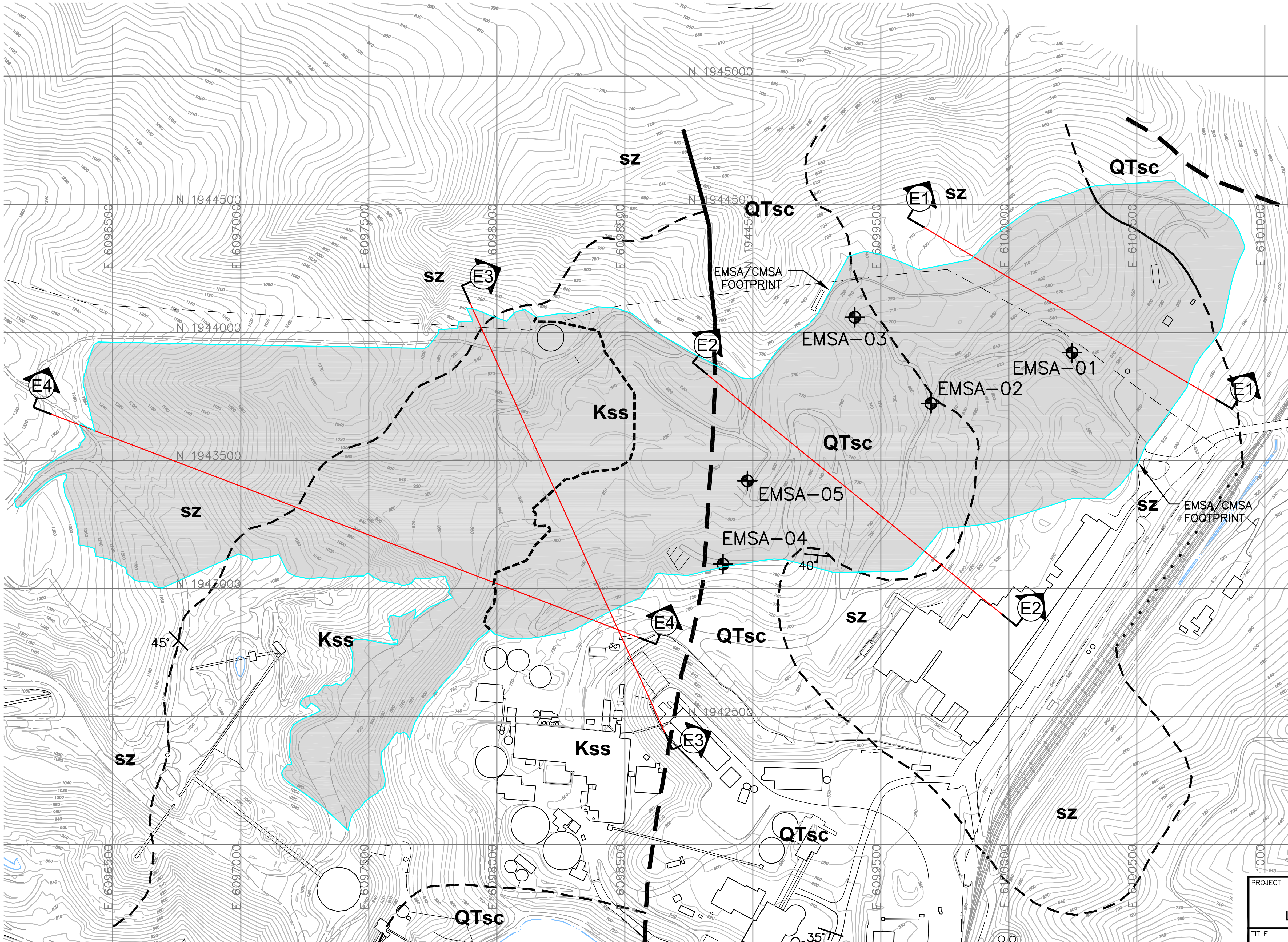
	CHECK	PHY	05/10		
	REVIEW	KGH	05/10		

Drawing file: Figure 2.dwg May 21, 2010 - 2:07pm



LEGEND

- GEOLOGIC CONTACT, CERTAIN
- GEOLOGIC CONTACT, APPROXIMATE
- GEOLOGIC CONTACT, CONCEALED
- FAULT CONTACT, CERTAIN
- FAULT CONTACT, APPROXIMATE
- 35° STRIKE AND DIP OF BEDDING
- **QTsc** SANTA CLARA FORMATION
- **Kss** FRANCISCAN COMPLEX SANDSTONE (GREYWACKE)
- **sz** SHEAR ZONE, MELANGE OF FRANCISCAN COMPLEX ROCKS – METABASALTS (GREENSTONE), SANDSTONE (GREYWACKE), AND LIMESTONE
- E2 SECTION ID
- EMSA/CMSA FOOTPRINT
- BOUNDARY BETWEEN EMSA AND CMSA
- EMSA–05 GEOTECHNICAL BOREHOLE – GOLDER, 2007

NOTE

1. GEOLOGY MODIFIED AFTER ROGERS, T.H. AND ARMSTRONG, C.F., 1973, ENVIRONMENTAL GEOLOGIC ANALYSIS OF THE MONTE BELLO RIDGE MOUNTAIN STUDY AREA, SANTA CLARA COUNTY, CALIFORNIA, CALIFORNIA DIVISION OF MINES AND GEOLOGY PRELIMINARY REPORT 17.

400 0 400 800
SCALE FEET

GEOLOGIC MAP

SCALE: 1"=400'

PROJECT
PROPOSED RECLAMATION PLAN
EAST AND CENTRAL MATERIALS STORAGE AREA
LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA

TITLE
**GEOLOGIC MAP
EAST AND CENTRAL MATERIALS
STORAGE AREA**

Golder Associates
Sunnyvale, California

PROJECT No.		063–7109	FILE No.	Figure 4.dwg
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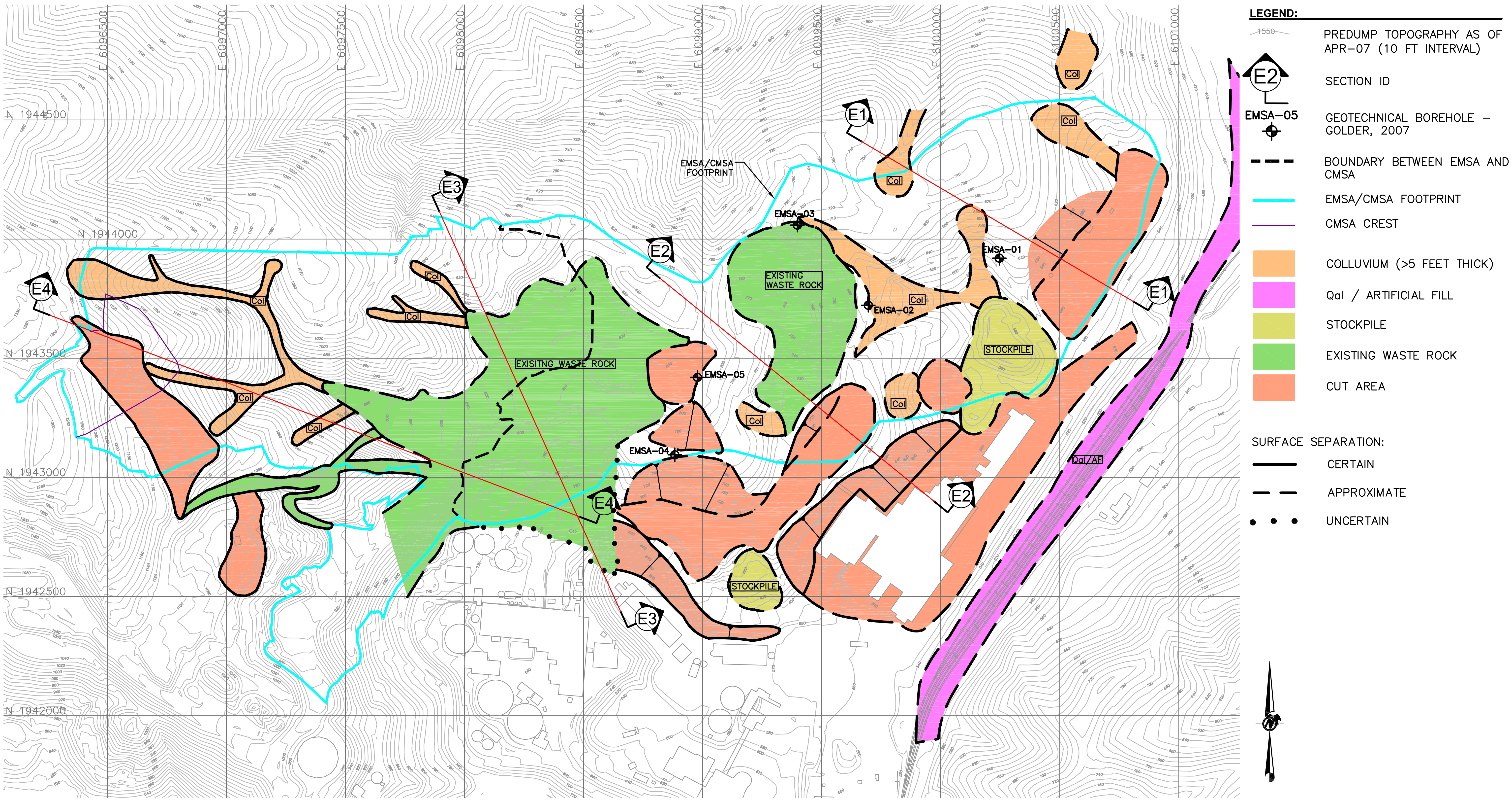
CHECK	PHY	05/10	**FIGURE 4**	
REVIEW	KGH	05/10		

Drawing file: Figure 4.dwg May 21, 2010 – 2:13pm



SURFACE MAPPING

SCALE: 1"=400'

400 0 400 800
SCALE FEET

PROJECT
PROPOSED RECLAMATION PLAN
EAST AND CENTRAL MATERIALS STORAGE AREA
LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA

TITLE
**SURFACE MAPPING
EAST AND CENTRAL MATERIALS
STORAGE AREA**

Golder Associates
Sunnyvale, California

PROJECT No.		063-7109	FILE No.	Figure 5.dwg
DESIGN	WLF	05/10	SCALE AS SHOWN	REV. 0
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CHECK	PHY	05/10		
REVIEW	KGH	05/10		

FIGURE 5

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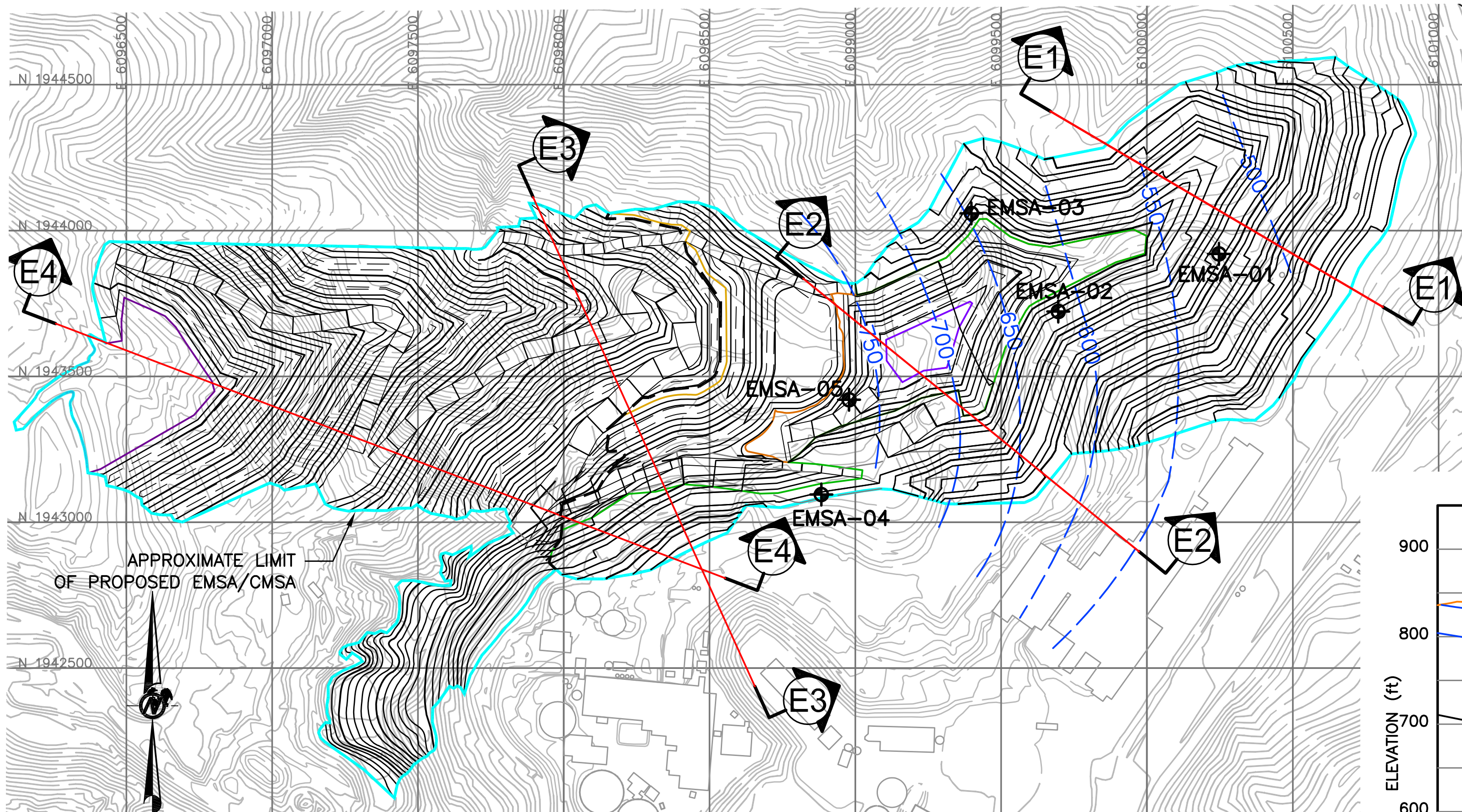


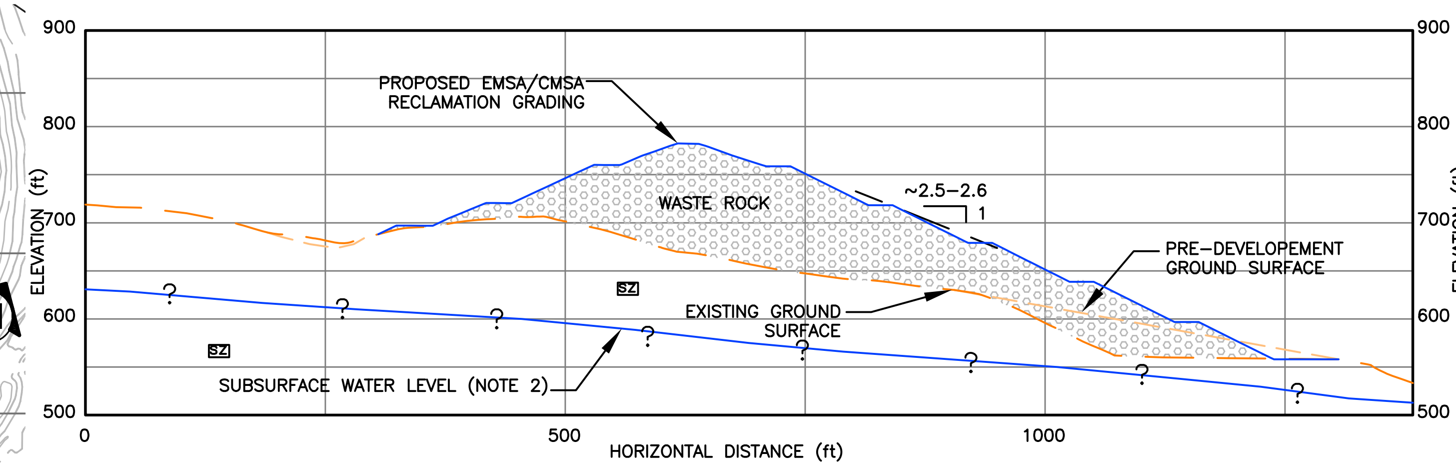
SITE PLAN

SCALE: 1"=600'

CONTOUR INTERVAL = 10'

600 0 600 1200

SCALE FEET



SECTION E1

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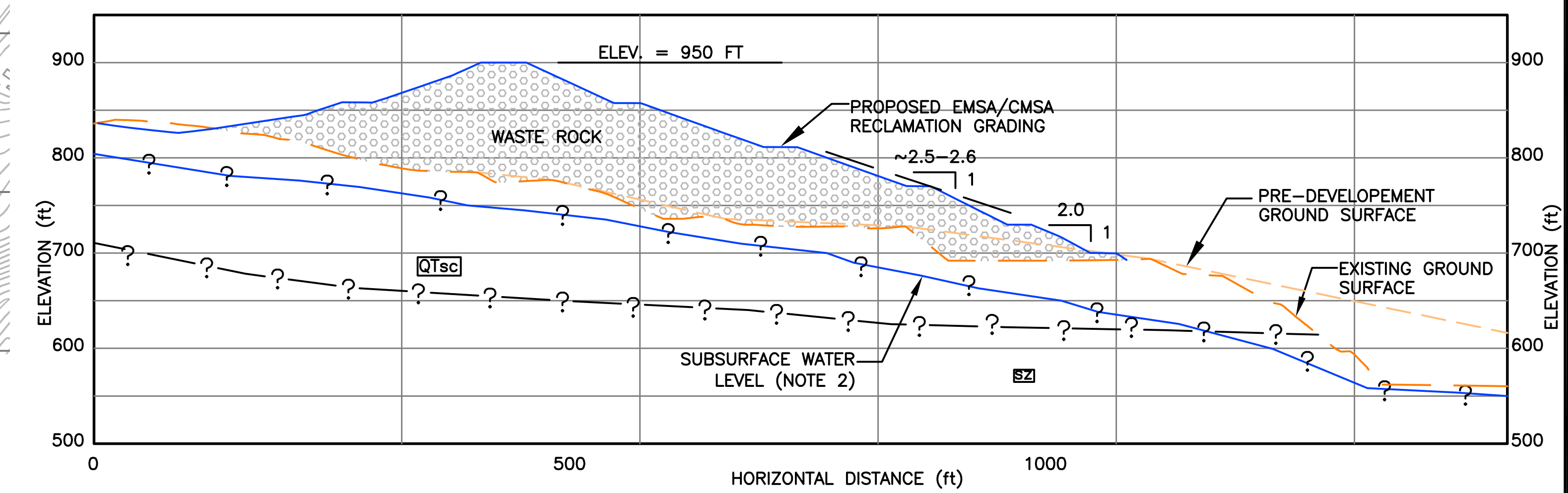

SECTION E2

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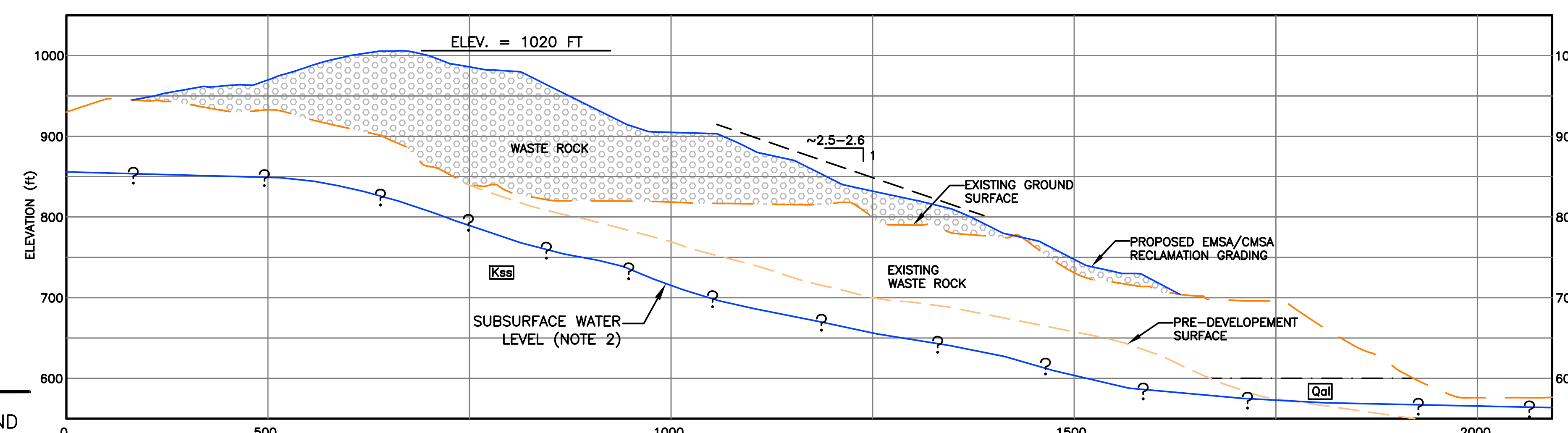

SECTION E3

SCALE: H/V 1"=200'

200 0 200 400

SCALE H/V 1"=200' FEET

LEGEND

1550	EXISTING TOPOGRAPHY (10 FT INTERVAL)
	ADJACENT STRUCTURES AND FACILITIES
E2	SECTION ID/REFERENCE FIGURE NUMBER
	EMSA/CMSA FOOTPRINT
	EMSA/CMSA CREST
?	SUBSURFACE WATER LEVEL PROFILE (NOTE 2)
?	GEOLOGIC UNITS CONTACT PROFILE
	BOUNDARY BETWEEN EMSA AND CMSA
EMSA-05	GEOTECHNICAL BOREHOLE – GOLDER, 2007
QTsc	SANTA CLARA FORMATION
Kss	FRANCISCAN COMPLEX SANDSTONE (GREYWACKE)
SZ	SHEAR ZONE, MELANGE OF FRANCISCAN COMPLEX ROCKS – METABASALTS (GREENSTONE), SANDSTONE (GREYWACKE), LIMESTONE, AND SERPENTINE
Qal	ARTIFICIAL FILL

NOTE

1. EXISTING TOPOGRAPHIC INFORMATION PROVIDED BY HAMMON, JENSEN, WALLEN AND ASSOCIATES. DATE OF TOPOGRAPHY: APRIL 9, 2007.
2. WATER LEVELS ARE ASSUMED BASED ON SUBSURFACE INVESTIGATIONS BY GOLDER (2007) AND OTHER HISTORIC DATA.

PROJECT

PROPOSED RECLAMATION PLAN
EAST AND CENTRAL MATERIALS STORAGE AREA
LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA

TITLE

CROSS-SECTIONS E1, E2, AND E3 EAST AND CENTRAL MATERIALS STORAGE AREA

Golder Associates
SUNNYVALE, CA

PROJECT No.	063-7109		FILE No.	Figure 6 and 7.dwg
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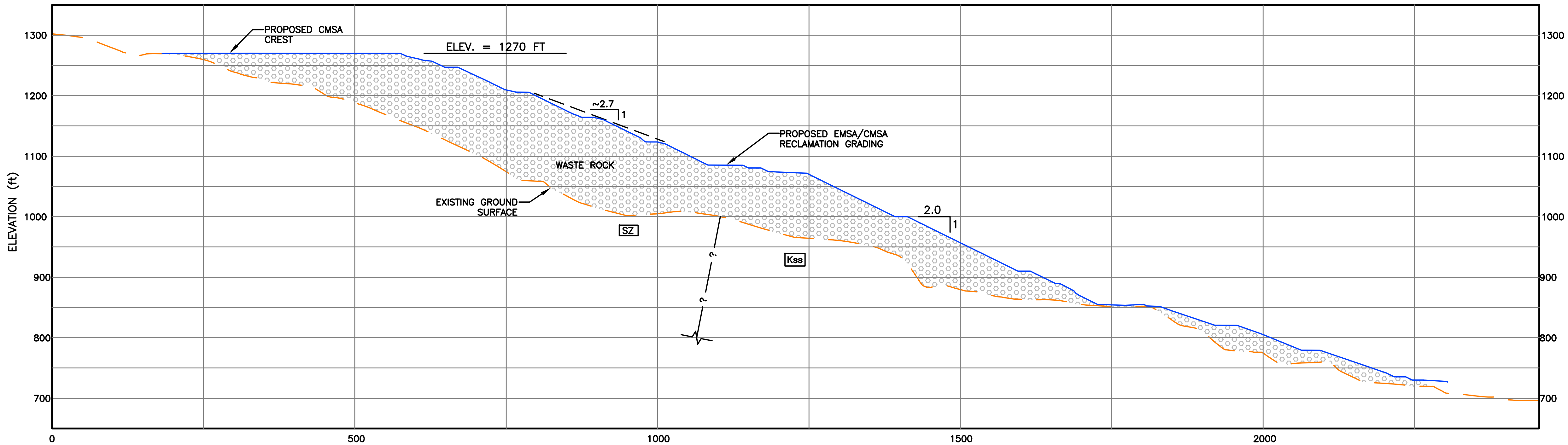
CHECK	PHY	05/10		
REVIEW	KGH	05/10		

FIGURE 6

Drawing file: Figure 6 and 7.dwg May 21, 2010 – 2:26pm



SECTION E4

SCALE: 1"=200'

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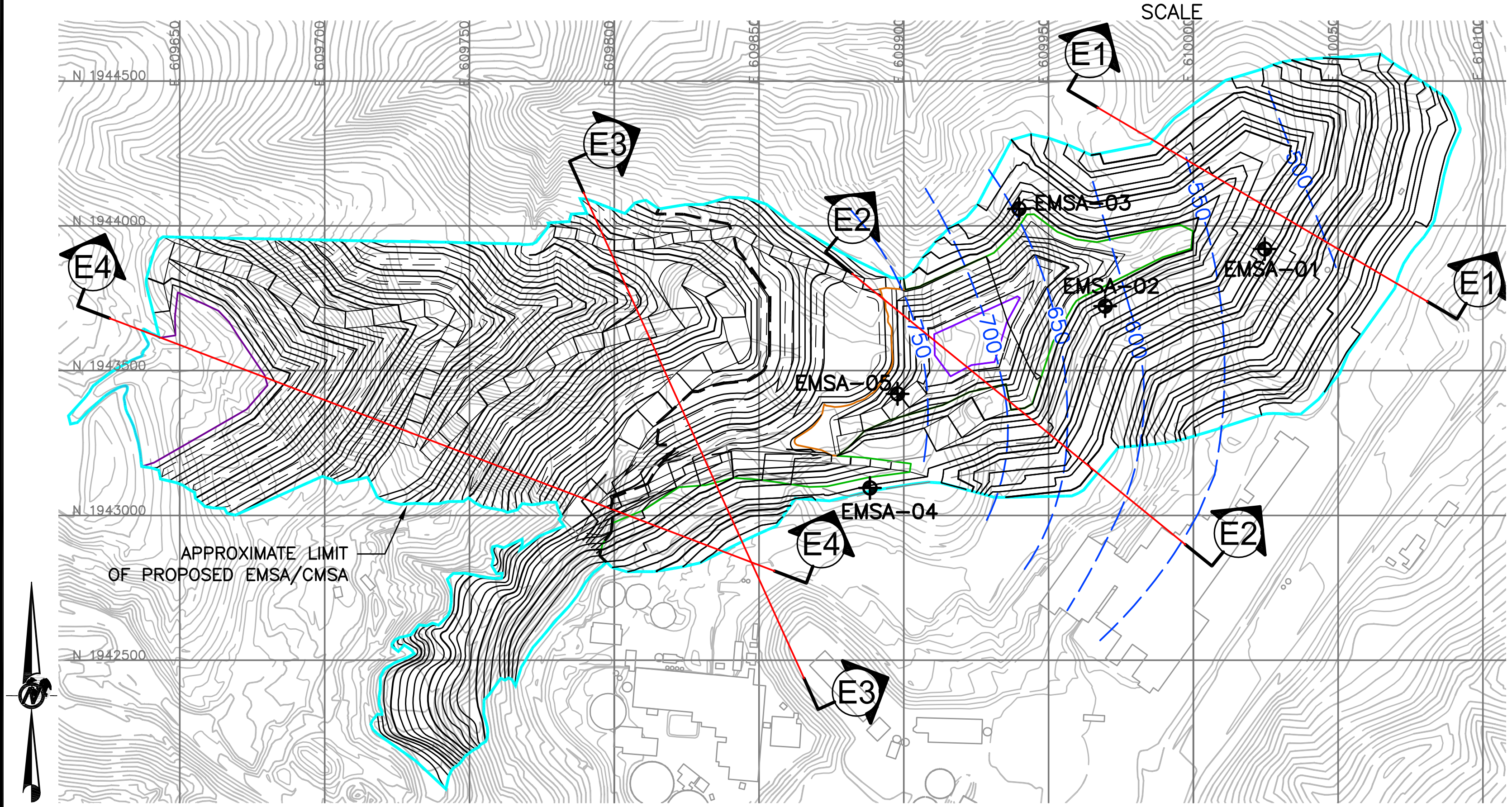
SCALE FEET



SITE PLAN

SCALE: 1"=600'

CONTOUR INTERVAL = 10'

600 0 600 1200
SCALE FEET

LEGEND

- EXISTING TOPOGRAPHY (10 FT INTERVAL)
- ADJACENT STRUCTURES AND FACILITIES
- SECTION ID
- EMSA/CMSA FOOTPRINT
- BOUNDARY BETWEEN EMSA AND CMSA
- CMSA CREST
- SUBSURFACE WATER LEVEL PROFILE (NOTE 2)
- GEOLOGIC UNITS CONTACT PROFILE
- EMSA-05 GEOTECHNICAL BOREHOLE – GOLDER, 2007
- QTsc SANTA CLARA FORMATION
- Kss FRANCISCAN COMPLEX SANDSTONE (GREYWACKE)
- SZ SHEAR ZONE, MELANGE OF FRANCISCAN COMPLEX ROCKS – METABASALTS (GREENSTONE), SANDSTONE (GREYWACKE), LIMESTONE, AND SERPENTINE
- Qal ARTIFICIAL FILL

NOTE

1. EXISTING TOPOGRAPHIC INFORMATION PROVIDED BY HAMMON, JENSEN, WALLEN AND ASSOCIATES. DATE OF TOPOGRAPHY: APRIL 9, 2007.
2. WATER LEVELS ARE ASSUMED BASED ON SUBSURFACE INVESTIGATIONS BY GOLDER (2007) AND OTHER HISTORIC DATA.

PROJECT

PROPOSED RECLAMATION PLAN
EAST AND CENTRAL MATERIALS STORAGE AREA
LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA

TITLE

CROSS-SECTION E4
EAST AND CENTRAL MATERIALS STORAGE AREA

Golder Associates
SUNNYVALE, CA

PROJECT No.		063-7109	FILE No. FIGURES 6, 7_R0.dwg
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CHECK	PHY	05/10	FIGURE 7
REVIEW	KGH	05/10	

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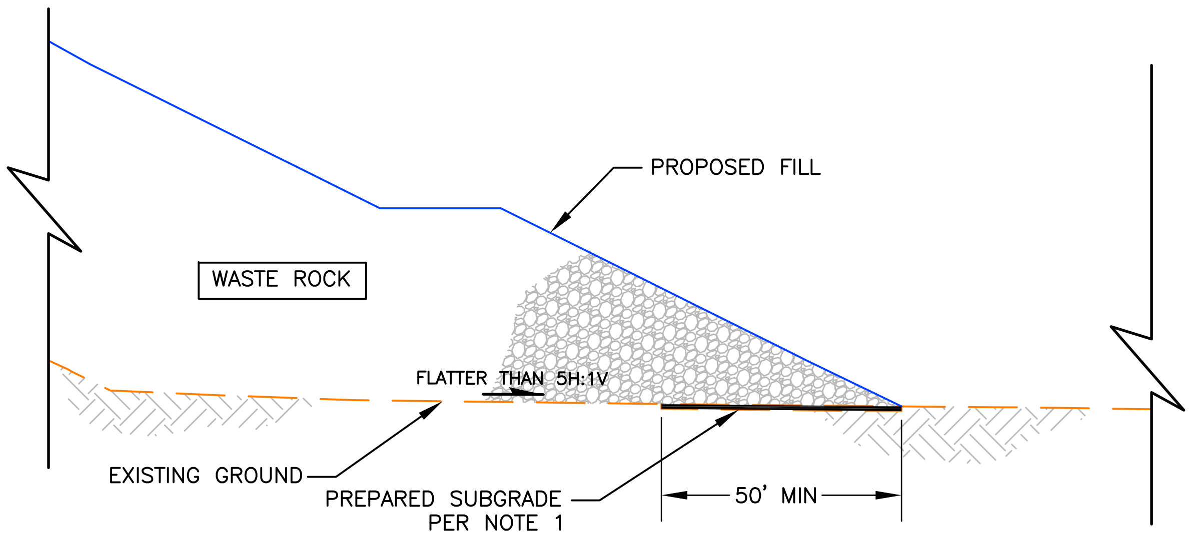
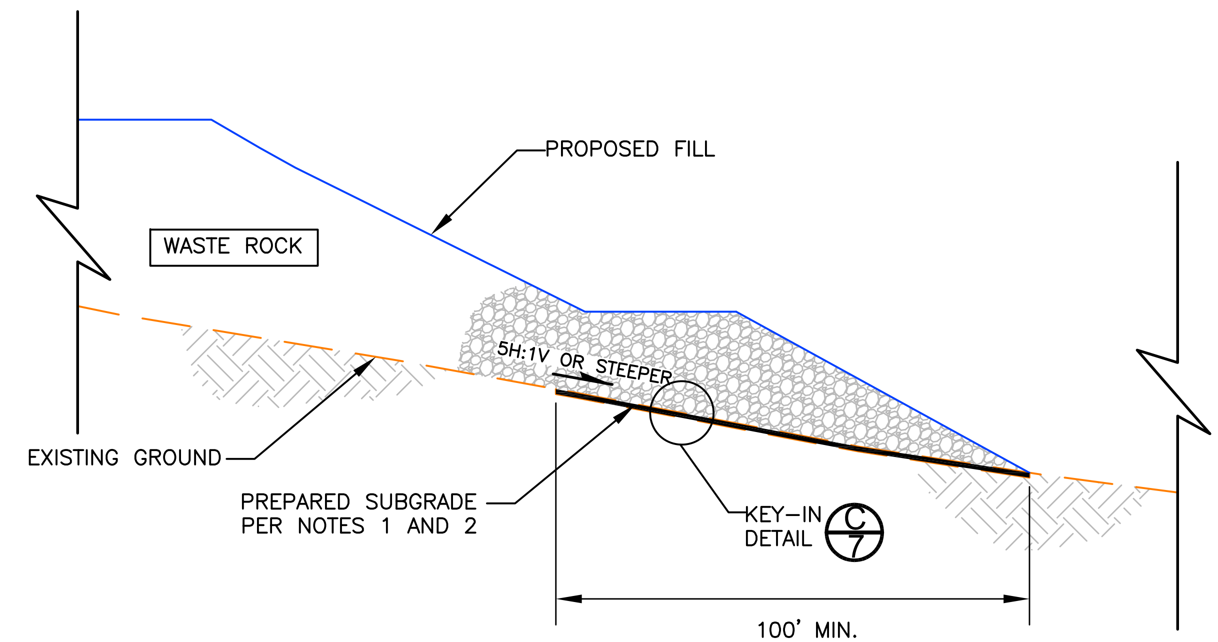


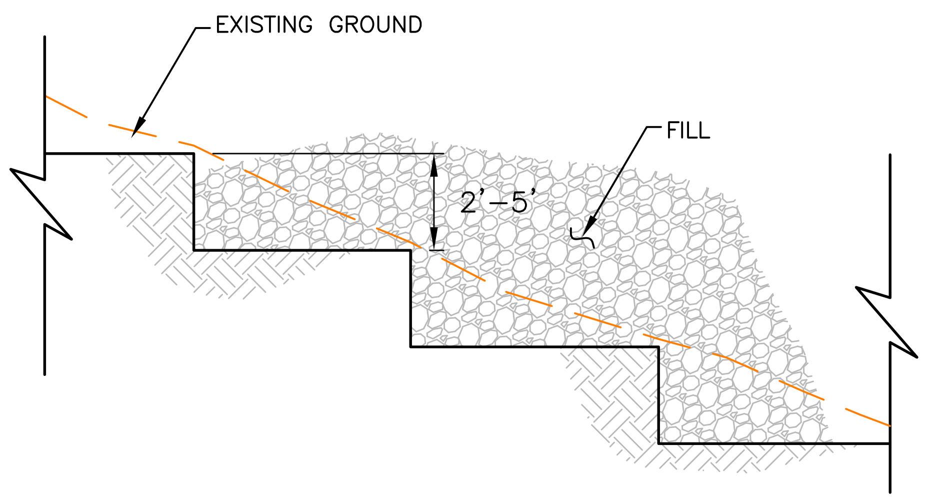
A SUBGRADE PREPARATION FOR OUTWARD SLOPING EXISTING GROUND FLATTER THAN 5H:1V

NTS



B SUBGRADE PREPARATION FOR OUTWARD SLOPING EXISTING GROUND 5H:1V OR STEEPER

NTS



C BENCH KEY-IN DETAIL

NTS

NOTE

1. SUBGRADE PREPARATION SHALL CONSIST OF OVER-EXCAVATION OF TOPSOIL, VEGETATION, AND FAT CLAYS. OVER-EXCAVATION SHALL BE PERFORMED UNTIL BEDROCK, GRANULAR SOIL, OR LEAN CLAY IS ENCOUNTERED. LEAN CLAY SHALL BE BE MEASURED TO HAVE A PLASTICITY INDEX (PI) NO GREATER THAN 25.
2. SUBGRADE PREPARATION OF SLOPES 5H:1V OR STEEPER SHOULD ALSO CONSIST OF BENCHING THE SLOPES WITH INDIVIDUAL BENCH HEIGHTS OF AT LEAST 5 FEET AS SHOWN IN DETAIL C.

PROJECT
PROPOSED RECLAMATION PLAN
EAST AND CENTRAL MATERIALS STORAGE AREA
LEHIGH SOUTHWEST CEMENT COMPANY, CALIFORNIA

TITLE
SUBGRADE PREPARATION

Golder Associates
SUNNYVALE, CA

PROJECT No.		063-7109	FILE No. Figure 8.dwg
DESIGN	PHY	05/10	SCALE AS SHOWN REV. 0
CADD	CJM	05/10	
CHECK	PHY	05/10	**FIGURE 8**
REVIEW	KGH	05/10	

Drawing file: Figure 8.dwg May 21, 2010 - 2:27pm

APPENDIX A

GEOTECHNICAL BORING LOGS

SUMMARY: BORING NO. EMSA-1

DATE DRILLED: 5/21/07 - 5/21/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Sand AND gravel to 3" diameter, dry

COORDINATES: N 1,943,921.0 FT, E 610,028.0 FT
ELEVATION: 614.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								CLAYEY SAND (SC) w/ few gravel, dark brown, gravel to 1" diameter, loose, dry	SC			0
5	EMSA-1-5		4 4 6	SPT		G				dry	medium dense	5
	EMSA-1-(5-7			Shelby		G						
								LIMESTONE (low grade), grey, to 3" diameter, subangular, medium weathered, hard, dry	LS			
	EMSA-1-10		12 13 18	SPT		A, G					dense	
10								GREENSTONE, dark brown/green, to 2" diameter, subangular, fine grained, medium to highly weathered, hard, dry	GS			10
			5 10 15	SPT				LIMESTONE (low grade), grey/dark red, to 3" diameter, fine grained, subangular, some calcite fractures, medium weathered, hard, dry	LS		medium dense	
15												15
	EMSA-1-20		10 19 21	SPT		A, G		GREENSTONE, green, to 1.5" diameter, fine grained, subrounded, trace calcite, medium weathered, dry	GS		dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-1

DATE DRILLED: 5/21/07 - 5/21/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Sand AND gravel to 3" diameter, dry

COORDINATES: N 1,943,921.0 FT
E 610,028.0 FT
ELEVATION: 614.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20												20
			13 19 21	SPT							dense	
25								@25': Green/dark brown, highly weathered, to 0.5" diameter, loose				25
			10 50 >50	SPT							very dense	
30								@30': No recovery	GS			30
			>50 >50 >50	SPT							very dense	
35												35
			>50 >50 >50	SPT				@39': Very hard			very dense	
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
▽ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-1

DATE DRILLED: 5/21/07 - 5/21/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Sand AND gravel to 3" diameter, dry

COORDINATES: N 1,943,921.0 FT, E 610,028.0 FT
ELEVATION: 614.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
40									GS			40
								Auger Refusal @ 40.5' BGS End of Boring @40.5' BGS No Water Encountered				
45												45
50												50
55												55
60												60

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED

A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY

∇ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

BOREHOLE LOG HANSON EMSA 063-7109.GPJ GLDR_OAK.GDT 2/11/09

SUMMARY: BORING NO. EMSA-2

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 3" diameter

COORDINATES: N 1,943,814.0 FT, E 6,099,713.0 FT
ELEVATION: 640.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								CLAYEY SAND (SC) w/ little gravel, dark yellowish brown, gravel to 2" diameter, loose, dry				0
	EMSA-2-5		2 4 2	SPT		A, G					loose	
5												5
				Shelby				@5.5': Increasing gravel size (limestone), medium to high plasticity fines	SC			
			3 6 27	SPT				@9': Mottled, greenstone and limestone gravel to 2" diameter			dense	
10												10
	EMSA-2-15		4 8 10	SPT		A, G		GREENSTONE, yellowish brown, mottled, to 3" diameter, subrounded, highly weathered, hard, dry			medium dense	
15									GS			15
			3 5 10	SPT							medium dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 3" diameter

COORDINATES: N 1,943,814.0 FT
E 6,099,713.0 FT

ELEVATION: 640.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20												20
			3 8 15	SPT							medium dense	
25								@25': Very mottled, brown/green/orange/red, mostly dark brown, some fines, completely weathered, fine gravel				25
			10 14 30	SPT							dense	
30									GS			30
			6 23 39	SPT							very dense	
35								@35': Medium to highly weathered				35
			8 21 42	SPT							very dense	
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-2

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 3" diameter

COORDINATES: N 1,943,814.0 FT
E 6,099,713.0 FT

ELEVATION: 640.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
40									GS		very dense	40
			6 50 >50	SPT								
45								End of Borehole @ 45' BGS No Water Encountered				45
50												50
55												55
60												60

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
▽ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-3

DATE DRILLED: 5/23/07 - 5/23/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: High grass

COORDINATES: N 1,944,094.0 FT, E 6,099,499.0 FT
ELEVATION: 709.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDSTONE (Santa Clara Fm), yellowish brown, red, mottled, some gravel to 1", fine grained, poorly sorted, subrounded, highly weathered, dry				0
4	EMSA-3-5		8 15 17	SPT		G				dry	dense	
5												5
9			11 24 30	SPT				@9': Trace fines, gravel, to 1.5" diameter, some quartz veins			very dense	
10									SS			10
14			15 50 >50	SPT				@14': Greywacke, quartz			very dense	
15												15
19			11 17 30	SPT				@19': Large pieces of quartz			dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-3 SHEET 2 OF 2

DATE DRILLED: 5/23/07 - 5/23/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: High grass

COORDINATES: N 1,944,094.0 FT, E 6,099,499.0 FT
ELEVATION: 709.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20												20
24			16 50 >50	SPT				@24': Dark yellowish brown, little fines, more cemented, damp		moist	very dense	
25												25
26									SS			
29			50 >50 >50	SPT							very dense	
30								@30': Gravel to 2" diameter, very hard				30
32								Auger Refusal @ 32' BGS End of Borehole @ 32' BGS No Water Encountered				
35												35
40												40

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
▽ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-4

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 2" diameter

COORDINATES: N 1,943,135.0 FT, E 6,098,783.0 FT
ELEVATION: 746.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDSTONE (Shear Zone), w/ some greywacke, gravel to 2" diameter, yellowish brown, red, mottled, fine grained, subrounded to subangular, highly weathered, dry				0
	EMSA-4-5		10 11 12	SPT		G				dry	medium dense	
5												5
	EMSA-4-(5.5-			Shelby		G		@ 5.5': Cobbles to 4" diameter				
			6 8 13	SPT							medium dense	
10									SS			10
			6 7 12	SPT				@14': Increasing greywacke to 3" diameter, green, brown, fine grained, subangular, highly weathered, dry			medium dense	
15												15
			7 10 13	SPT				@19': Mottled, red, yellow, brown, completely weathered			medium dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED

A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY

▽ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-4

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 2" diameter

COORDINATES: N 1,943,135.0 FT, E 6,098,783.0 FT
ELEVATION: 746.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
20–25			5, 6, 8	SPT					SS	moist	medium dense
25–30			7, 14, 18	SPT				SILTY SAND (SM) w/ little gravel to 0.5", very dark brown, soft, moist, slight sheen, slight odor	SM	dry	dense
30–38			13, 50, >50	SPT				SANDSTONE (Shear Zone), w/ some greywacke, gravel to 2" diameter, yellowish brown, red, mottled, fine grained, subrounded to subangular, highly weathered, dry	SS		very dense
38								Auger Refusal @ 38' BGS End of Borehole @ 38' BGS No Water Encountered			

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED

A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY

▽ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

BOREHOLE LOG HANSON EMSA 063-7109.GPJ GLDR_OAK.GDT 2/11/09

SUMMARY: BORING NO. EMSA-5

DATE DRILLED: 5/22/07 - 5/22/07

DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer

SURFACE CONDITIONS: Grass, sand, gravel to 3"

COORDINATES: N 1,943,360.0 FT, E 6,098,978.0 FT

ELEVATION: 792.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDSTONE (Santa Clara Fm), yellowish brown, red, mottled, greywacke, to 0.5" diameter, fine grained, subrounded, unconsolidated, highly weathered, dry				0
	EMSA-5-5		22 50 >50	SPT		G				dry	very dense	
5												5
	EMSA-5-10		50 >50 >50	SPT		G					very dense	
10									SS			10
			50 >50 >50	SPT							very dense	
15												15
			20 50 >50	SPT							very dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED

A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY

▽ WATER LEVEL - ATD
▼ WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-5

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Grass, sand, gravel to 3"

COORDINATES: N 1,943,360.0 FT
E 6,098,978.0 FT

ELEVATION: 792.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20								@20': Gravel to 1.5" diameter, more consolidated				20
			32 50 >50	SPT							very dense	
25								@25': Calcite veins in rock fragments, subangular	SS			25
30			26 50 >50	SPT							very dense	30
								Auger Refusal @ 32' BGS End of Borehole @ 32' BGS No Water Encountered				
35												35
40												40

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Lehigh Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

APPENDIX B

SUMMARY OF LABORATORY TEST RESULTS

APPENDIX B-1

FOUNDATION SOILS

#200 Sieve Wash Analysis
ASTM D 1140

COOPER TESTING LABORATORY

Job No.: 287-031a **Project No.:** 063-7109.011 **Run By:** MD
Client: Golder Associates **Date:** 6/21/2007 **Checked By:** DC
Project: Hanson/East Materials Storage Area

Boring:	EMSA-1	EMSA-1	EMSA-1	EMSA-2	EMSA-2	EMSA-3	EMSA-4	EMSA-5
Sample:	1	3	5	1	4	1	1	1
Depth, ft.:	5	10	20	5	15	5	5	5
Soil Type:	Brown Clayey SAND w/ Gravel	Marbled Blue & Greenish Brown Lean Clayey SAND w/ Gravel	Mottled Gray & Black Sandy Lean CLAY	Brown Lean Clayey SAND	Mottled Brown & Gray Lean Clayey SAND	Light Brownish Yellow Sandy CLAY	Brown Clayey SAND w/ Gravel	Light Bown Clayey SAND
Wt of Dish & Dry Soil, gm	290.8	452.4	657.4	426.9	384.1	564.9	810.3	370.9
Weight of Dish, gm	83.5	77.9	80.4	84.4	84.5	79.8	84.5	81.1
Weight of Dry Soil, gm	207.3	374.5	577.0	342.5	299.6	485.1	725.8	289.8
Wt. Ret. on #4 Sieve, gm	42.5	89.0	79.2	48.7	34.4	25.2	227.5	27.7
Wt. Ret. on #200 Sieve, gm	166.9	225.2	271.2	200.8	161.4	205.4	535.7	168.4
% Gravel	**20.5**	**23.8**	**13.7**	**14.2**	**11.5**	**5.2**	**31.3**	**9.6**
% Sand	**60.0**	**36.4**	**33.3**	**44.4**	**42.4**	**37.1**	**42.5**	**48.6**
% Silt & Clay	**19.5**	**39.9**	**53.0**	**41.4**	**46.1**	**57.7**	**26.2**	**41.9**

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

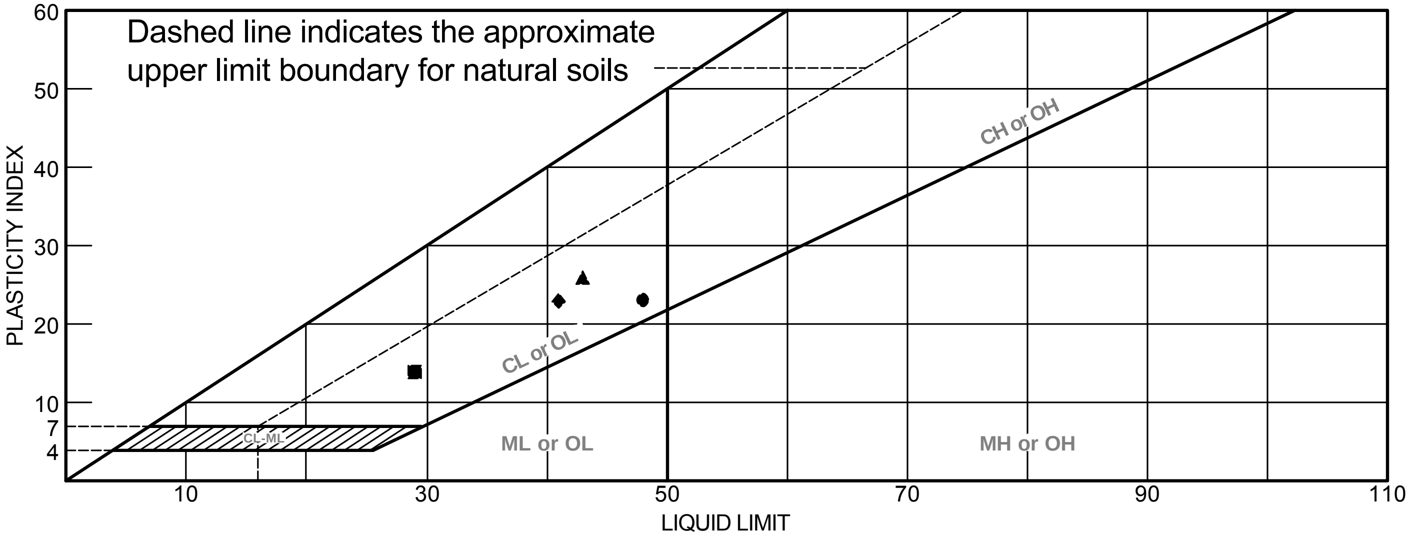
#200 Sieve Wash Analysis
ASTM D 1140

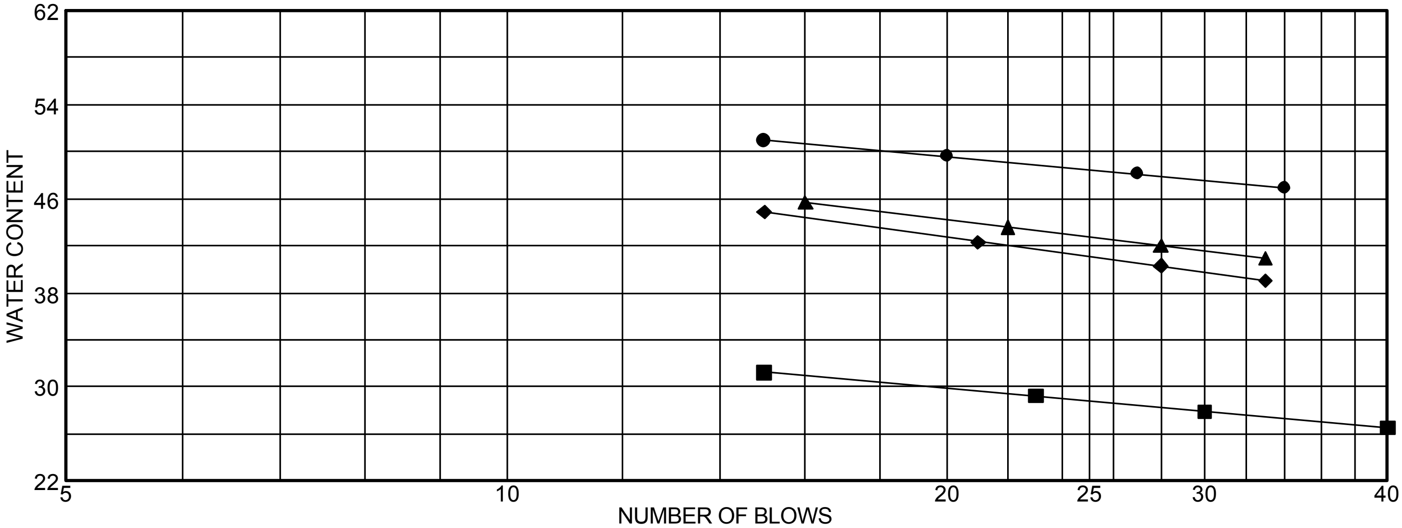
Job No.: 287-031b
Client: Golder Associates
Project: Hanson/East Materials Storage Area
Project No.: 063-7109.011
Date: 6/21/2007
Run By: MD
Checked By: DC

Boring:	EMSA-5	EMSA-1	EMSA-4						
Sample:	2								
Depth, ft.:	10	5-7	5.5-8						
Soil Type:	Light Brown Clayey SAND	Gray Sandy CLAY w/ Gravel	Light Yellowish Brown Clayey SAND w/ Gravel						
Wt of Dish & Dry Soil, gm	631.0	611.3	784.5						
Weight of Dish, gm	100.2	174.3	329.5						
Weight of Dry Soil, gm	530.8	437.1	455.0						
Wt. Ret. on #4 Sieve, gm	53.7	66.2	95.7						
Wt. Ret. on #200 Sieve, gm	318.1	188.2	314.1						
% Gravel	**10.1**	**15.1**	**21.0**						
% Sand	**49.8**	**27.9**	**48.0**						
% Silt & Clay	**40.1**	**56.9**	**31.0**						

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Lean Clayey SAND	48	25	23			
■	Mottled Brown & Gray Lean Clayey SAND	29	15	14			
▲	Marbled Blue & Greenish Brown Lean Clayey SAND w/ Gravel	43	17	26			
◆	Mottled Gray & Black Sandy Lean CLAY	41	18	23			

Project No. 287-031 **Client:** Golder Associates

Project: Hanson/East Materials Storage Area - 063-7109.011

● **Source:** EMSA-2 **Sample No.:** 1 **Elev./Depth:** 5'

■ **Source:** EMSA-2 **Sample No.:** 4 **Elev./Depth:** 15'

▲ **Source:** EMSA-1 **Sample No.:** 3 **Elev./Depth:** 10'

◆ **Source:** EMSA-1 **Sample No.:** 5 **Elev./Depth:** 20'

Remarks:

●

■

▲

◆

LIQUID AND PLASTIC LIMITS TEST REPORT

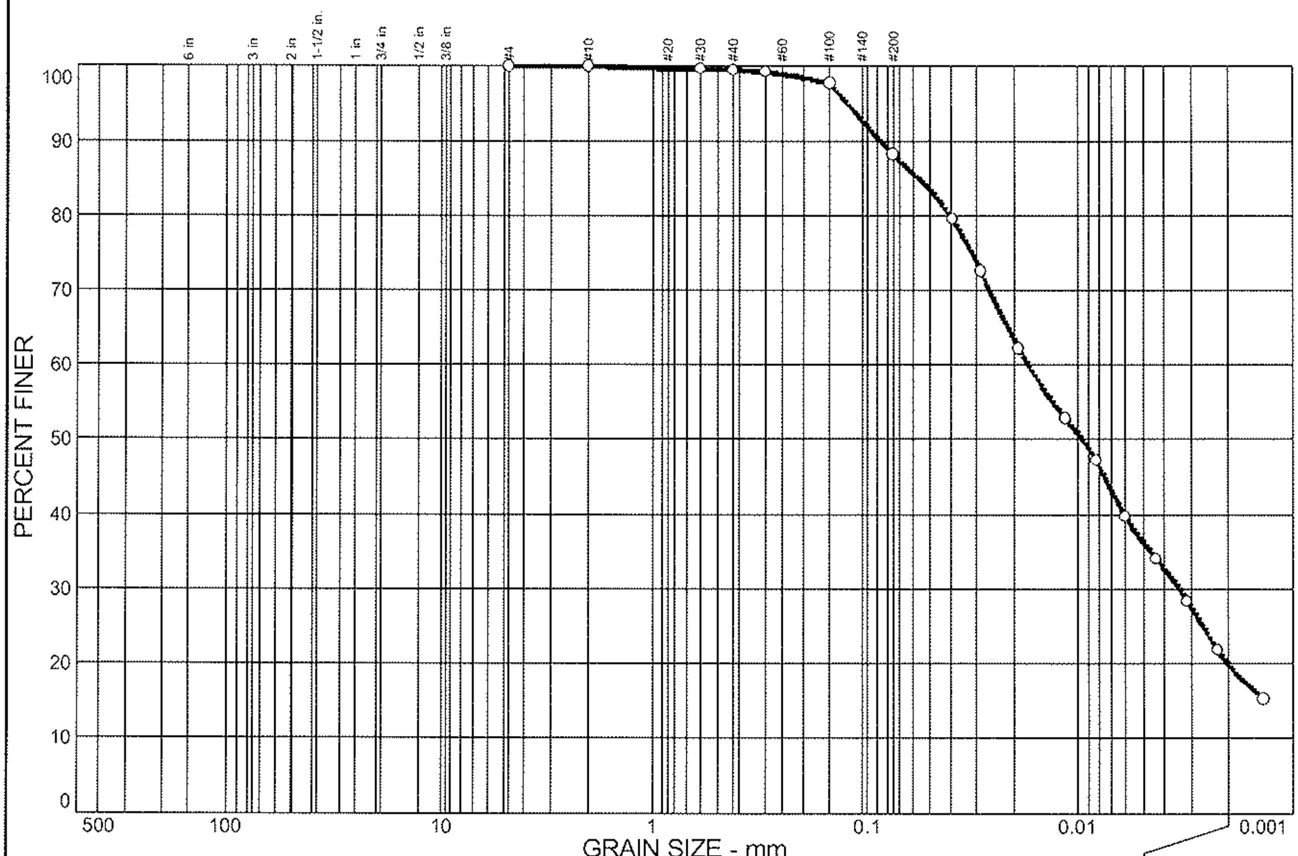
COOPER TESTING LABORATORY

Figure

APPENDIX B-2

FINE WASTE

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.5	11.3	68.3	19.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#30	99.6		
#40	99.5		
#50	99.2		
#100	97.7		
#200	88.2		
0.0393 mm.	79.5		
0.0288 mm.	72.5		
0.0191 mm.	62.2		
0.0115 mm.	52.8		
0.0083 mm.	47.2		
0.0060 mm.	39.7		
0.0043 mm.	34.1		
0.0031 mm.	28.4		
0.0023 mm.	21.9		
0.0014 mm.	15.3		

* (no specification provided)

Soil Description

Gray Silty CLAY

Atterberg Limits

PL= 19 LL= 24 PI= 5

Coefficients

D_{85}= 0.0570 D_{60}= 0.0172 D_{50}= 0.0096
D_{30}= 0.0034 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO=

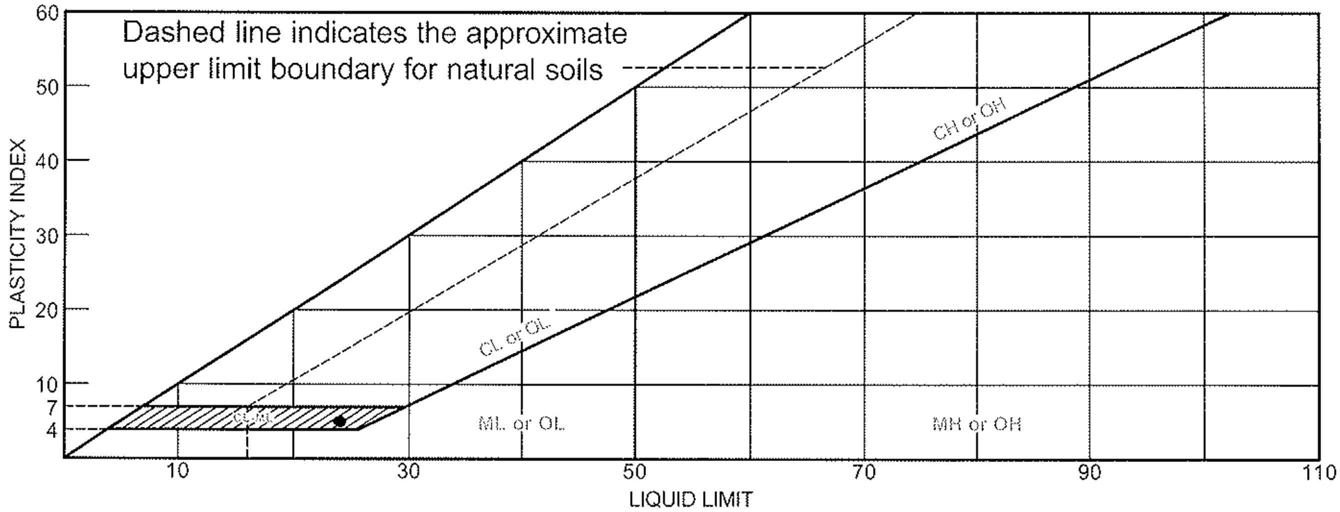
Remarks

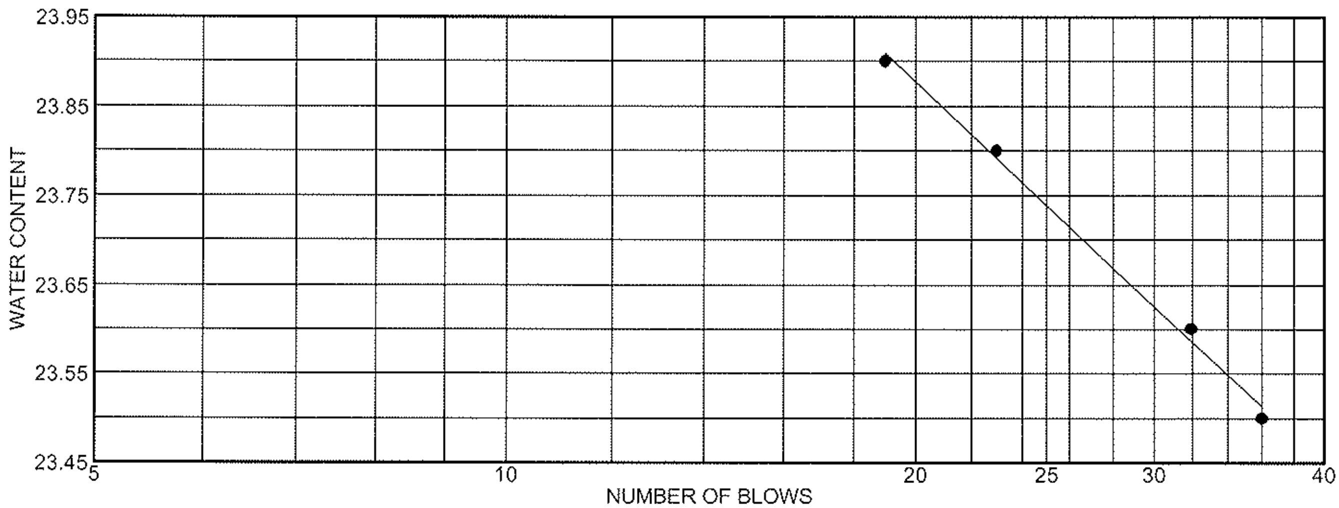
Sample No.: **Source of Sample:** (In House 3/5/08) **Date:**
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Golder & Associates
Project: Hanson - 0637109-100-103
Project No: 287-035 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Silty CLAY	24	19	5	99.5	88.2	CL-ML

Project No. 287-035 **Client:** Golder & Associates

Project: Hanson - 0637109-100-103

● **Source:** (In House 3/5/08)

Remarks:

●

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Moisture-Density-Porosity Report
Cooper Testing Labs, Inc.

Job No:	287-035	**Date:**	03/07/08
Client:	Golder Associates	**By:**	RU
Project:	Hanson - 0637109-100-103	**Remarks:**	

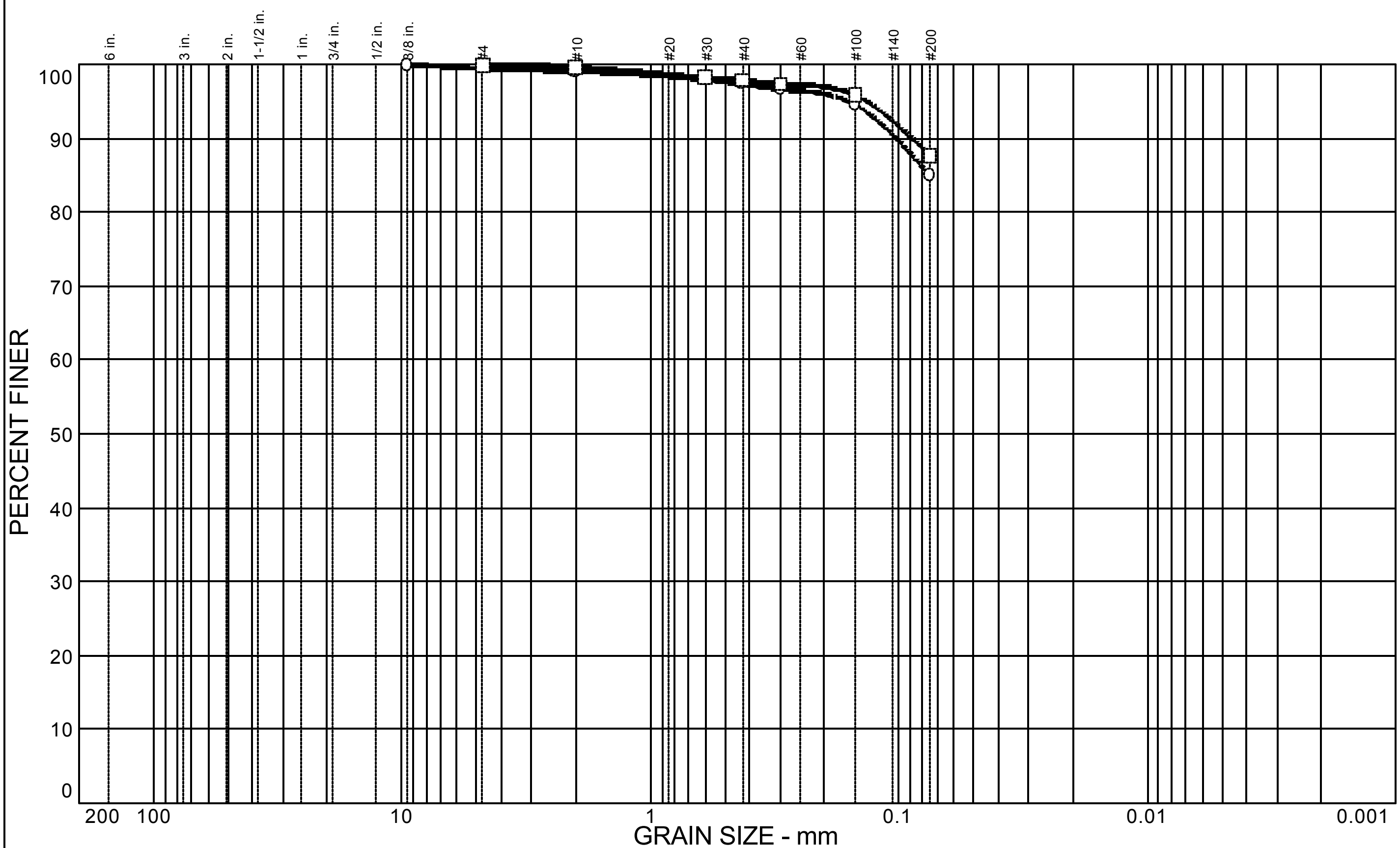
Boring: **Sample:** **Depth, ft:**	(In House 3/5/08)						
Visual Description:	Gray Silty CLAY						
Actual G_s							
Assumed G_s	2.70						
Total Vol cc	250.3						
Vol Solids,cc	99.7						
Vol Voids,cc	150.6						
Moisture, %	53.8						
Wet Unit wt, pcf	103.3						
Dry Unit wt, pcf	67.2						
Saturation, %	96.2						
Porosity, %	60.2						
Air filled Poros.,%	2.3						
Water filled Poros.,%	57.9						
Void Ratio	1.51						
Series	1	2	3	4	5	6	7

Note: If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.5	14.4	85.1		CL		18	30
□			12.3	87.7		CL		18	32

SIEVE inches size	PERCENT FINER ○	□	
3/8	100.0		

	GRAIN SIZE		
D_{60}			
D_{30}			
D_{10}			

	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	
#4	99.5	100.0	
#10	99.1	99.7	
#30	98.0	98.3	
#40	97.4	97.9	
#50	96.7	97.4	
#100	94.6	95.9	
#200	85.1	87.7	

SOIL DESCRIPTION

○ Gray Lean CLAY

□ Gray Lean CLAY

REMARKS:

○

□

○ Source: FW-1 1/3

□ Source: FW-2 1/3

COOPER TESTING LABORATORY

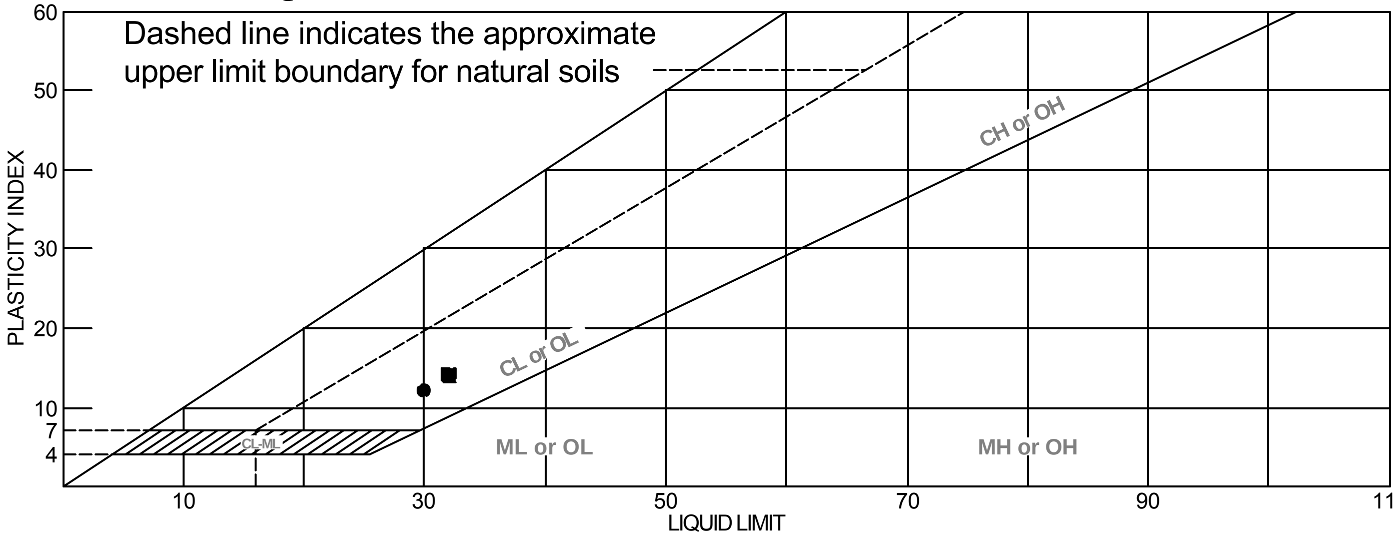
Client: Golder Associates

Project: Hanson Dump Review - 063.730

Project No.: 287-037

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Lean CLAY	30	18	12	97.4	85.1	CL
■	Gray Lean CLAY	32	18	14	97.9	87.7	CL

Project No. 287-037 **Client:** Golder Associates

Project: Hanson Dump Review - 063.730

● **Source:** FW-1 1/3

■ **Source:** FW-2 1/3

Remarks:

●

■

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Moisture-Density-Porosity Report

Cooper Testing Labs, Inc.

Job No: 287-037 **Date:** 06/24/08
Client: Golder Associates **By:** RU
Project: Hanson Dump Review - 063.730 **Remarks:** FW-2;2/3 - sample disturbed; m/c only.

Boring:	FW-1	FW-2	FW-2					
Sample:	1/3	1/3	2/3					
Depth, ft:	0	0	0					
Visual Description:	Gray Lean CLAY	Gray Lean CLAY	Gray Lean CLAY					
Actual G_s								
Assumed G_s	2.70	2.70	2.70					
Total Vol cc	147.1	150.9	374.1					
Vol Solids,cc	72.0	62.1	180.7					
Vol Voids,cc	75.1	88.7	193.3					
Moisture, %	38.5	50.7	30.6					
Wet Unit wt, pcf	114.4	104.7	106.4					
Dry Unit wt, pcf	82.6	69.5	81.5					
Saturation, %	99.7	95.8	77.2					
Porosity, %	51.0	58.8	51.7					
Air filled Poros.,%	0.1	2.5	11.8					
Water filled Poros.,%	50.9	56.4	39.9					
Void Ratio	1.04	1.43	1.07					
Series	1	2	3	4	5	6	7	8

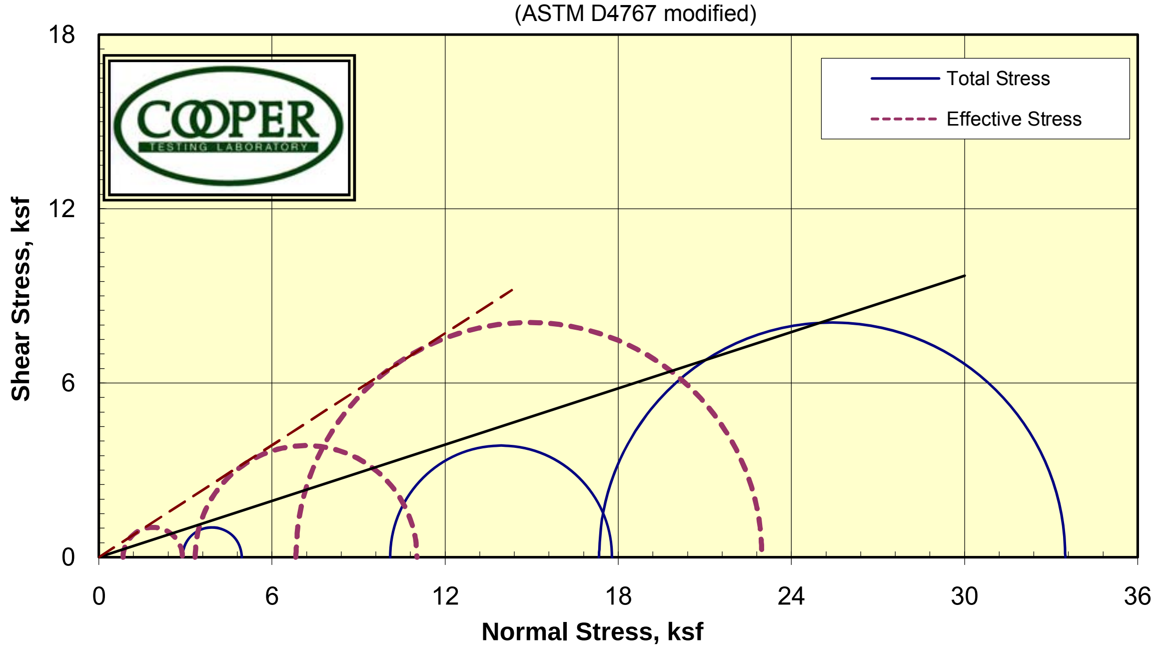
Note: If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

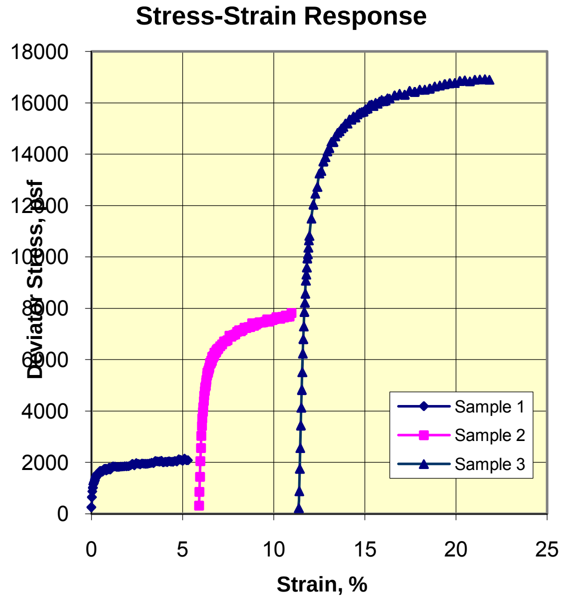
The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

Triaxial Consolidated Undrained

(ASTM D4767 modified)





Stage	1	2	3
MC, %	36.8		
Dry Dens., pcf.	82.5		
Sat. %	95.4		
Void Ratio	1.042		
Diameter in	2.41		
Height, in	5.00		
	Final		
MC, %	21.9	18.6	17.3
Dry Dens., pcf.	91.5	96.1	98.1
Sat. %	100.0	100.0	100.0
Void Ratio	0.590	0.502	0.467
Diameter, in	2.35	2.30	2.33
Height, in	4.73	4.72	4.49
Cell, psi	70.0	120.0	170.0
BP, psi	49.9	49.9	49.7
	Effective Stresses At:		
Strain, %	5.0	5.0	5.0
Deviator ksf	2.058	7.691	16.165
Excess PP	2.052	6.758	10.504
Sigma 1	2.899	11.026	22.989
Sigma 3	0.842	3.335	6.823
P, ksf	1.870	7.180	14.906
Q, ksf	1.029	3.845	8.083
Stress Ratio	3.445	3.306	3.369
Rate in/min	0.001	0.001	0.001

Total C	0	Effective C	0.0
Total Phi	17.9	Effective Phi	32.7

Job No.: 287-037 **Date:** 6/18/2008

Client: Golder Associates BY:DC

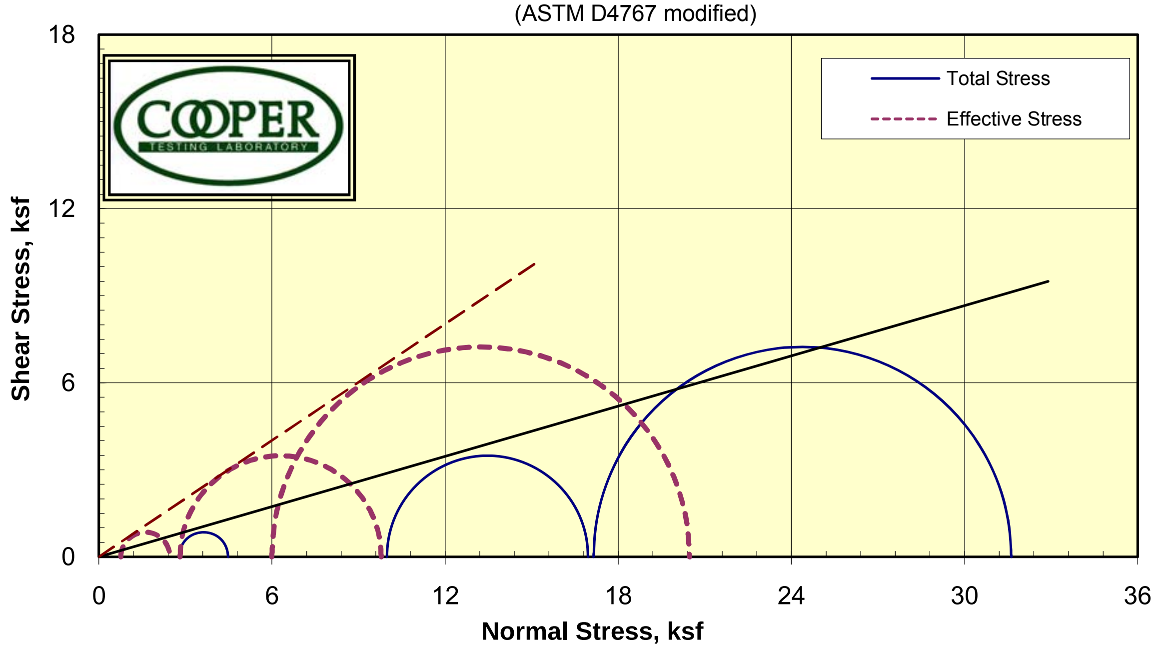
Project: Hanson Dump Review - 063.730

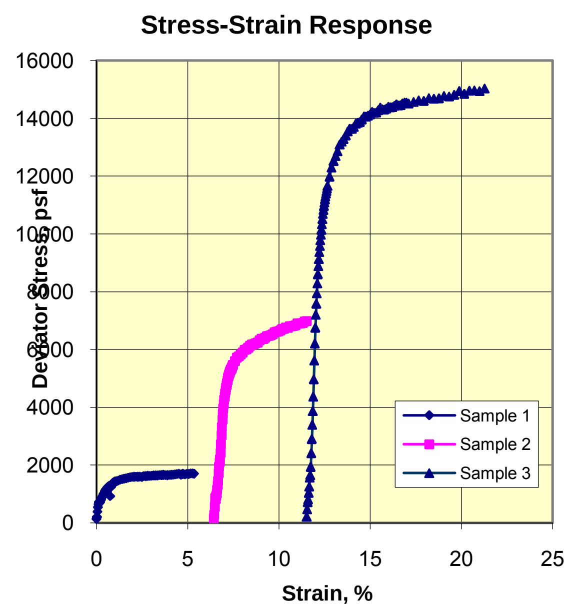
Sample: FW-1;2/3 Gray Lean CLAY

Remarks: ** Staged Test ** Strengths at 5% strain.

Triaxial Consolidated Undrained

(ASTM D4767 modified)





Stage	1	2	3
MC, %	52.5		
Dry Dens., pcf.	68.7		
Sat. %	97.4		
Void Ratio	1.454		
Diameter in	2.41		
Height, in	5.00		
	Final		
MC, %	22.8	19.2	17.7
Dry Dens., pcf.	77.7	81.3	82.9
Sat. %	100.0	100.0	100.0
Void Ratio	0.615	0.519	0.478
Diameter, in	2.34	2.28	2.32
Height, in	4.68	4.70	4.48
Cell, psi	70.0	120.0	170.0
BP, psi	50.7	50.7	51.0
	Effective Stresses At:		
Strain, %	5.0	5.0	5.0
Deviator ksf	1.701	6.973	14.476
Excess PP	2.015	7.164	11.145
Sigma 1	2.466	9.787	20.470
Sigma 3	0.764	2.814	5.993
P, ksf	1.615	6.301	13.231
Q, ksf	0.851	3.486	7.238
Stress Ratio	3.226	3.478	3.415
Rate in/min	0.001	0.001	0.001

Total C	0	Effective C	0.0
Total Phi	16.1	Effective Phi	33.8

Job No.: 287-037 **Date:** 6/24/2008

Client: Golder Associates BY:DC

Project: Hanson Dump Review - 063.730

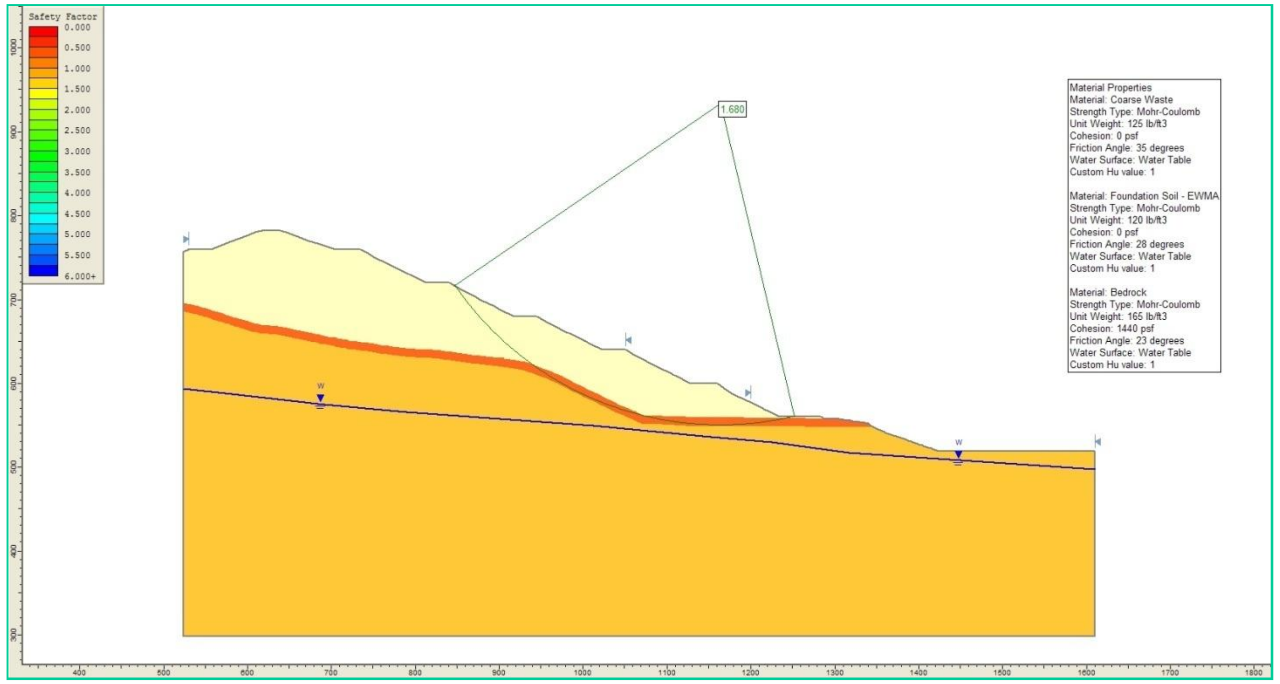
Sample: FW-2;3/3 Gray Lean CLAY

Remarks: ** Staged Test ** Strengths at 5% strain.

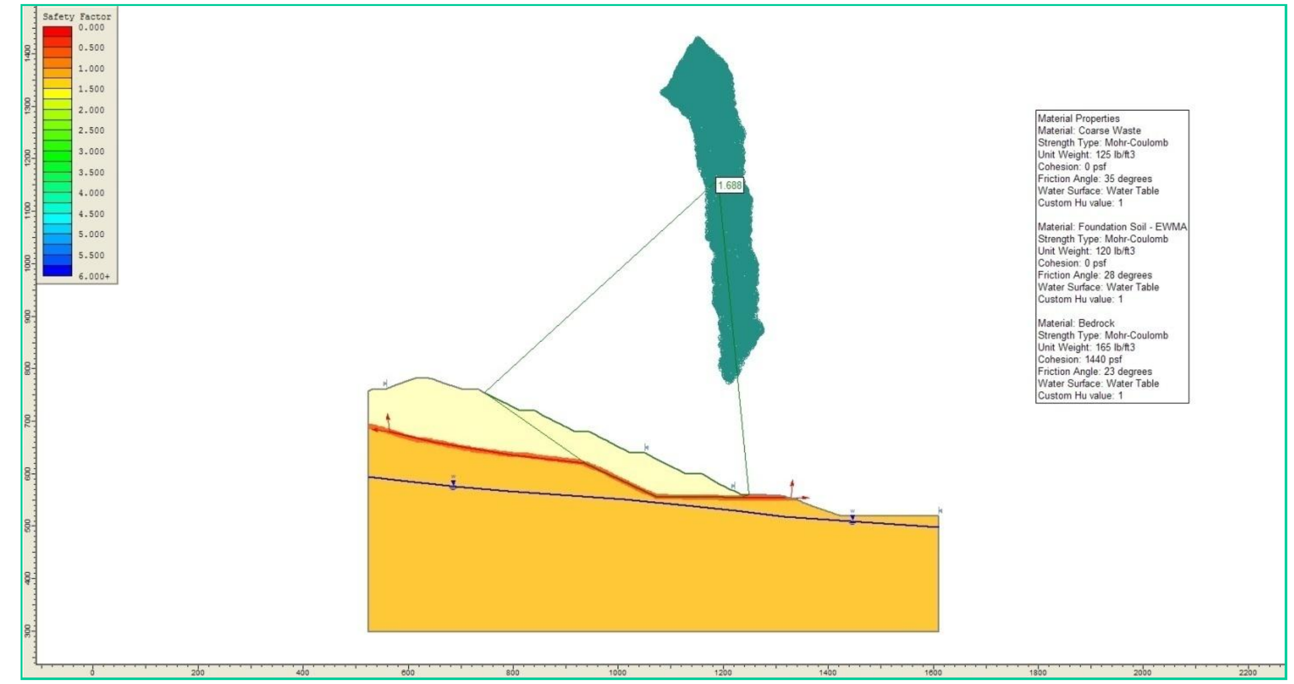
APPENDIX C

SLOPE STABILITY EVALUATION OF PROPOSED RECLAMATION PLAN

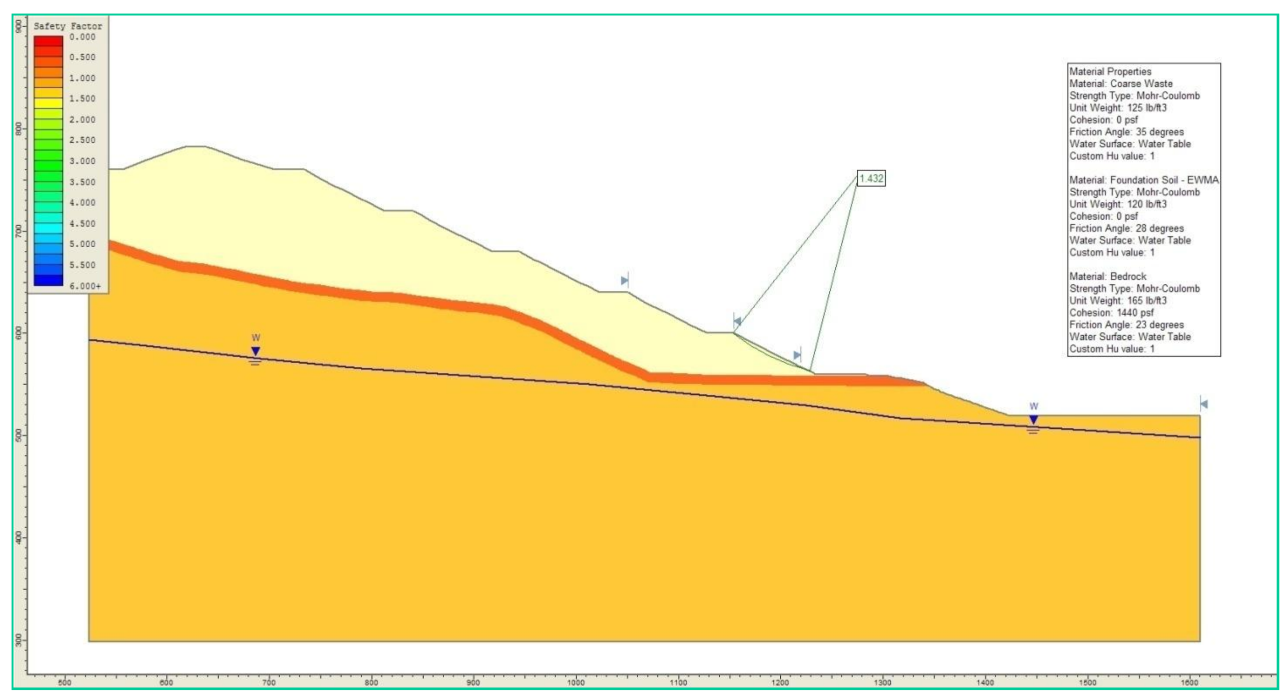
EAST/CENTRAL MATERIALS STORAGE AREA



SECTION E1 – STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.68)



SECTION E1 –STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.69)



SECTION E1 –STATIC
SINGLE-LIFT FAILURE
(FOS = 1.43)

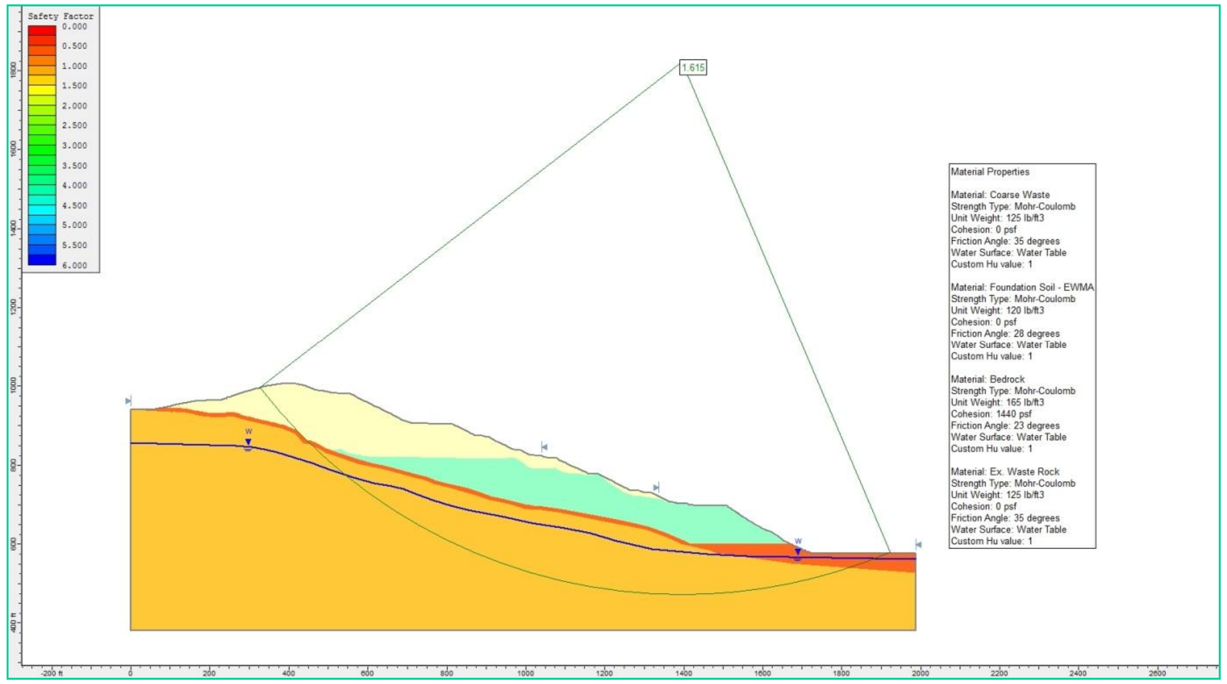
Golder Associates

Job no. 063-7109.100

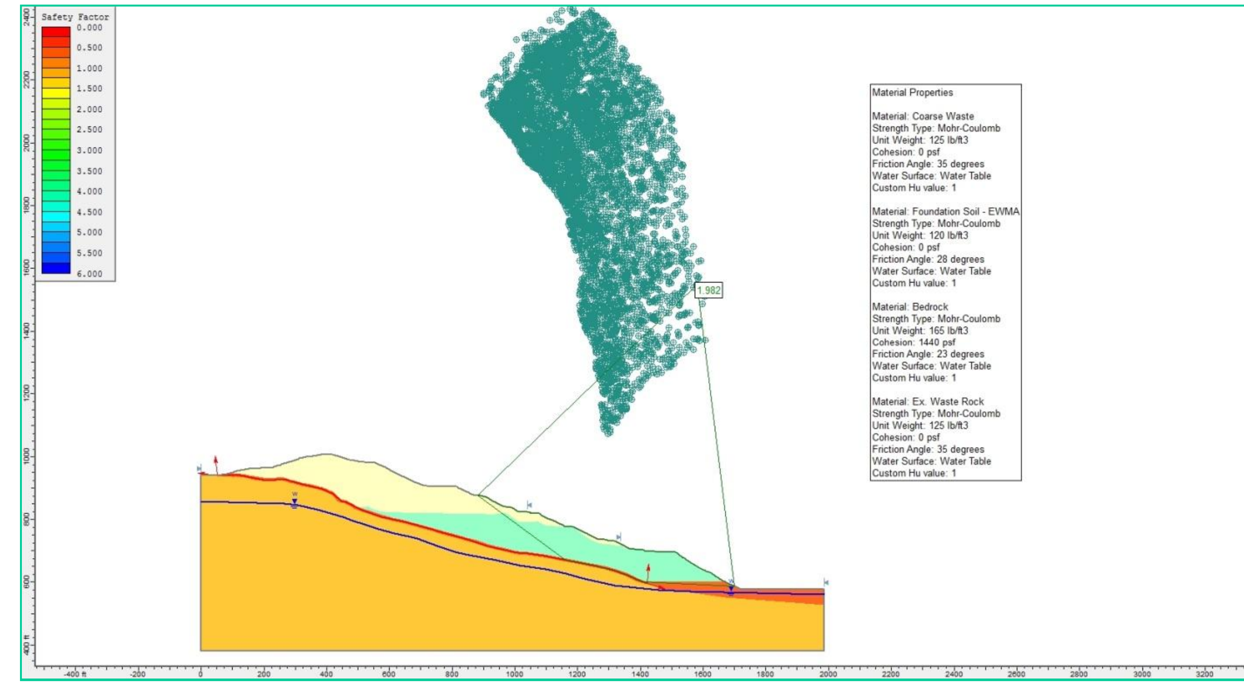
APPENDIX C1

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

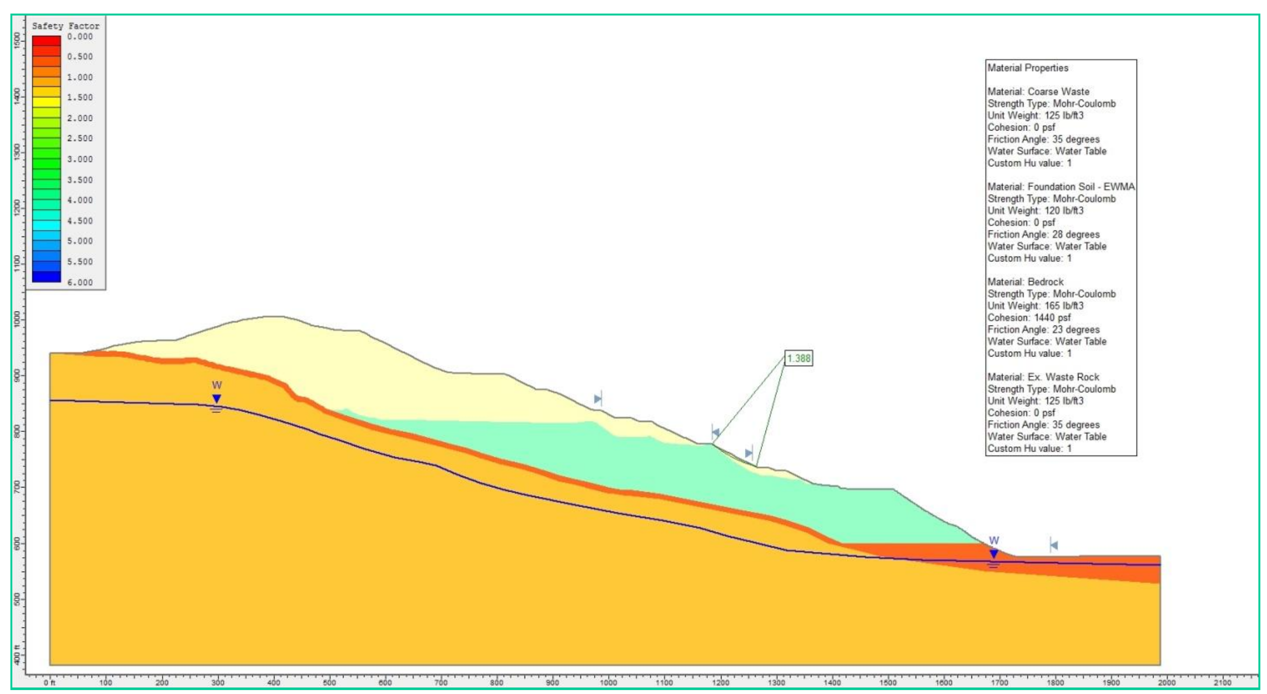
STATIC ANALYSES OF PROPOSED
RECLAMATION SLOPE – SECTION E1



SECTION E3 – STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.62)



SECTION E3 –STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.98)



SECTION E3 –STATIC
SINGLE-LIFT FAILURE
(FOS = 1.39)

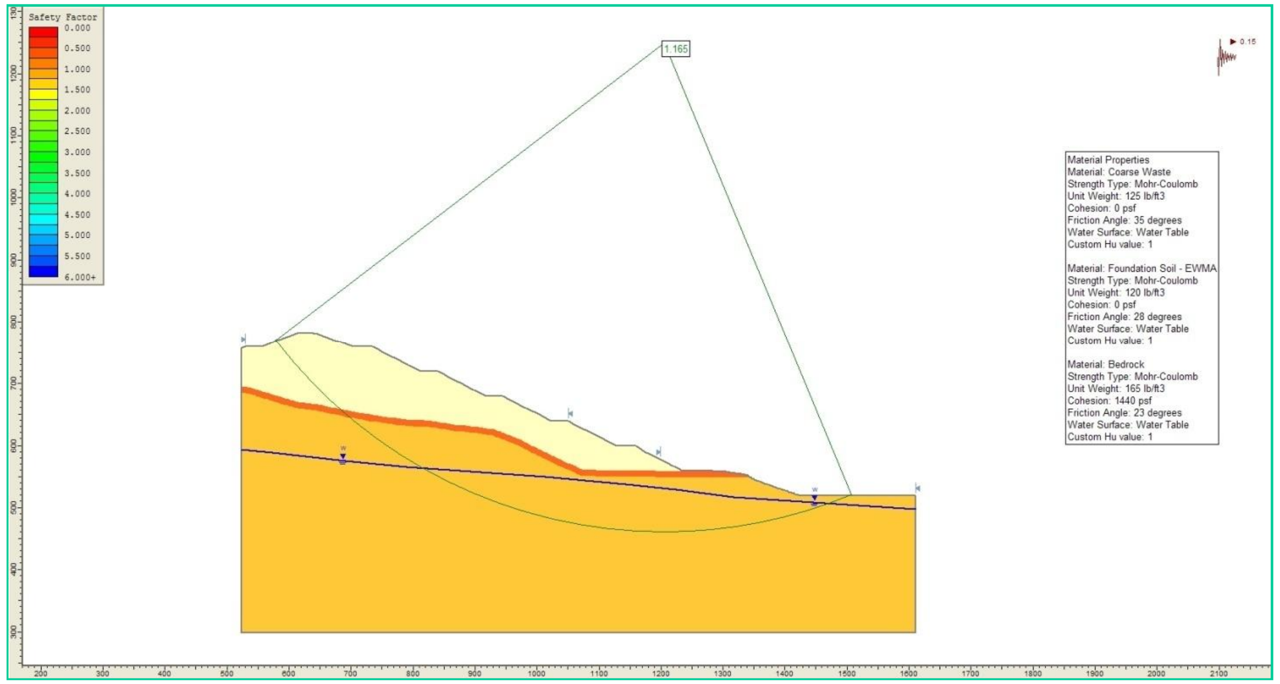
Golder Associates

Job no. 063-7109.100

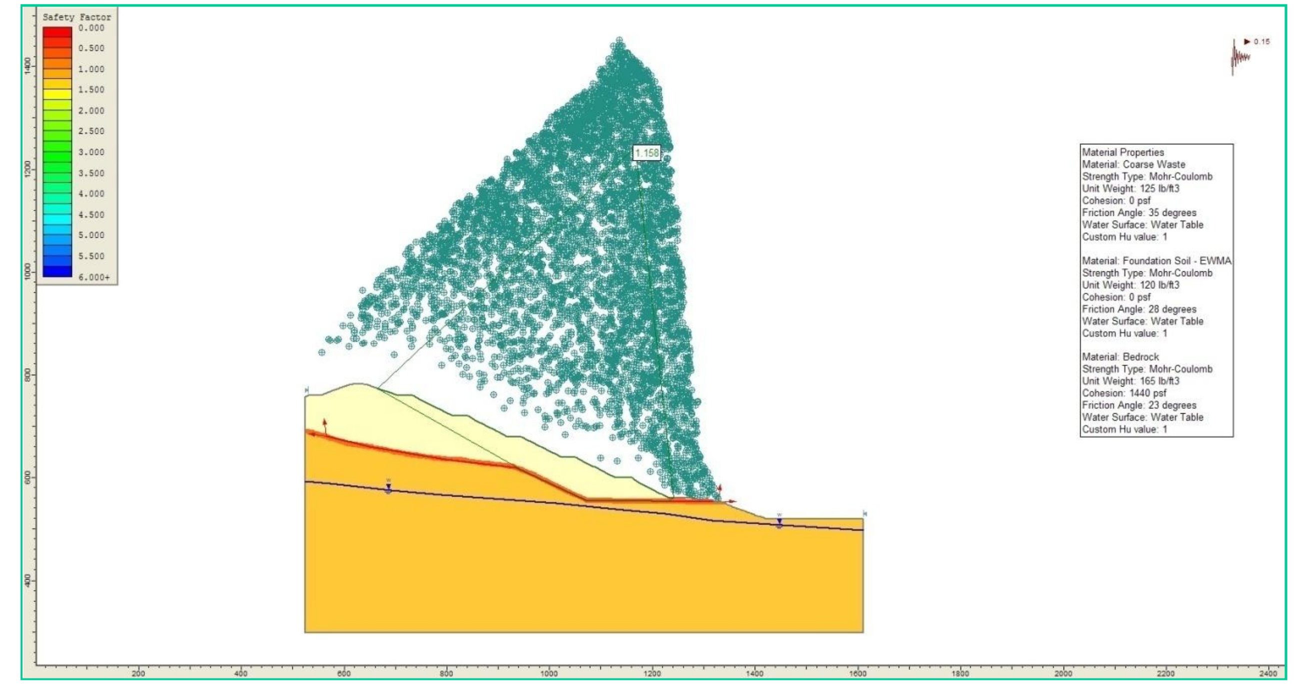
APPENDIX C2

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

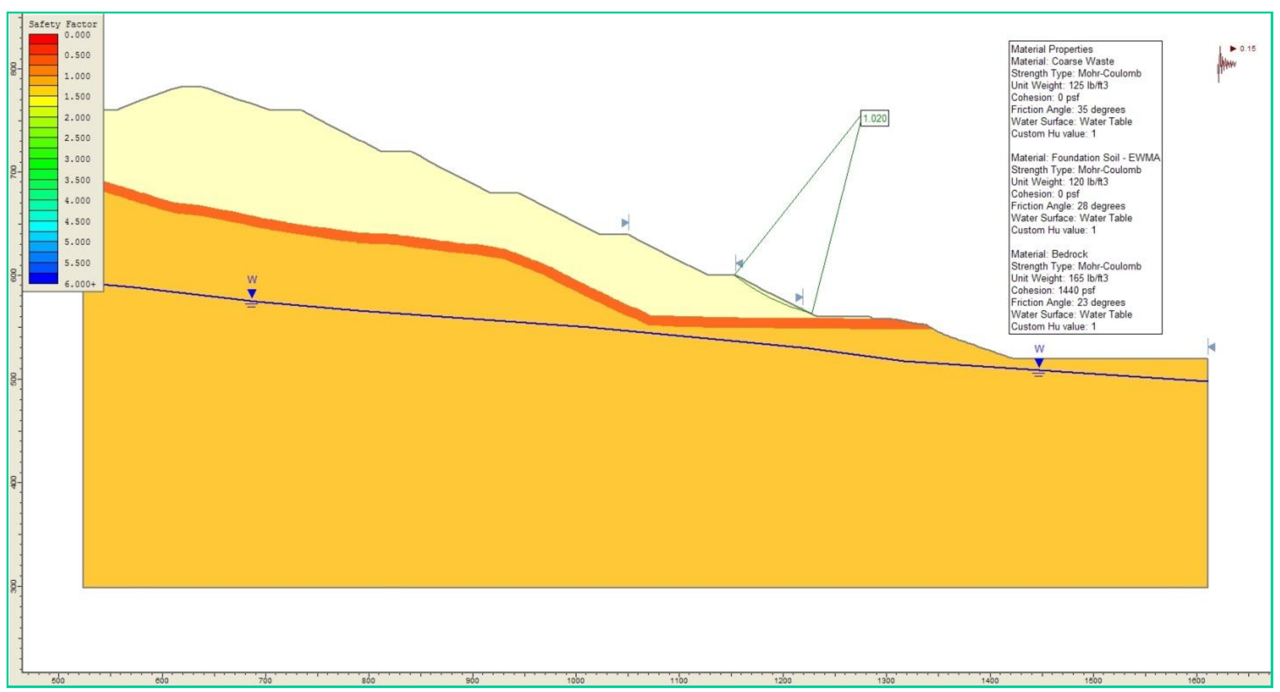
STATIC ANALYSES OF PROPOSED
RECLAMATION SLOPE – SECTION E3



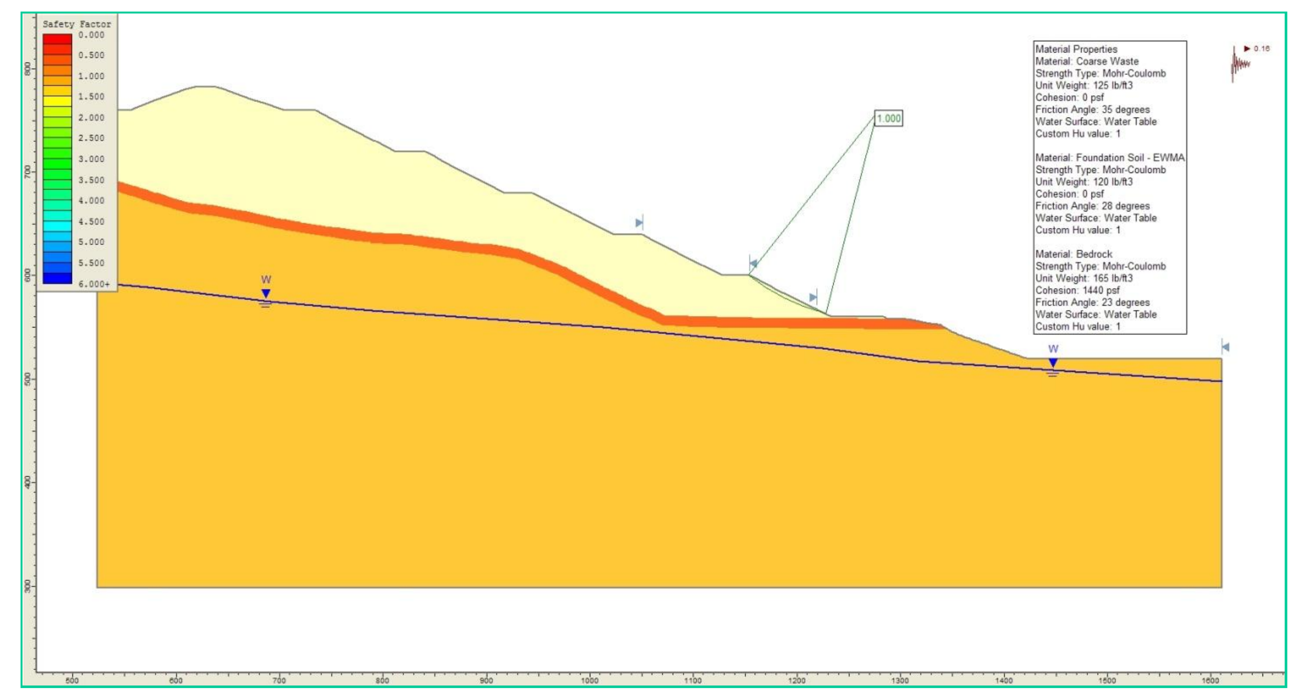
SECTION E1 – PSEUDO-STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.17)



SECTION E1 – PSEUDO-STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.16)



SECTION E1 – PSEUDO-STATIC
SINGLE-LIFT FAILURE
(FOS = 1.02)



SECTION E1 – YIELD ACCELARATION
SINGLE-LIFT FAILURE
(ky = 0.16g)

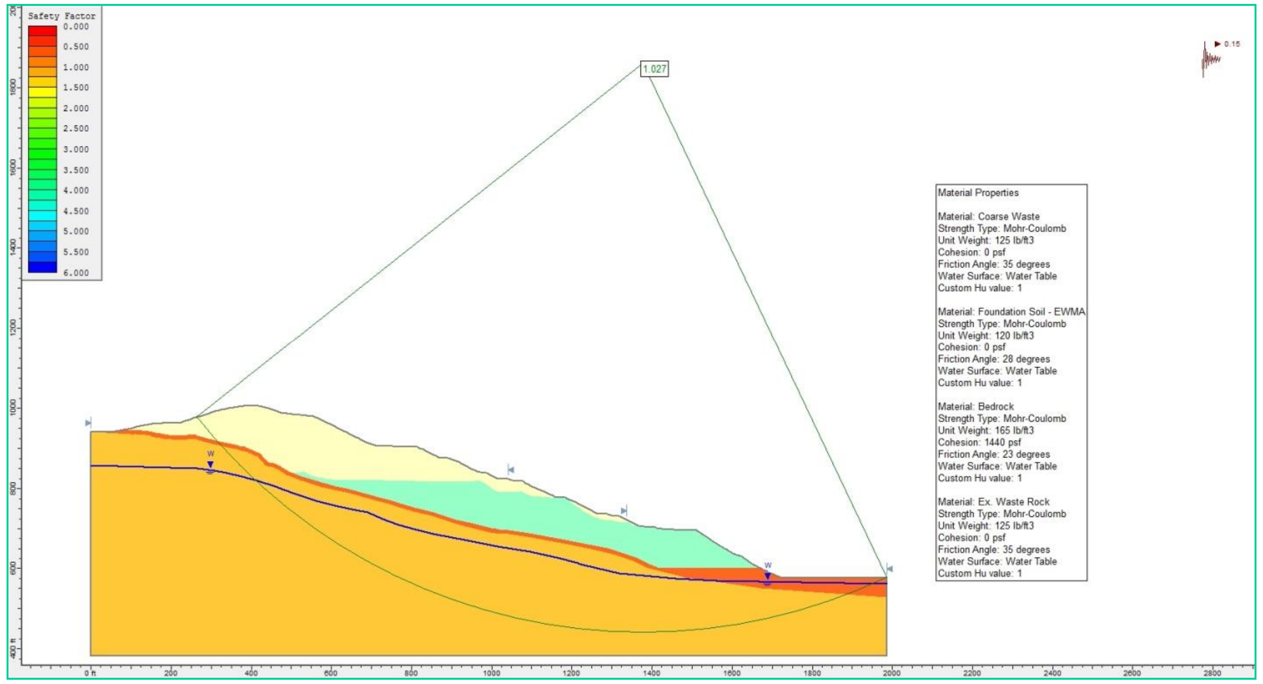
Golder Associates

Job no. 063-7109.100

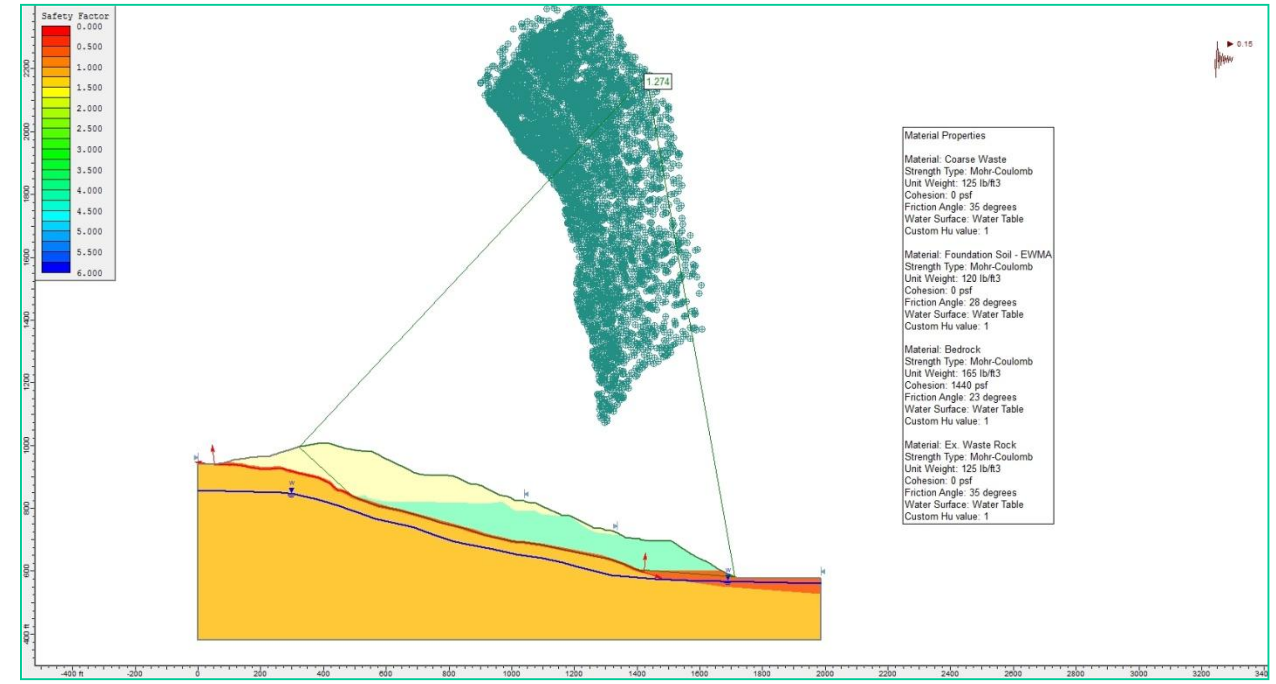
APPENDIX C3

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

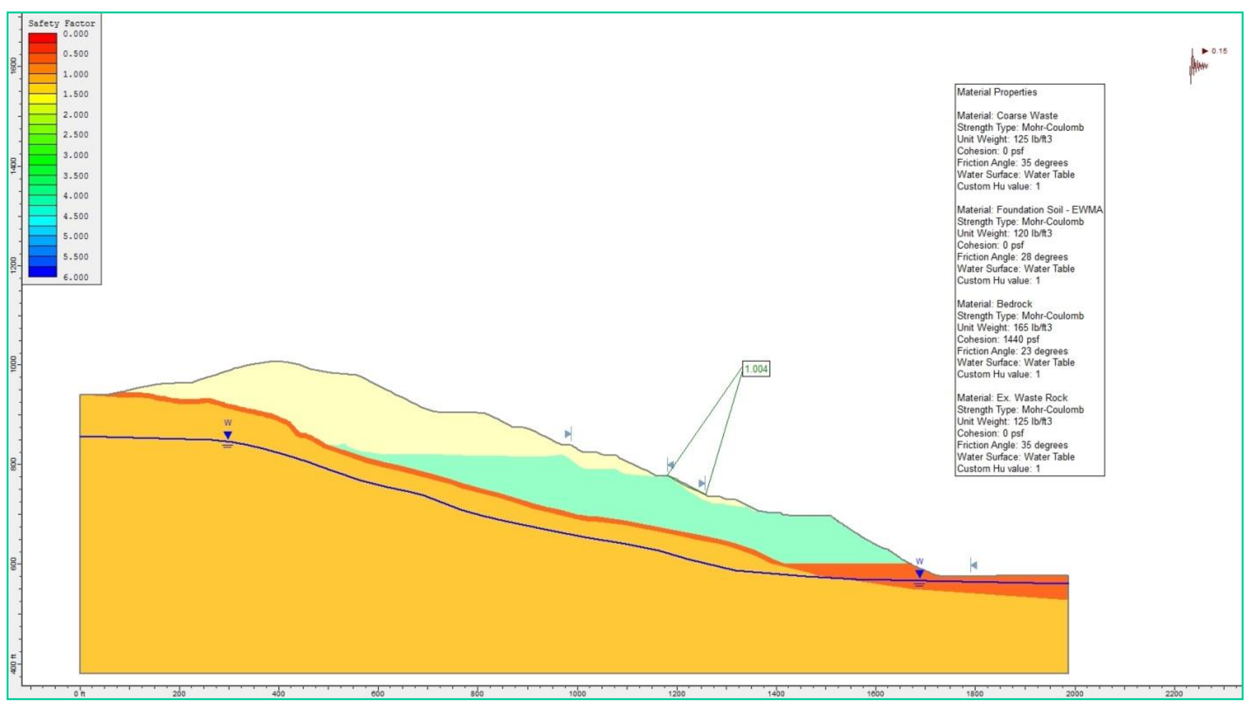
SEISMIC STABILITY OF PROPOSED
RECLAMATION SLOPE – SECTION E1



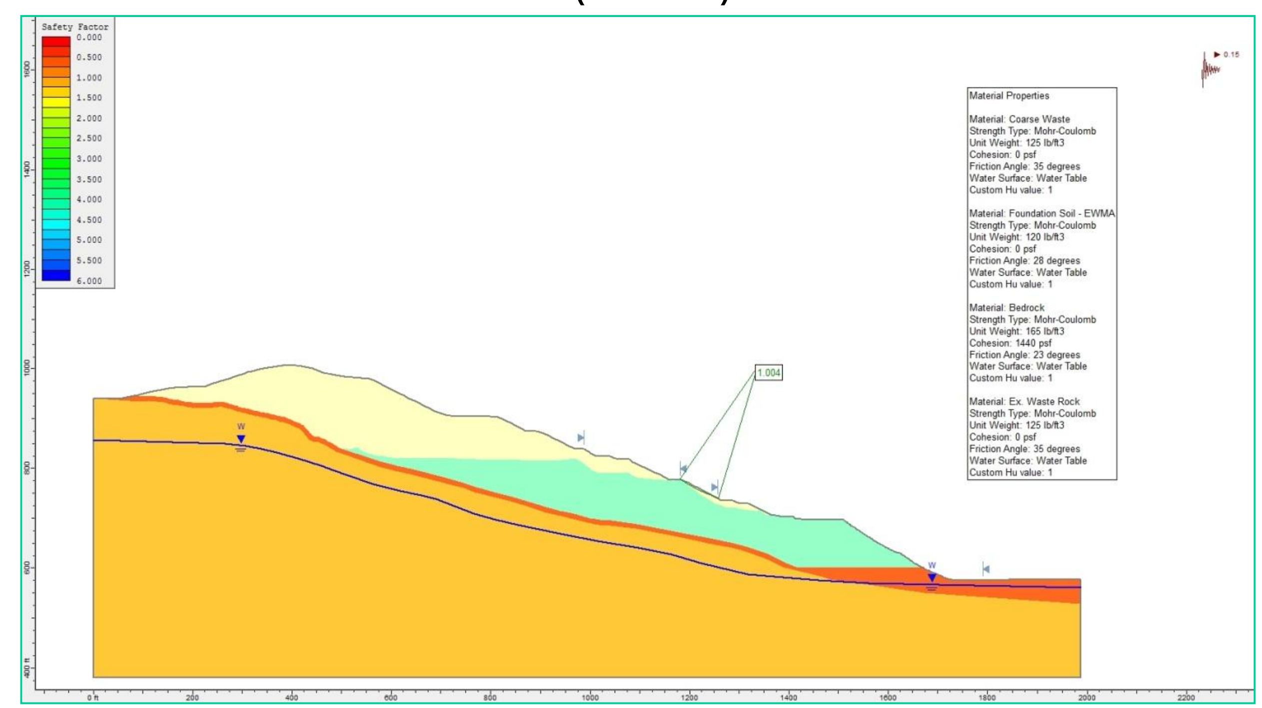
SECTION E3 – PSEUDO-STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.03)



SECTION E3 – PSEUDO-STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.27)



SECTION E3 – PSEUDO-STATIC
SINGLE-LIFT FAILURE
(FOS = 1.00)



SECTION E3 – YIELD ACCELARATION
SINGLE-LIFT FAILURE
(ky = 0.15g)

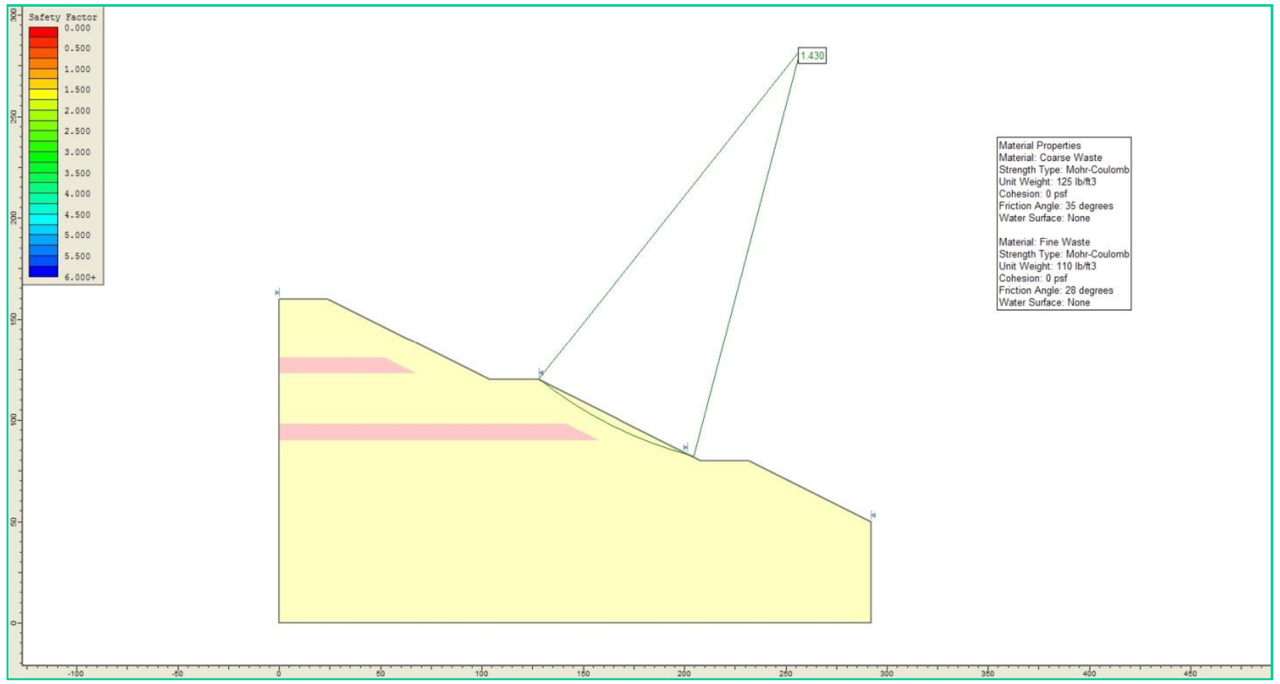
Golder Associates

APPENDIX C4

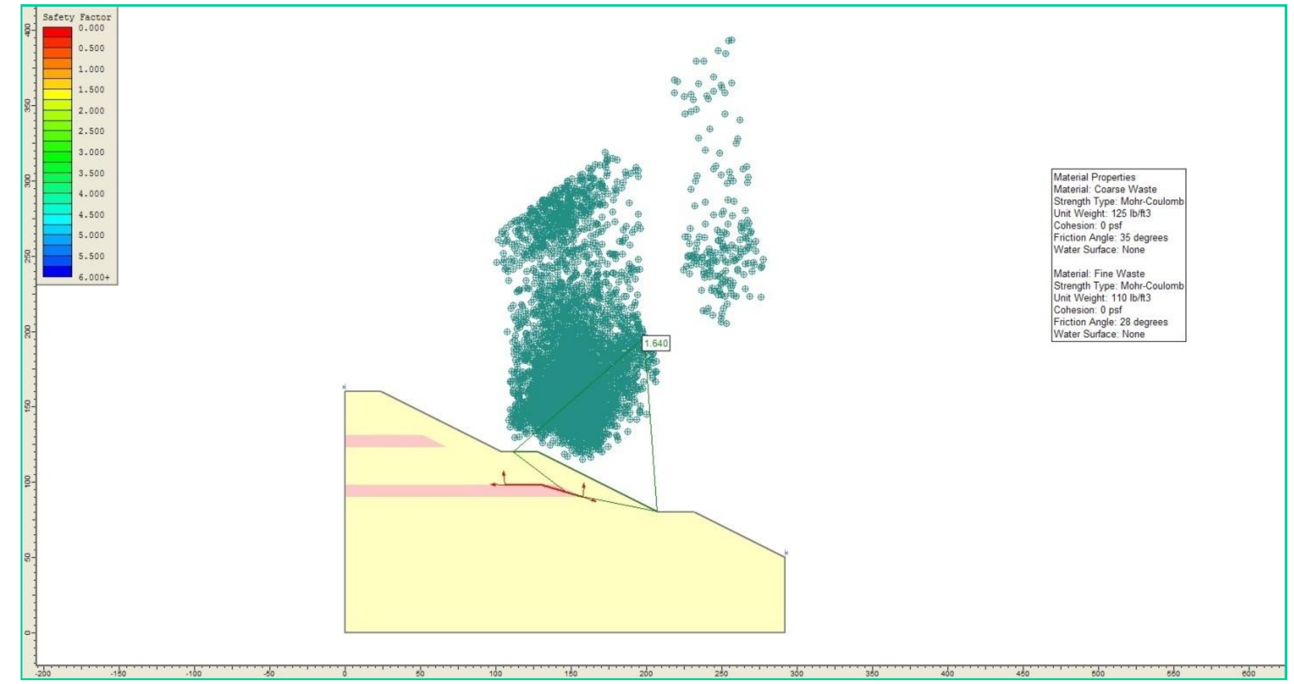
CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

SEISMIC STABILITY OF PROPOSED
RECLAMATION SLOPE – SECTION E3

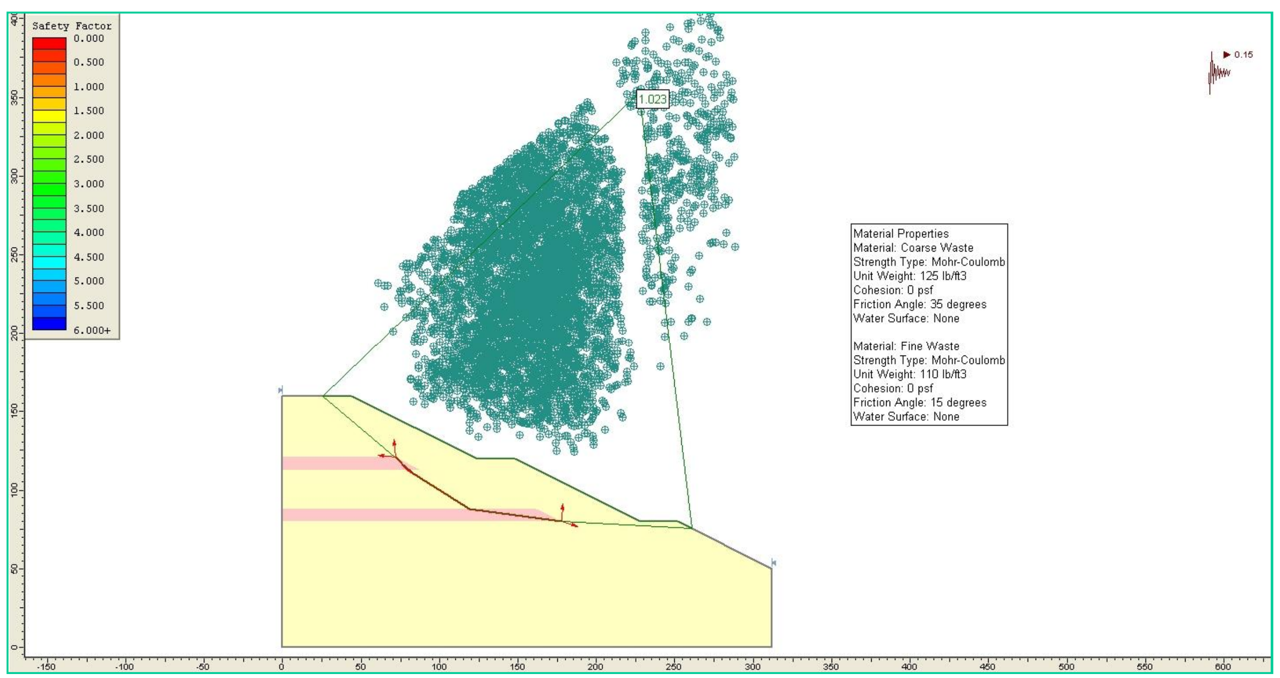
Job no. 063-7109.100



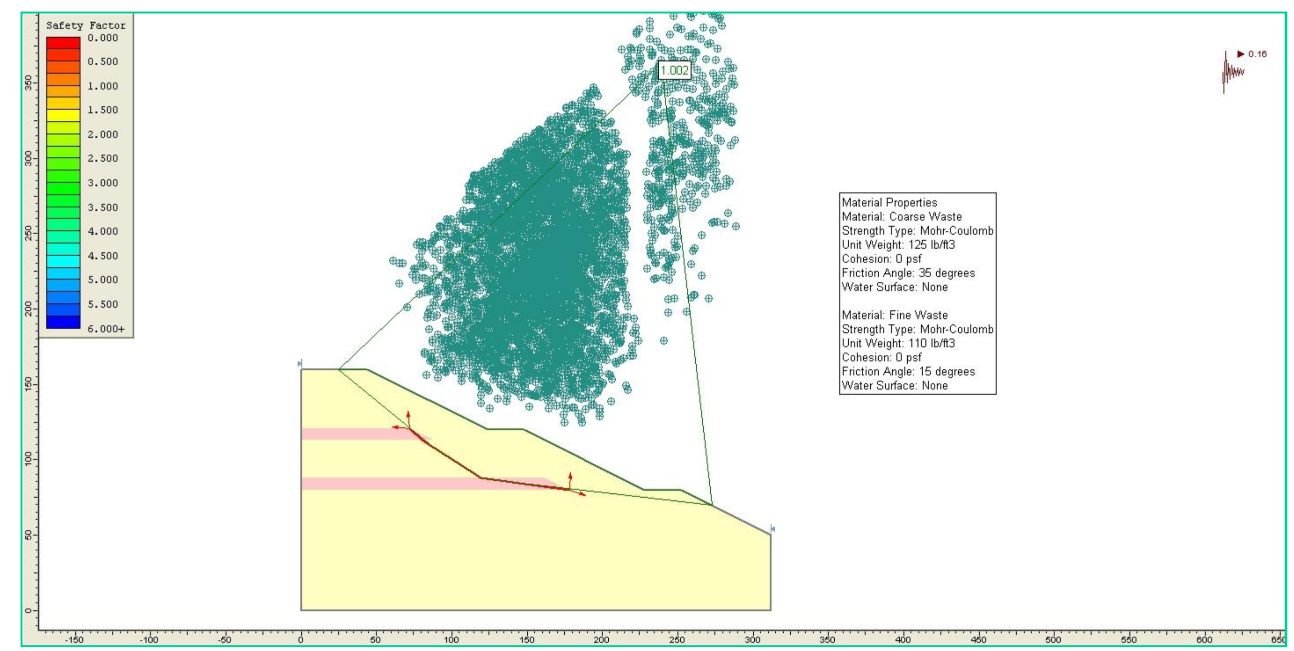
CONCEPTUAL SECTION – STATIC
LOCAL FAILURE - CIRCULAR
(FOS = 1.43)



CONCEPTUAL SECTION –STATIC
LOCAL BLOCK FAILURE THROUGH FINE WASTE
(FOS = 1.64)



CONCEPTUAL SECTION – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FINE WASTE
(FOS = 1.02)



CONCEPTUAL SECTION – YIELD ACCELARATION
LOCAL BLOCK FAILURE THROUGH FINE WASTE
(ky = 0.16g)

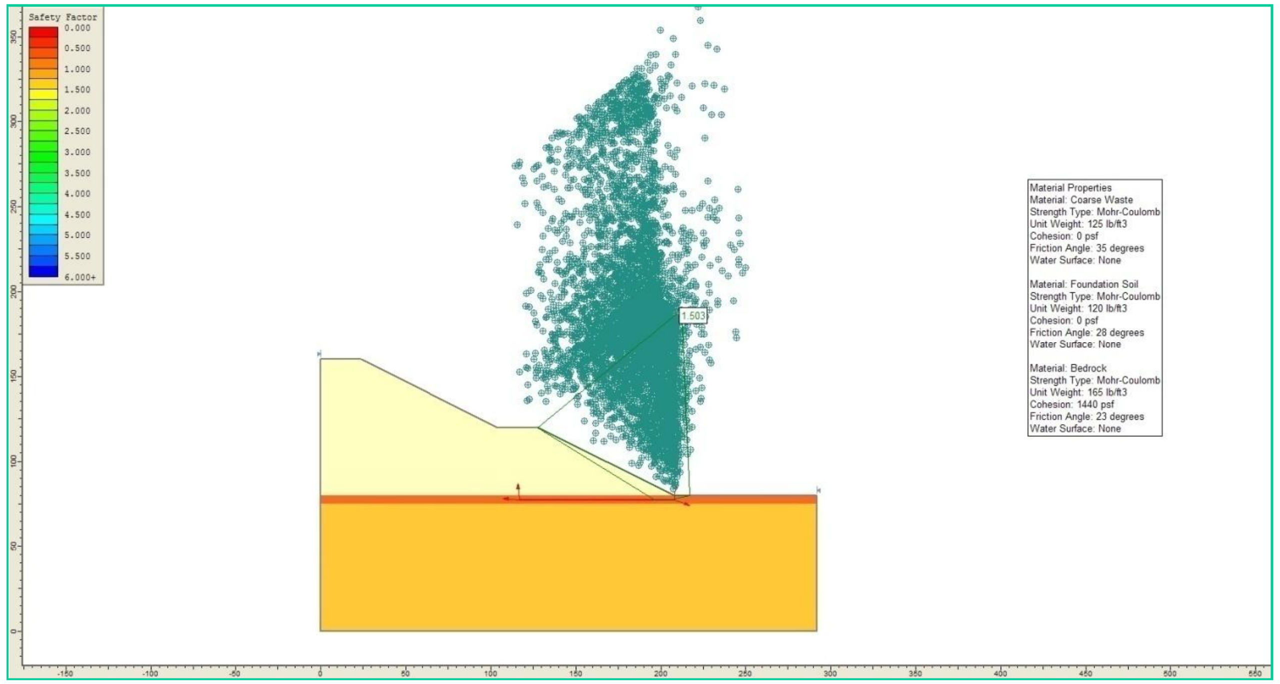
Golder Associates

Job no. 063-7109.100

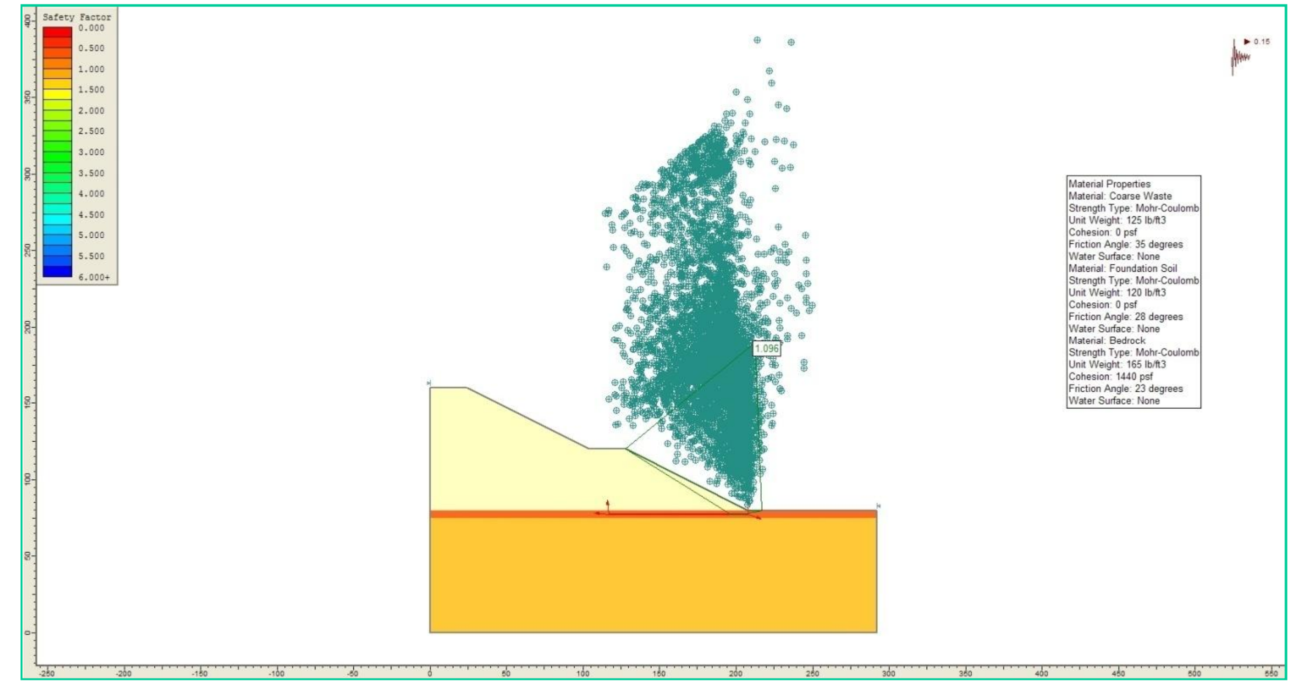
APPENDIX C5

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

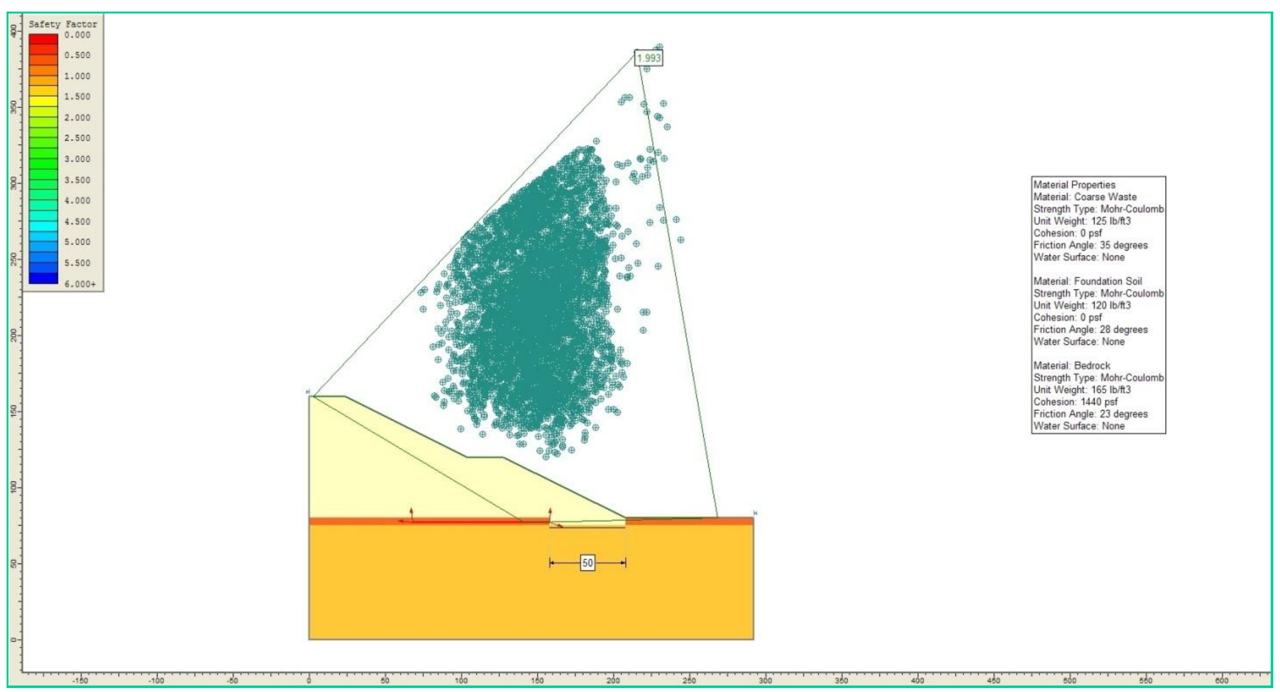
LOCAL STABILITY OF RECLAIMED SLOPES
WITH FINE WASTE



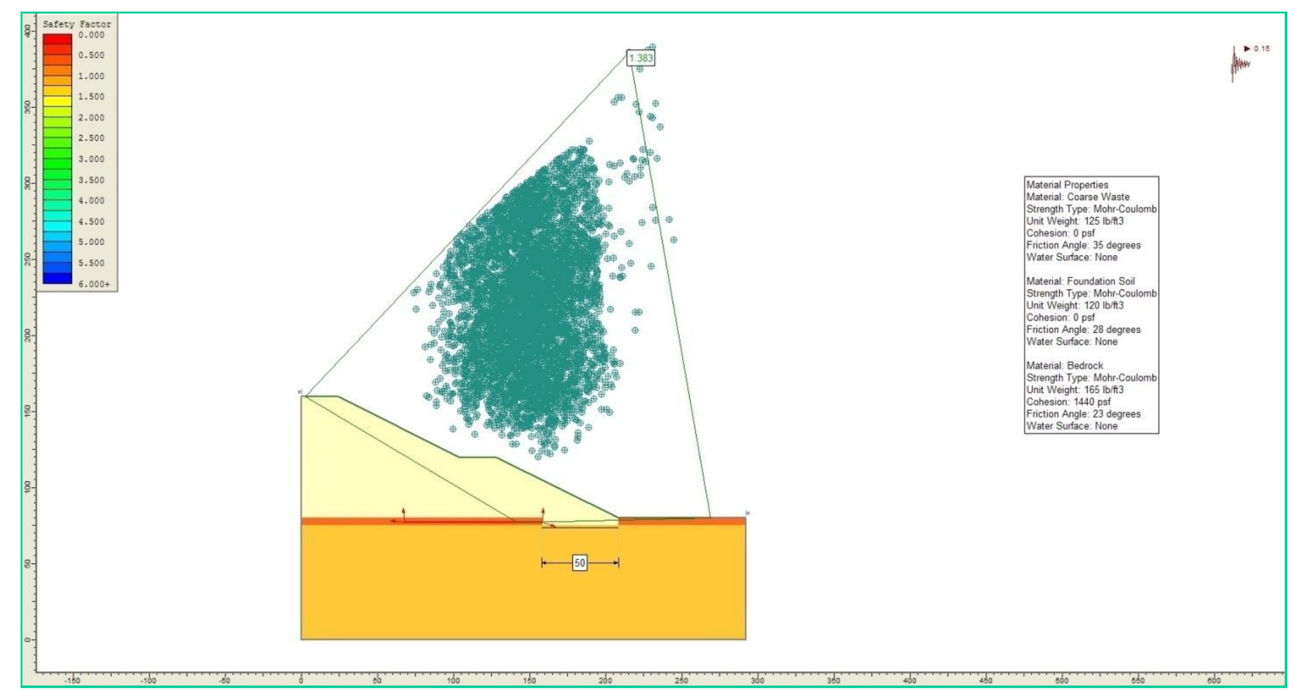
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.50)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.10)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.99)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.38)

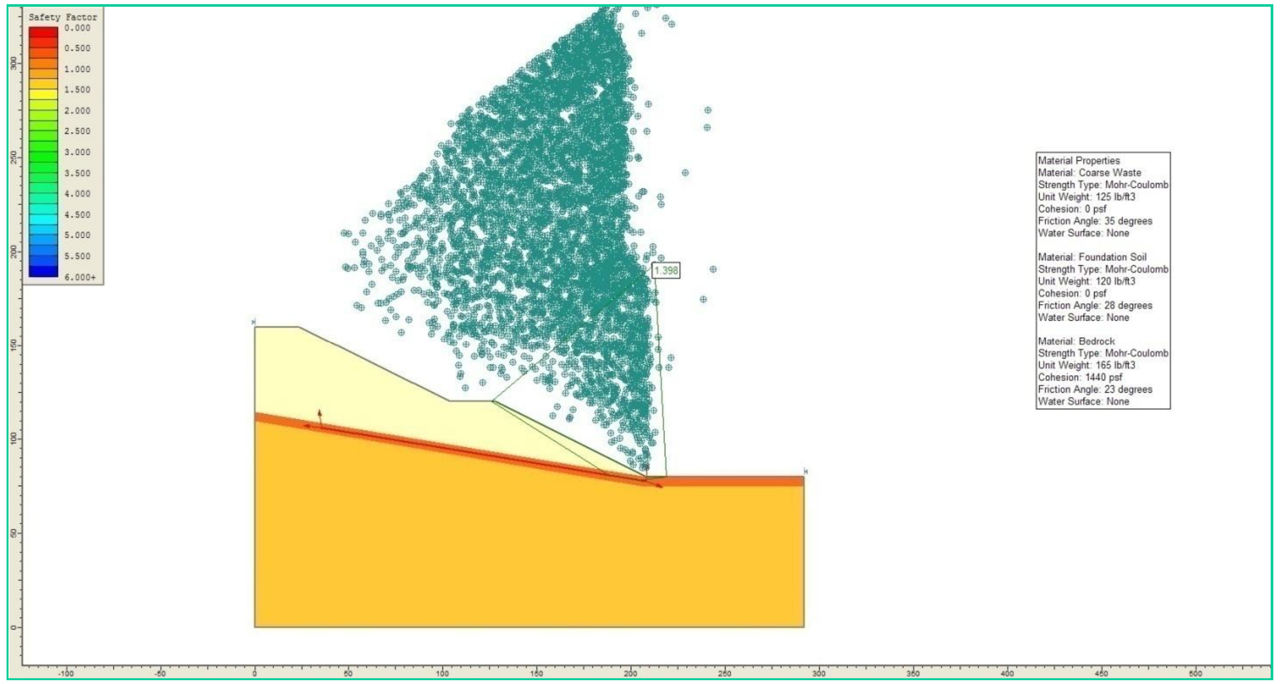
Golder Associates

Job no. 063-7109.100

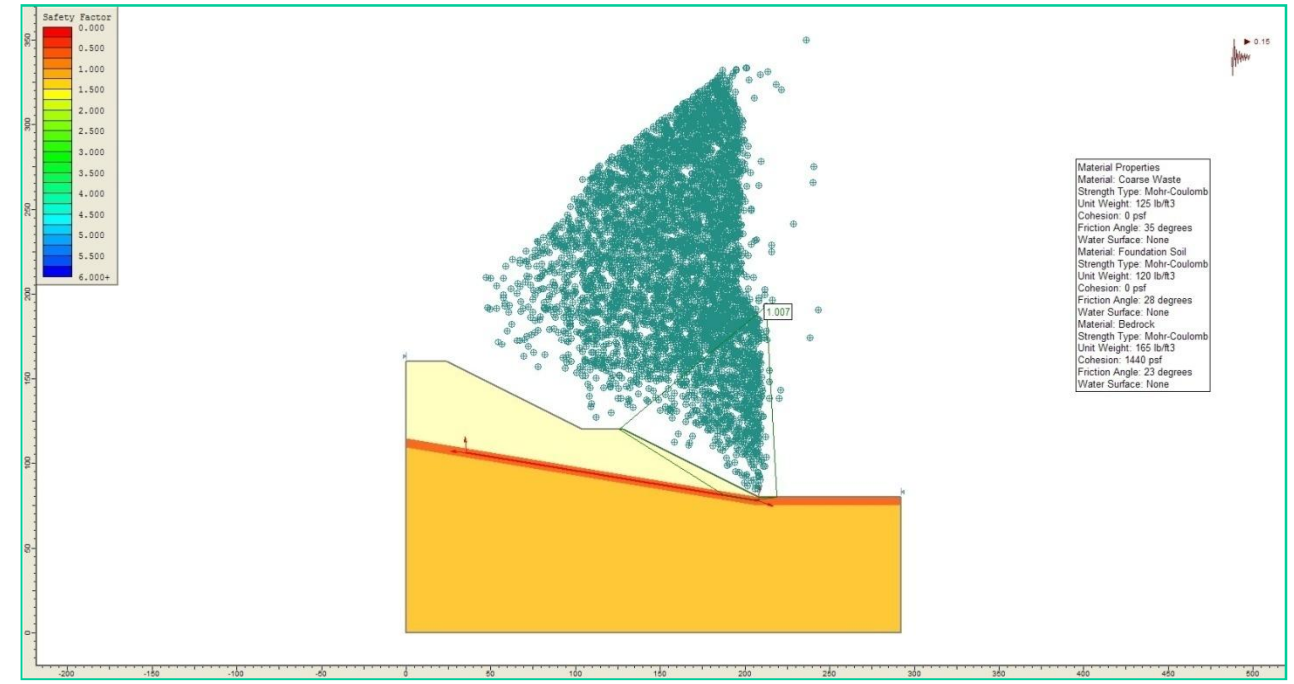
APPENDIX C6

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

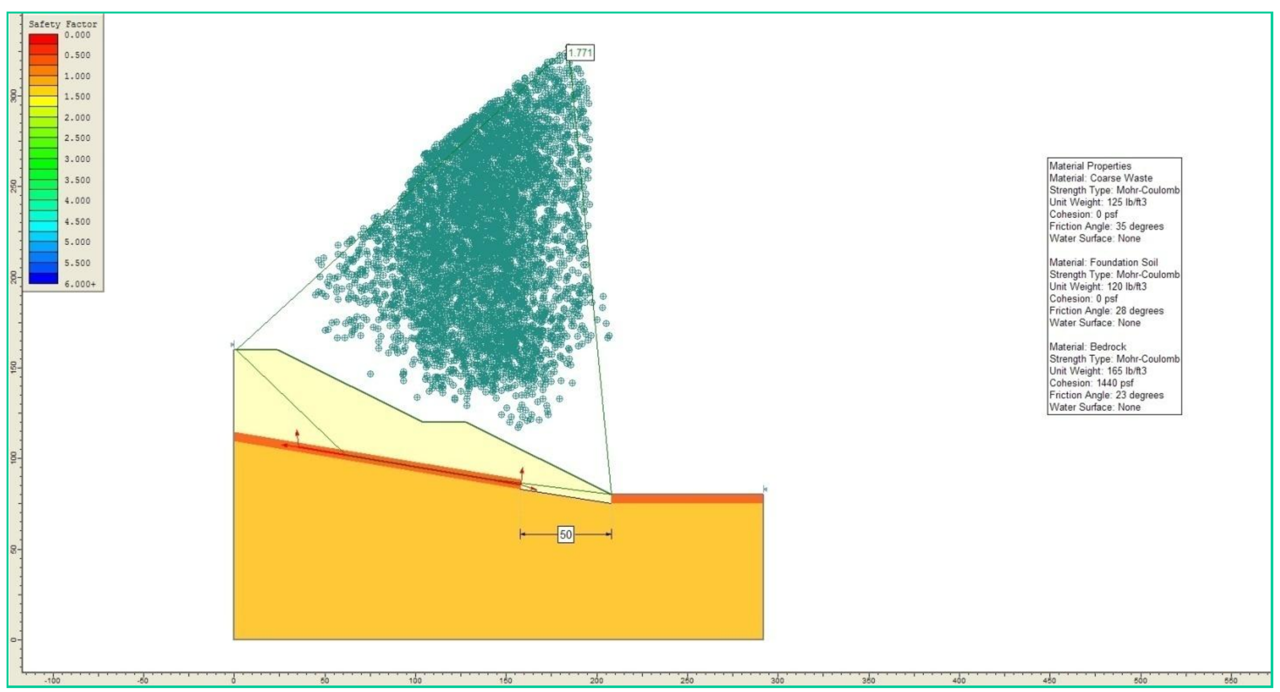
SENSITIVITY STUDY – VARIATION OF SUBGRADE (FLAT)



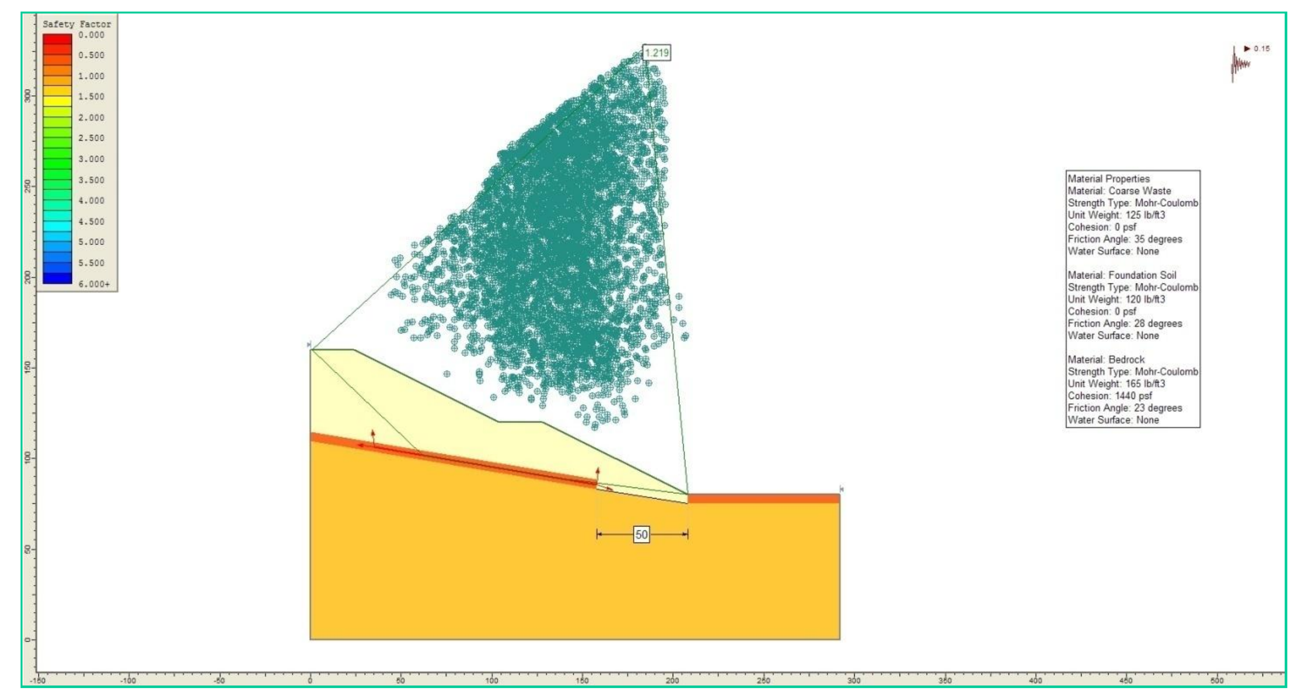
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.40)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.01)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.77)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.22)

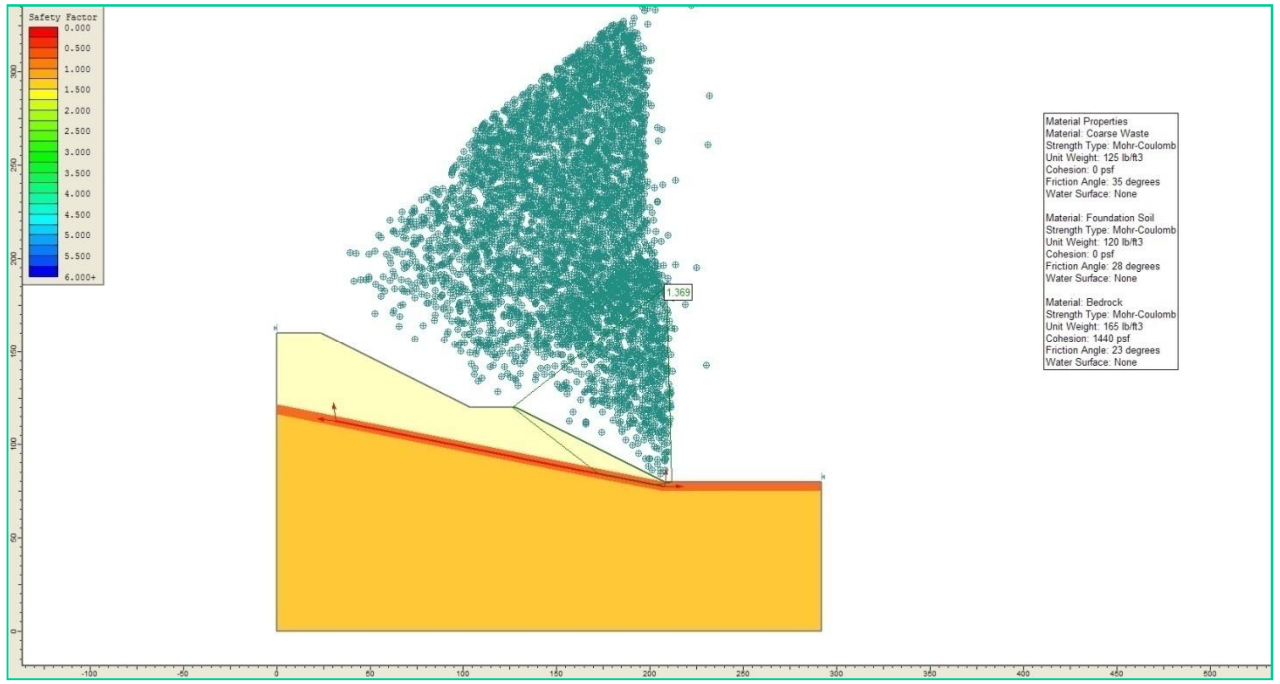
Golder Associates

Job no. 063-7109.100

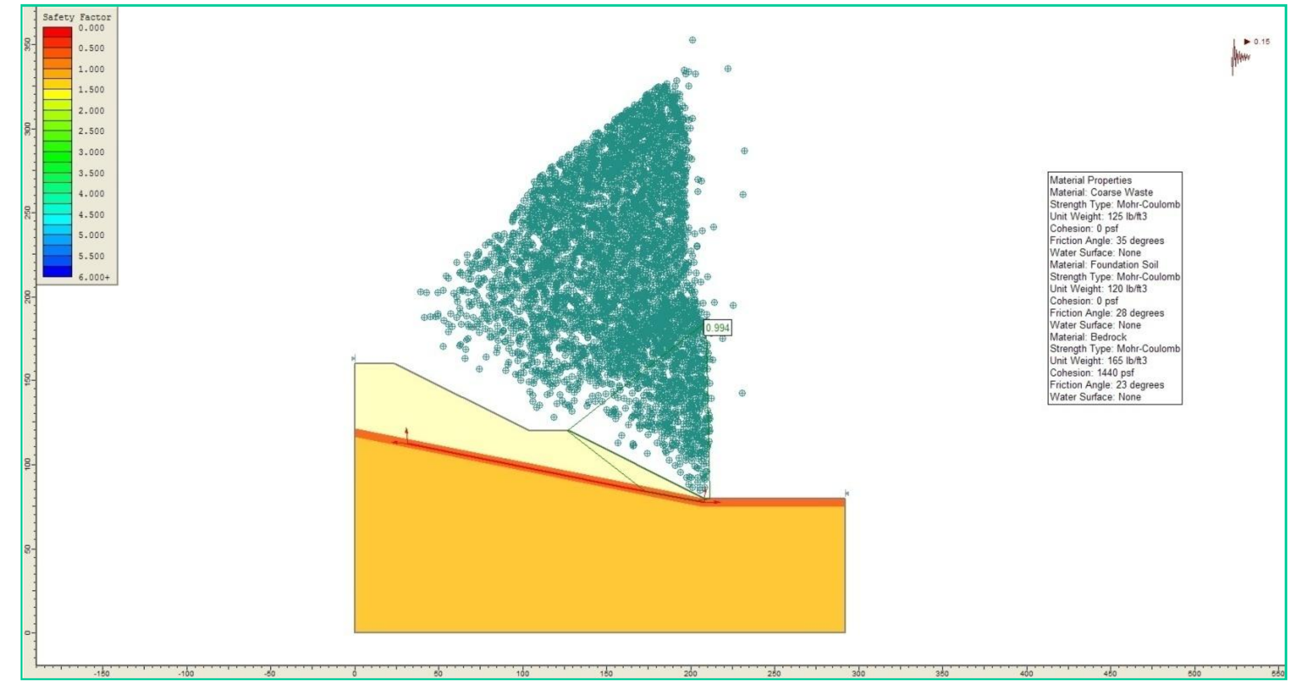
APPENDIX C7

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

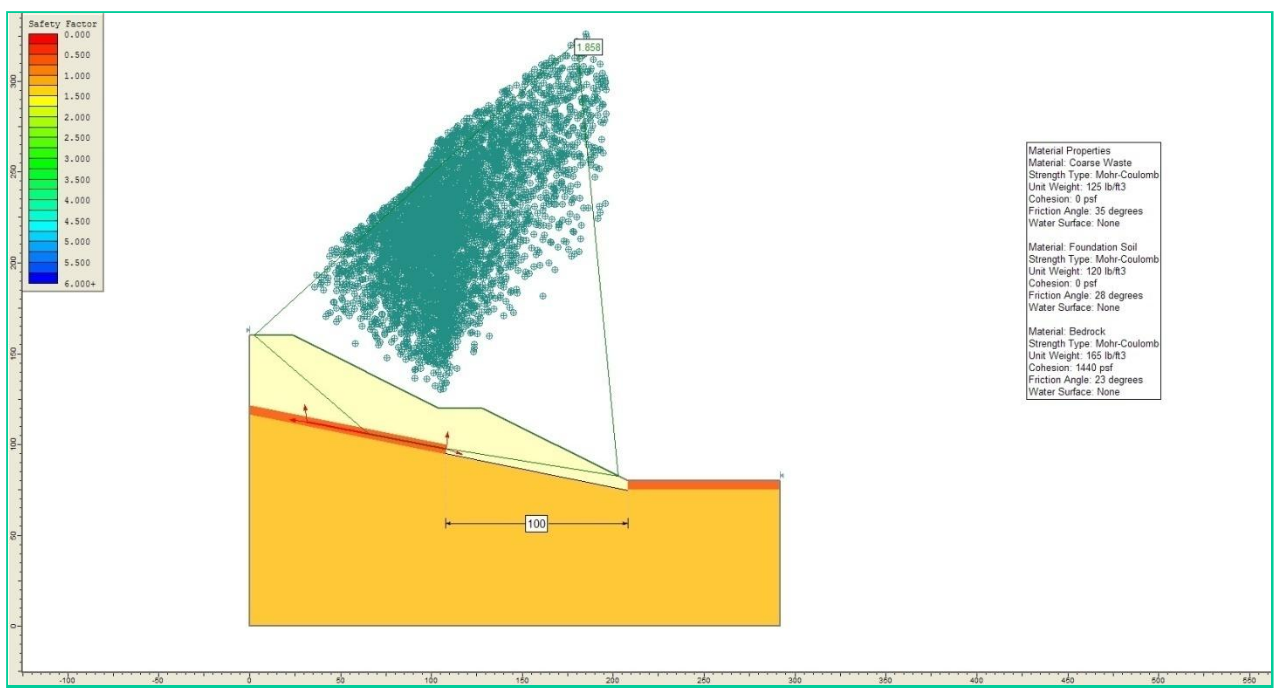
SENSITIVITY STUDY – VARIATION OF SUBGRADE (6H:1V)



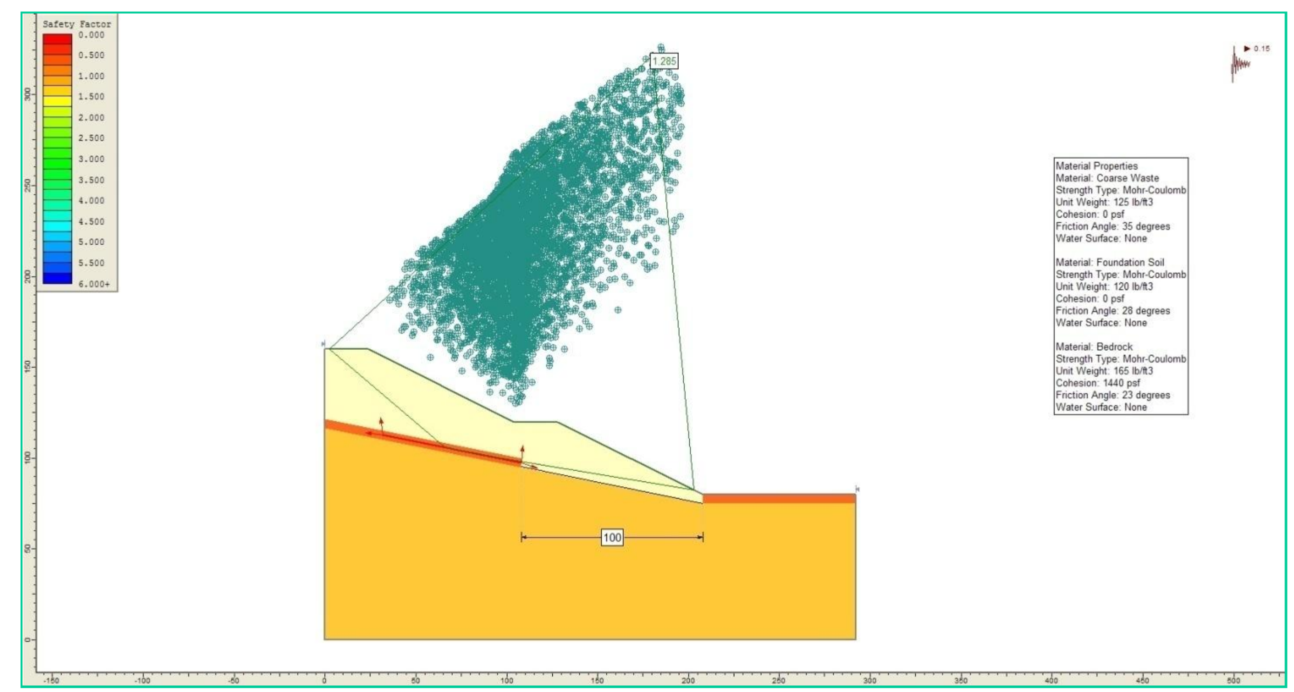
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V)
(FOS = 1.37)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V)
(FOS = 0.99)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V)
(FOS = 1.86)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V)
(FOS = 1.29)

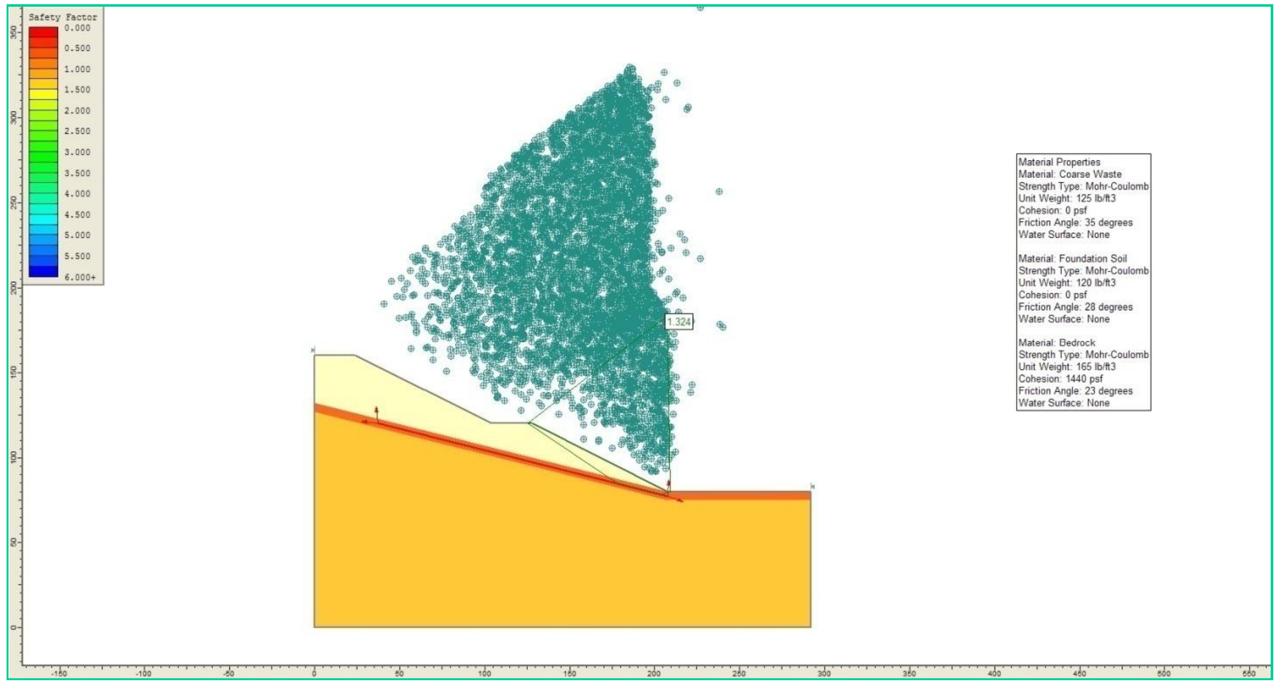
Golder Associates

Job no. 063-7109.100

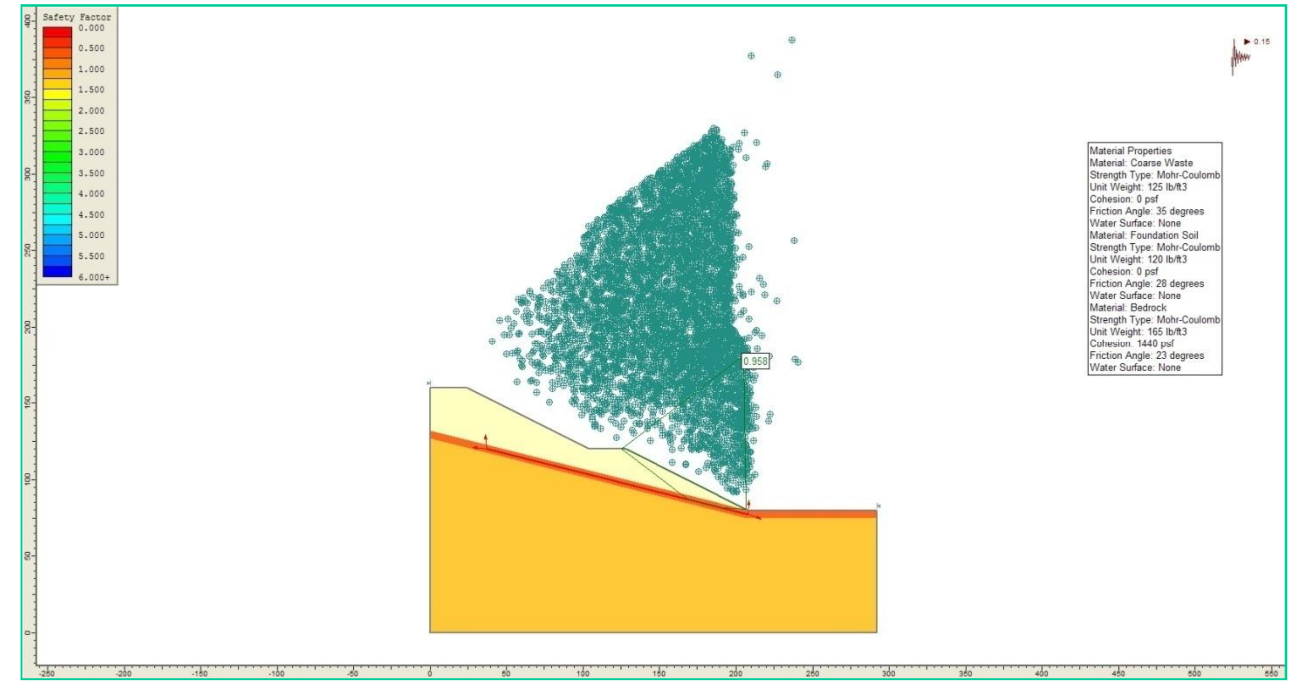
APPENDIX C8

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

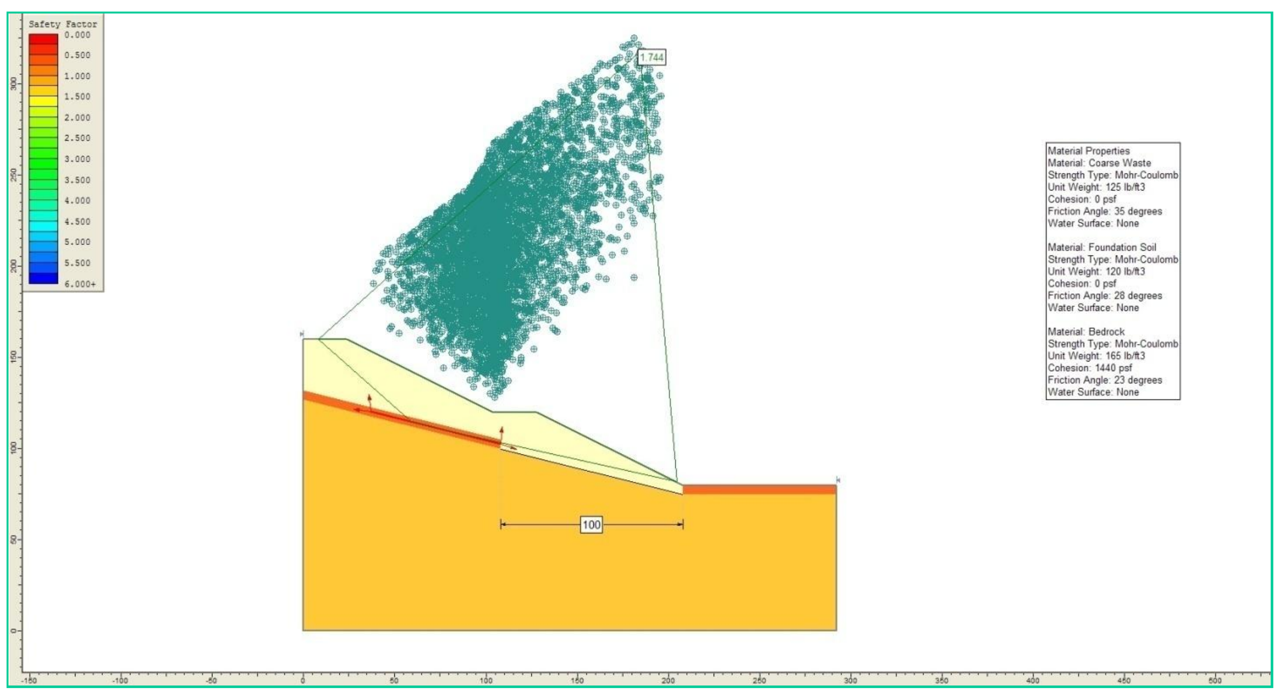
SENSITIVITY STUDY – VARIATION OF SUBGRADE (5H:1V)



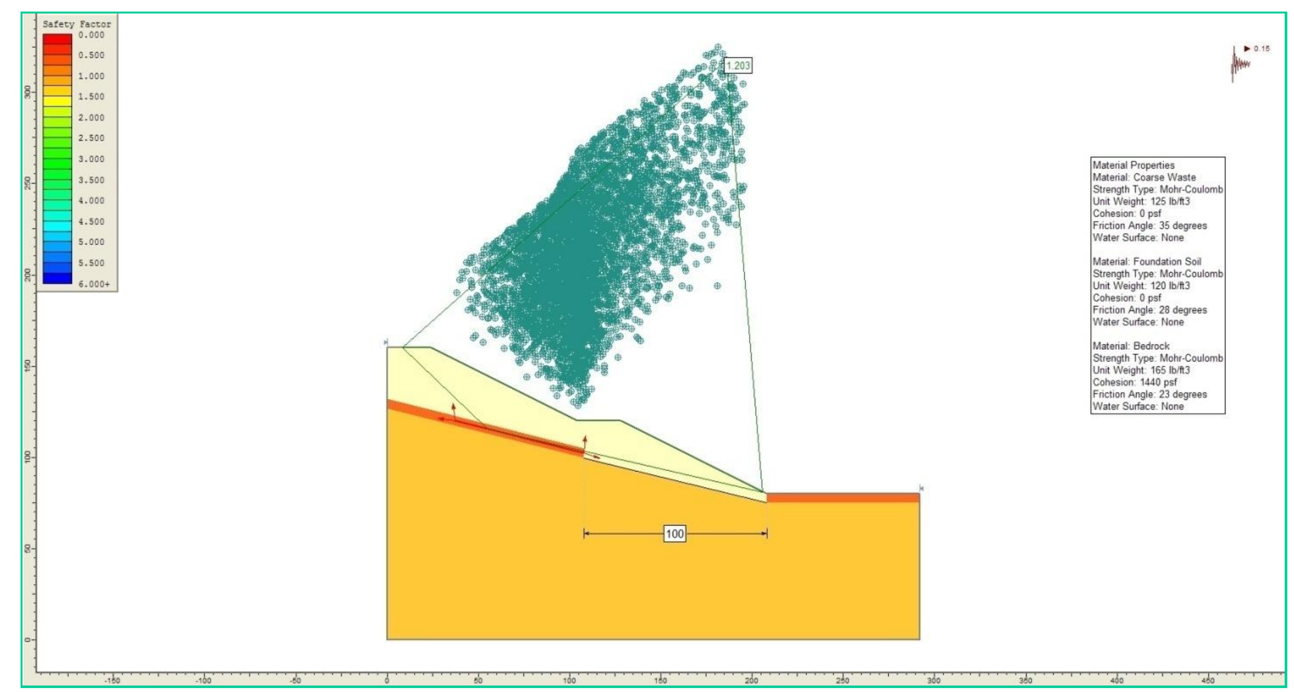
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 1.32)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 0.96)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 1.74)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 1.20)

Golder Associates

Job no. 063-7109.100

APPENDIX C9

CMSA/EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

SENSITIVITY STUDY – VARIATION OF SUBGRADE (4H:1V)