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c/o MBI Consulting Group, Inc.
Attention: Mr. Mike Brumbaugh
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Sent via email: ***mike@mbi-re.com***

Subject: **PRELIMINARY GEOTECHNICAL ENGINEERING INVESTIGATION**
LINCOLN MEADOWS SUBDIVISION
NWC VIRGINIATOWN AND HUNGRY HOLLOW ROADS
LINCOLN, CALIFORNIA

Dear Mr. Brumbaugh:

In accordance with your request and authorization of CTE CAL Inc. (CTE) proposal dated January 16, 2015, CTE has completed a preliminary geotechnical investigation at the above referenced project site. The attached report contains the results of our subsurface investigation, laboratory testing program and engineering evaluation of the geotechnical and geological elements of the project site and proposed construction. Specifically the report provides geotechnical engineering design parameters and construction recommendations for design of the proposed project structure and site improvements.

Based on CTE's subsurface investigations, site materials testing, and our geotechnical and geological engineering evaluation, the project is considered feasible from a geotechnical standpoint provided the recommendations contained in the attached report are incorporated into the project design and construction. CTE shall review grading, foundation, and retaining wall plans once they are available in order to verify that the plans are in substantial conformance with the recommendations contained in this report.

If you have any questions regarding our findings or recommendations, please do not hesitate to contact this office. The opportunity to be of service is appreciated.

Respectfully submitted,

CTE CAL, INC.

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PRELIMINARY GEOTECHNICAL ENGINEERING INVESTIGATION
LINCOLN MEADOWS SUBDIVISION
NWC VIRGINIATOWN AND HUNGRY HOLLOW ROADS
ELK GROVE, CALIFORNIA

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1.0 INTRODUCTION AND SCOPE OF SERVICES

1.1 Introduction

This report presents the results of a geotechnical and geological engineering investigation, performed by CTE CAL, Inc. (CTE) for the Lincoln Meadows Subdivision Project site located at the northwestern corner of the intersection between Virginia Town Road and Hungry Hollow Road in Lincoln, California. The report provides conclusions and recommendations regarding the geotechnical design elements of the project and provides geotechnical recommendations for the construction of the proposed hotel development project.

The project is proposed to be subdivision of an approximately forty acre parcel into 148 single family residential lots. Figure 1 shows the general location of the site. Figure 2 shows a plan view of the site explorations.

The investigation contained herein included surface and subsurface field explorations, laboratory testing of site soil deposits, geologic and seismic hazard evaluation of the project site, and engineering evaluation and analysis of the proposed project site and proposed improvements. Based on the results of the investigation and analysis performed by CTE the project is considered feasible if the recommendations contained herein are incorporated into the design and construction of the project. References utilized in the investigation and analysis cited are presented in Appendix A.

1.2 Scope of Services

The scope of services provided for this preliminary investigation included:

- Review of readily available geologic reports and documents pertinent to the site area.
- Explorations to determine subsurface conditions to the depths influenced by the proposed construction.
- Laboratory testing of representative soil samples to provide data to evaluate the geotechnical design characteristics of the site foundation soils.

- Determination of the general geology and evaluation of potential geologic seismic hazards at the site.

- Preparation of this report describing the investigations performed and providing opinions/conclusions and geotechnical engineering recommendations for design and construction.

2.0 SITE AND PROJECT DESCRIPTION

The project site consists of an approximately forty acre, unoccupied, rectangular shaped parcel that is located at the northwestern corner of the intersection between Virginia Town and Hungry Hollow Roads, Lincoln, California. To the north of the project site is a vacant lot. An existing single family residential subdivision is to the west. A block wall was along the eastern margin of the subdivision. At the time of our field reconnaissance, the gently rolling site sustained grasses/weeds and scattered trees. Barbed wire fencing was along the roads. A relatively shallow, bermed drainage channel cut diagonally through the central portion of the site and, near to the eastern side of the property, turns northerly. Numerous shallow depressions (1 to 2 feet deep) and small mounds (1 to 2 feet tall), possibly from historic dry mining of surficial soils, were throughout the parcel. A gravel paved access lane connected the western end of the channel (next to the subdivision) with Virginiatown Road to the south. The site generally slopes down toward the northwest with elevations varying from approximately 219 feet above mean sea level (MSL) in the southeastern portion of the site to about 197 feet above MSL in the northwestern portion of the parcel.

During the site reconnaissance no indications of surface and/or subsurface structures, other than those presented above, were observed. However the possible presence of such structures could not be precluded by the site reconnaissance or subsurface investigation. A site index map containing the location of the project site is shown on Figure 1.

As part of our investigation a review of Google Earth historic aerial photographs was conducted. The oldest photograph reviewed was taken in 1993 and comparred to a 2014 aerial photograph. The western subdivision was not evident on the 1993 photograph. The comparison indicated that

the subject site has not changed significantly since 1993 except for the block wall along the eastern boundary of the western subdivision and is similar to that observed on the 2014 aerial photograph.

The project includes designing the subdivision to include 148 lots for future one- and two-story, wood frame, single family, residential structures, underground utilities, and access pavements with curbs, gutters and sidewalks as well as open space as shown on a "VESTING TENTATIVE SUBDIVISION MAP, LINCOLN MEADOWS" (sheet 1 of 2, dated September 24, 2014) by Baker-Williams Engineering Group of Carmichael, California. Site grading is undefined but is expected to have cuts and fills anticipated to be on the order of five to ten feet, not including remedial grading operations. It is indicated that the existing channel will be relocated.

3.0 FIELD AND LABORATORY INVESTIGATIONS

3.1 Field Investigations

The field exploration program included performing a site reconnaissance and excavating seven exploratory borings in order to determine the geometry and geotechnical characteristics of subsurface geologic deposits and depth to groundwater, if encountered. In addition, representative samples of the subsurface soil deposits were obtained from the soil borings for use in laboratory testing to determine the engineering properties and geotechnical design parameters. The borings (designated B-1 through B-7) were excavated using a track-mounted, CME-75 drill rig using eight-inch outer diameter hollow stem flight augers to the maximum depth drilled of approximately 21.5 feet below existing ground surface (egs).

The field subsurface exploration program included performing Standard Penetration Tests (SPT) using a standard split barrel sampler (1.4-inch inside diameter, 2-inch outside diameter) and a modified spilt barrel drive sampler (2-inch inside diameter, 2.5-inch outside diameter) which were operated in accordance with ASTM D-1586. The drive samplers were utilized to obtain samples of the subsurface soils at depth intervals of 5-ft or less by driving the samplers into the

bottom of the borehole with successive blows of a 140-pound automatic hammer free-falling 30 inches.

The number of blows required to drive the sampler three, six-inch intervals at each sampling location, 18-inches total of sampler penetration, was recorded and are shown on the test boring logs contained in Appendix B. The raw results of the drive sampler testing are shown on the boring logs in the column "Penetration Test (blows/foot)". The standard penetration blow counts (N) were corrected and used during the geotechnical engineering evaluation and analysis to correlate soil strength and structure bearing characteristics.

Soils were logged in the field by a CTE Field Engineer and were classified based on the Unified Soil Classification System (ASTM D2487), sampler drive resistance, field testing, and visual observations. Exploration logs prepared for each of the borings provide soil descriptions, field in-situ test results, and blow count data. The boring logs are included in Appendix B which contains the Boring Log Legend and Definition of Soil Terminology as shown on Plates BL1 and BL2, respectively. The location of the test borings are shown on Figure 2.

Relatively undisturbed soil samples obtained from the drive samplers were contained in capped, stainless steel sample tubes or placed in zip lock plastic bags. Bulk soil samples were recovered directly from drill cuttings or were obtained from surface deposits and place in sample bags. Soil samples were then transported to CTE's laboratory for further testing. Field descriptions within the boring logs have been modified, where appropriate, to reflect laboratory test results. Upon completion of drilling the borings were backfilled from final boring depth up to original ground surface with cement grout. Details of the soils encountered are shown on the Boring Logs which are presented in Appendix B.

3.2 Laboratory Testing Program

Laboratory tests were conducted on representative soil samples for classification purposes and to evaluate physical properties and engineering characteristics. Laboratory tests conducted on representative soil samples collected from the borings included moisture content, dry density, plasticity, expansion index, R-value, and particle size distribution. Test method descriptions and laboratory test results are presented in Appendix C.

4.0 GEOLOGY

4.1 General Geologic Setting

The site is located near to the eastern edge of California's Great Vally Geomorphic Province, a geologically young, large, flat-lying alluvial plain in the central portion of California. It is 40 to 60 miles (60 to 100 km) wide and stretches approximately 450 miles (720 km) from north-northwest to south-southeast, inland from and parallel to the Pacific Ocean Coast Ranges to the west and Sierra Nevada Mountains to the east. The Great Valley has been filled with hundreds to thousands of feet of eroded sediments, ranging in age from Pleistocene to Holocene. Recent alluvial deposits generally consist of poorly sorted silts, fine sands and clays with less extensive lenses of medium to coarse grained sands and gravel. These alluvial units overlie Pliocene-Pleistocene continental clastic deposits, which in turn overly older continental and marine deposits. An unconformable pre-Tertiary basement complex of granitic and metamorphic rocks underlies the sediments.

Based on our investigation and review of readily available published geologic literature/maps (CGS Geologic Map 1A “Geologic Map of the Sacramento Quadrangle”, 1981; scale 1:250,000) the site is mapped to be underlain by deposits of the Pleistocene Riverbank Formation consisting of undifferentiated arkosic alluvial deposits. Below is a brief description of the soils encountered during the investigation. More detailed descriptions are provided in the Boring Logs in Appendix B.

4.2 Generalized Soil Conditions

Soil materials encountered in our site explorations are generally consistent with the above referenced published geologic mapping. Native alluvial deposits were encountered in the borings. The native alluvial deposits generally consisted of an uppermost soil layer comprised of

medium dense to very dense, gravelly clayey sand with variable silt (Unified Soil Classification: SC) to depth of about 5 feet below existing ground surface (egs). Underlying the clayey sand layer were interlayers of dense to very dense silty sands (SM) and clayey sands (SC) with variable gravel, sandy clays (CL), and silty sandy gravel (GM) containing some lenses of dense silty sand with variable gravel to the maximum depth of our explorations of about 21.5 feet below egs.

Since the earth material profile described above is generalized, the reader is advised to consult the Test Boring Logs contained in Appendix B, if determination of the earth material conditions at a specific depth and location are desired. The boring logs contain a more detailed earth material description regarding color, earth material type, and Unified Soil Classification System (USCS) symbol.

It should be noted that earth material conditions cannot be fully determined by limited test borings and earth material sampling and testing. Hence, unexpected earth material conditions might be encountered during construction. If soil deposits are encountered during construction which vary substantially from materials encountered during the investigation appropriate recommendations will be during construction.

4.3 Groundwater Conditions

Observations of groundwater conditions were made during the excavation of our test borings at the time of field exploration. Groundwater was encountered only within the exploratory boring number B-5 at a depth of about 9 feet below egs. Free groundwater was not observed in the other

borings excavated. We consider the groundwater found in boring B-5 to be perched in a silty sandy gravel layer.

Groundwater levels can fluctuate on a seasonal basis due to changes in precipitation, irrigation, pumping, etc. Based on site topography and the time period our investigation was performed groundwater levels might increase. With proper drainage groundwater is not expected to affect the proposed development. However, excavations below perched groundwater might be impacted by seepage; therefore, we recommend grading and utility excavations be performed during dry-season when ground water levels are lowest.

Wet weather construction methods should be anticipated to be required if construction is scheduled to occur during the rainy season. During periods of appreciable precipation localized higher groundwater / perched water situations should be expected producing locally or widespread saturated surface soils. If construction is undertaken during wet-season/heavy-rains, saturated soils will not be expected to be acceptable for grading or compaction and could hamper progress due to limited equipment mobility and/or inability to achieve appropriate moisture content to achieve required soil compaction.

Saturated soils resulting from significant precipitation events may need to be dried by aeration or an additive, such as lime, cement, or kiln dust added to stabilize the working surface and allow for soil proper soil. Moisture conditioning (drying or wetting) of the engineered fill will likely be needed for the project. Appropriate erosion control and permanent site surface drainage elements per the latest California Building Code should be designed and implemented as per the project civil engineer.

4.4 General Geologic Hazards Observations

The site is not located within an Alquist-Priolo Special Studies Zone and the potential for fault rupture, damage from fault displacement, or fault movement directly below the site is considered to be very low. However, the site is located within an area where shaking from earthquake generated ground motion waves should be considered likely.

The soils encountered in the explorations are generally dense or hard, and therefore are not generally considered to be significantly compressible under anticipated higher surcharge pressures or loadings. According to plasticity test results and expansion index tests, the clayey surficial deposits, where encountered, have very low to low expansion potential. The granular soils are considered to have very low expansion tendancies. The soils encountered in the explorations are considered adequate for support of lightly to moderately loaded structures with conventional shallow foundations.

The soil conditions, groundwater level, and relative distances to several active faults in the general region of Northern California are geotechnical concerns that also control the selection of suitable foundation support for the proposed improvements. Design and construction recommendations presented herein have been developed based on the noted site conditions.

4.5 Geologic Hazards

The site is not mapped within an Alquist-Priolo Special Studies Zone. The potential for fault rupture or damage from fault displacement or fault movement directly below the site or near to the site is considered to be very low. However, the site is located within an area where shaking from earthquake generated ground motion waves should be considered likely. The closest portion of an Alquist Priolo active fault is the Cleveland Hill Fault (about 60 kilometers to the north). This fault zone is indicated to be capable of generating an earthquake on the order of magnitude 5.7.

4.6 Seismic Ground Motion Values

The mapped and design spectral response accelerations below presents seismic design criteria for the subject project site obtained from the United States Geological Survey (USGS) website (http://earthquake.usgs.gov/designmaps/us/application.php) with the USGS Seismic Design Maps application. The values are based on data provided by the 2008 USGS National Seismic Hazard Mapping Project and are for use with the 2013 California Building Code (CBC). The values for spectral response accelerations reference with a risk category of I or II or III.

Mapped and Design Spectral Accelerations	
Description	**Value**
2013 CBC Site Classification[1]	D[2]
Site Latitude	38.90278°N
Site Longitude	121.26778°W
S_s Spectral Acceleration for a Short Period	0.488 g
S_1 Spectral Acceleration for a 1-Second Period	0.245 g

[1] In general accordance with the *2013 CBC*, Table 1613.5.2. CBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

[2] The *2013 CBC* requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. Borings extended to a maximum depth of 21.5 feet, and this seismic site class definition considers that hard soil continues below the boring bottom.

4.7 Liquefaction and Seismic Settlement Evaluation

Liquefaction occurs when saturated fine-grained sands and/or silts lose their physical strength temporarily during earthquake induced shaking and behave as a liquid. This is due to loss of point-to-point grain contact and transfer of normal stress to the pore water. Liquefaction potential varies with water level, soil type, material gradation, relative density, and probable intensity and duration of ground shaking.

The California Geological Survey (CGS) has designated certain areas within California as potential liquefaction hazard zones. These are areas considered at risk of liquefaction-related ground failure during a seismic event based upon mapped surficial deposits and the depth to the areal groundwater table. The project site is not currently mapped for potential liquefaction hazard by the CGS (refer to CGS website: (http://gmw.consrv.ca.gov/shmp/html/pdf_maps_no.html). Based on readily available published geologic information, there is no historical record of liquefaction occurring at the site. Subsurface information obtained during our study indicates the site is predominately underlain by generally dense to very dense silty and clayey sand soils with variable gravel to the maximum 21.5 feet depth of our deepest exploration (see Exploration Logs, Appendix B).

Saturated and loose fine sands/silts--which are typically considered potentially vulnerable to liquefaction -- were not encountered in our explorations. Depth to areal groundwater is indicated to be about 80 to 85 feet below egs per the "Groundwater Elevation Map", contained in the South Sutter Water District Groundwater Management Plan, October 2009, prepared by Luhdorff & Scalmanini Consulting Engineers. Based on the information discussed above, it is our opinion that the overall potential for liquefaction at the site is relatively very low in the event of a seismic event.

4.8 Earthquake Induced Landsliding

Based on information available on the California Geological Survey (CGS) website the subject site is not currently within a State of California Seismic Hazard Zone for seismically induced landsliding. In addition, the site and surrounding terrain within the area is relatively gently sloping; therefore, seismically induced and/or other landslides are not considered a significant hazard at the site.

4.9 Tsunamis and Seiche Evaluation

The site is not located near to large bodies of water and is at about 200+ feet above MSL. Based on the geometry of the site, the potential for tsunami damage or damage caused by oscillatory waves (Seiche) is not considered likely at the site.

4.10 Compressible and Expansive Soils

Compressible materials consisting of surficial organic material, loose soils, undocumented fills, debris, rubble, rubbish, are considered unsuitable materials for structure support of structures and improvements. As such all fill materials existing at the site will require removal and recompaction. In addition in areas where loose, wet soils were removed as well as areas where trees have been cleared, remedial grading will also be required to remove the loose soils and ensure the removal of the entire tree root systems.

All unsuitable soils are to be overexcavated and replaced with engineered fill as recommended in Section 5.1. Deeper native materials are not expected to be subject to more than nominal increases in loading and are therefore not considered significantly compressible. If the grading recommendations presented in Sections 5.1 and Section 5.2 are implemented, compression of structure bearing soils beyond typically acceptable levels is not expected.

Atterberg limits laboratory testing was conducted on samples of uppermost site silty clay (CL). The test results indicate the clay soils have Liquid Limits (LL) ranging from 21 to 28 with Plasticity Indexes ranging from 4 to 13; and, expansion index test results ranging from 4 to 8. Based on the Atterberg limits and expansion index laboratory testing, the expansion potential of these uppermost clayey soils is considered to be very low to low. Such materials are indicated to be present across the site and within the uppermost five feet below egs. Based on our experience in the general area, it is our opinion that there may be areas of moderately expansive clay to occur.

Mitigation measures (not preventative) if potentially moderately expansive clayey site soil are encountered during mass grading in permanent building and pavement areas could include moisture conditioning the materials to at least 3% above optimum moisture content, installing at least two feet of non-expansive soil beneath the rough pad soil subgrade with deepened reinforced footings, performing chemical treatment of the soil via lime treating, or through the installation of a post-tensioned slab-on-ground foundation system. If moderately to highly plastic clays are encountered during mass grading, CTE could provide alternative recommendation(s) consisting of removal, special moisture conditioning, or material modification through the addition of lime, cement, or fly ash.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

We conclude that the proposed construction is feasible from a geotechnical standpoint, provided the recommendations in this report are incorporated into the design of the project. Standard

Guide Grading Specifications for the proposed earthwork and improvements are included in the following sections and Appendix D. However, recommendations in the text of this report supersede those presented in Appendix D. All recommendations could require modifications based on conditions encountered during grading. In addition, changes in the locations of the proposed structures and pavements could also necessitate modifications to the recommendations provided herein. Recommendations for the design and construction of the proposed structures and associated improvements are included below.

5.2 Site Preparation

Project site stripping should include removal and disposal of all debris, vegetation, and any other organic material. We recommend overexcavation of any unsuitable materials such as soils disturbed during removal of existing undocumented fills, the removal of the channel, and / or other hidden features (such as subsurface drainage tiles, etc.), or otherwise unsuitable/unstable materials. Loose, wet or otherwise unstable soils should be excavated and evaluated for reuse as engineered fill.

Any foundations, pavements, septic systems, underground utilities, or any other obstructions encountered during grading that extend below the limits of excavation should be completely removed to competent material.

Utilities that extend into the construction area and are scheduled to be abandoned should be properly capped at the perimeter of the construction zone or moved as directed in the plans. The surface of the resulting excavations should be scarified to a depth of 12 inches and recompacted to 90 percent relative compaction per ASTM D1557 at moisture content to at least three percent above optimum moisture content.

Once the construction areas have been cleared and any excavations made then the subgrades that will receive engineered fill should be scarified to at least 8 inches. The loosened soils should be uniformly moisture conditioned to at least 3% percent above optimum moisture content and compacted to at least 90 percent relative compaction per ASTM D 1557. The uppermost twelve-

inches of the soil subgrade section supporting pavements should be compacted to at least 95% relative compaction per ASTM D1557.

Inability to achieve the stated compaction or instability of the subgrade materials or saturated soils could result in further criteria being provided during grading for the removal of loose, wet, or soft soils, or for the need of special stabilizing measures. If unanticipated, unsuitable materials are encountered at subgrade such that proper compaction cannot be obtained, mitigation measures, such as overexcavations to remove such material, could be recommended. In addition, construction equipment on saturated soils could destabilize the earth materials, sometimes to several feet of depth, which might necessitate further overexcavation and/or special stabilization.

The building pads should extend at least five feet laterally beyond proposed structure limits, where feasible. Suitability of soils exposed in the bottom of all subgrades should be verified by a representative of our office during site grading. Upon favorable review, exposed subgrades should be scarified and recompacted (in-place) an additional 8 inches and/or prior to placing engineered fill materials to rough pad grade. The recompacted subgrades should be proof-rolled with very heavy construction equipment (e.g., loaded water truck). The recommendations herein anticipate relatively low expansion potential soils (native and / or engineered fill with expansion index of 30 or less) will comprise the upper 2 feet of the building pads. If moderately to highly plastic clay materials should be encountered during grading, this office should be consulted and modification to our recommendations will be provided.

CTE personnel shall observe and approve the bottom of all overexcavations to confirm adequate conditions have been reached and shall observe and approve the scarification, moisture conditioning and recompaction of the excavated surfaces.

5.3 Fill Materials

Any material containing rubble or debris (asphalt, concrete, wood, rebar, etc.), cobbles or boulders greater than 3-inches, and / or moderately to highly plastic clay are not considered suitable for use as engineered fill material and should be removed during site

clearing/grubbing/grading. All excavated native soil materials derived from grading should be reviewed by the geotechnical engineer or his representative as to suitability for re-use as on-site engineered fill. Approved excavated materials to be used as engineered fill should be processed by removing organics and all constituents greater than 3-inch dimension; the remaining materials should be thoroughly mixed and moisture conditioned (wetted or dried) to produce a consistent blend with respect to grain size and moisture content. Engineered Fill materials in structure pad and pavement areas should consist of materials with an Expansion Index not exceeding 30 (EI<30). In all other areas proposed for surface improvements the top 2 feet of materials below subgrade level shall have an Expansion Index not exceeding 50 (EI<50).

5.4 Grading and Earthwork

CTE should continuously observe the grading and earthwork operations for this project. Such observations are essential to identify field conditions that differ from those predicted by this investigation, to adjust designs to actual field conditions, and to verify that the grading is in overall accordance with the recommendations presented in this report. Recommendations for the proposed earthwork and improvements are included herein and are also contained in Standard Guide Specifications for Grading located in Appendix D. Recommendations contained in the text of this report supersede those presented in Appendix D.

Engineered fill comprised of low expansive native granular soils or similar import soils within the building pad should be compacted to at least 90 percent relative compaction with a moisture at least 120% percent above optimum moisture content (per ASTM D-1557). Subgrade low expansive soils for engineered fill and/or recompacted subgrade soils to support new pavement, concrete drives or flatwork should be compacted to at least 95 percent relative compaction (per ASTM D-1557) to a depth of at least 12 inches below planned subgrade surface.

It is anticipated that properly prepared and moisture conditioned, native low plastic soils can be used as structural fill at the site provided they are placed at depths as decribed above in Section 5.3. Borrow areas (either on- or off-site sources) should be observed by our representative and samples obtained for laboratory testing (if required) at least four days prior to any materials

being imported to the site and/or reused from on-site sources. Organic, deleterious, moderately to highly expansive (plasticity index of 15 or greater and/or expansion index greater than 30) and oversized materials (greater than six inches in maximum dimension) should be removed during earthwork and not re-used as engineered fill.

Optionally, in lieu of replacing moderatively expansive site materials (should they occur) with structural fill meeting the requirements of Section 5.3, pre-saturating subgrade soils beneath floor slabs-on-grade and pavements (includes flatwork) and utilizing lime treatment of the uppermost 16-inches of subgrade soil beneath the floor slabs and 12 inches in pavement and surface improvement areas. For preliminary planning purposes only, we suggest at least three percent (3%) lime if this option is elected. We recommend that representative samples of the actual subgrade soils be obtained just after completion of the clearing and stripping and tests run to confirm the need for and the quantity of lime required.

5.5 Fill Placement and Compaction

As stated above, an engineer or his field representative from CTE should verify that the proper site preparation has occurred before fill placement begins. After stripping and grubbing, surface improvement areas shall be scarified to a minimum 6-inch depth and compacted to no less than 90% relative compaction (per ASTM D1557). All fill should be placed in relatively thin lifts (typically not more than 8 inches uncompacted thickness) at relative compaction of not less than 90% (ASTM D1557) at 3% above optimum moisture content. Since low plasticity soils can swell significantly if their moisture levels are initially low it is recommended that all fill materials be moisture conditioned to at least 120% above optimum moisture content prior to compaction and the moisture content maintained until concrete or pavement placement.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of foundations, exterior flatwork/slabs and pavements. Construction traffic over the completed subgrade should be avoided in order to prevent disturbance of subgrade soils. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade consisting of engineered fill

should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to construction.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, backfilling of excavations to the completed subgrade, placement and compaction of engineered fills, proof-rolling, backfilling of utility trenches, etc.

5.6 Temporary Construction Slopes

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Foundation excavations should be observed by and approved by CTE personnel during construction in order to confirm the adequacy for structural foundation bearing, confirm the appropriateness of these recommendations, and to allow for an opportunity to provide additional recommendations if deemed necessary.

5.7 Structure Foundation Recommendations

Continuous and isolated spread footings are considered suitable for use at this site to support the new house structures. All structure footings should be founded in engineered fill as recommended herein and/or in low expansive, firm, undisturbed native soil. CTE's geotechnical engineer or his representative should observe soil conditions exposed in foundation excavations. If the soil conditions encountered differ significantly from those presented in this report, then supplemental recommendations will be required.

Foundation dimensions and reinforcement should be based on allowable bearing values of 2,500 pounds per square foot (psf) for spread footings of at least 12-inches in width penetrating into and embedded below rough pad soil grade at least 12 inches deep for the one-story buildings,

and 18 inches deep for two-story buildings. An increase in the bearing capacity of 250 psf per foot of additional footing depth to a maximum 3500 psf is allowed. The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include short duration wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

We recommend that all footings be reinforced as required by the structural engineer to provide structural continuity, to permit strong spanning of local irregularities and to be rigid enough to accommodate potential differential movements estimated at about one-half inch over 20 linear feet. Based on the conditions observed at the site, the total structure settlement is expected to be on the order of one inch for static compression. Dynamic settlement due to an earthquake event is not expected to adversely affect the proposed improvements. The continuous and isolated spread footings should be designed by the project structural engineer.

The foundation excavations should be clean (i.e., free of all loose slough) and dry prior to placing steel and concrete. Foundation excavations should be moisture conditioned to 120 percent over optimum moisture content prior to foundation and slab concrete placement. The concrete for the foundation should not be placed against a dry excavation surface. Concrete should be pumped or placed by means of a tremie or elephant's trunk to avoid aggregate segregation and earth contamination.

Concrete should not be chuted against the excavation sidewalls for excavations over five feet deep. Rebar reinforcement should be properly supported with proper clearances maintained during concrete placement. The concrete should be properly vibrated to mitigate formation of voids and to promote bonding of the concrete to steel reinforcing. These recommendations are predicated upon CTE’s representative observing the bearing materials as well as the manner of concrete placement.

5.8 Resistance of Lateral Loads

The following recommendations may be used for shallow footings on the site. Foundations placed in approved bearing materials may be designed using a coefficient of friction of 0.30 (total frictional resistance equals the coefficient of friction times the dead load). A design passive resistance value of 250 pounds per square foot per foot of depth (with a maximum value of 1000 pounds per square foot) may be used. The allowable lateral resistance can be taken as the sum of the frictional resistance and the passive resistance, provided the passive resistance does not exceed two-thirds of the total allowable resistance.

5.9 Foundation Setback

The bottoms of utility trenches placed along the perimeter of the foundation should be above an imaginary plane that projects at a 45 degree angle down from the lowest outermost edge of the foundation. Where trenches pass through the plane the trench should be installed perpendicular to the face of the foundation for a distance of at least the depth of the foundation. Deepening of affected foundation is considered an effective means of attaining the prescribed setbacks.

5.10 Concrete Slabs-On-Grade

For buildings utilizing shallow spread foundations, lightly loaded concrete slabs should be designed by the structural designer for the anticipated loadings based on a modulus of subgrade reaction estimated at 100 pounds per square inch per inch (psi/in). The modulus was provided based on the slab being supported on 4 inches or more of coarse granular material (i.e., ¾ - inch washed, crushed rock or compacted aggregate base) and estimates obtained from NAVFAC 7.1 design charts. This value is for a small loaded area (1 sq. foot or less) such as for small truck wheel loads or point loads and should be adjusted for larger loaded areas. We recommend that slabs should be at least four inches thick for light duty loads. Slabs subjected to heavier loads may require thicker slab sections and/or increased reinforcement.

Floor slab reinforcement should determined by the structural designer. The minimum reinforcement could consist of #3 reinforcing bars placed on maximum 18-inch centers, (for slabs supported on low expansive subgrade soils) or 24-inch centers each way (for slabs

constructed on lime treated soils or non-expansive engineered fill/native soil) at mid-slab height. The moisture content of subgrade soils should be at least 120 percent over optimum moisture content in the upper 18-inches beneath the floor slabs. These moisture levels for building areas found to be underlain by potentially expansive soils should be verified by the Geotechnical Engineer or his representative within 24 hours of slab concrete placement. Utility trenches should be plugged with low permeability material wherever the trenches pass beneath the bottoms of the building perimeter foundations.

On most project sites, the site mass grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade soils may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade soils may not be suitable for placement of base rock and concrete and corrective action will be required.

We recommend the areas underlying the floor slabs be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck or water truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrade soil areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base rock and concrete.

Slabs-on-grade subject to light vehicle (e.g., automobile) traffic should be at least 5.0 inches thick, or as per the project structural engineer, and have a minimum four-inch thick layer of Class 2 aggregate base compacted to at least 95 percent relative compaction placed beneath slabs. If elastic design is utilized for designing slabs-on-grade, a modulus of subgrade reaction (k) value of 100 pci should be used for slabs supported on site soils or sand. For design of slabs founded on Class 2 aggregate base the design k value may be increased to 120 pci.

We suggest the following measures for mitigating (not preventing) moisture intrusion into moisture sensitive interior floor slab(s). The floor slabs should be underlain by a 4-inch thick layer of crushed washed rock which is intended to serve as a capillary mitigating moisture break and to provide uniform slab support. Gradation of this material should be such that 100 percent will pass a 1-inch sieve and 0 to 5 percent passes the No. 4 sieve. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder. At a minimum, we recommend a 10-mil moisture vapor barrier (sealed at all laps, splices, penetrations, etc.) be placed above the gravel moisture break. The vapor barrier should extend laterally into the footings. If maximum two-inches of clean sand should be placed above the vapor retarder (not recommended), then we recommend a moisture barrier be placed against the outer face of the perimeter footing. Please note that the sand can be a conduit for water beneath the slab. In addition, the sand can form boils/pockets in the slab concrete. If proposed floor areas or coverings are considered especially sensitive to moisture emissions, additional recommendations from a specialty consultant should be obtained. CTE is not an expert at preventing moisture penetration through slabs. Therefore, a qualified architect or other experienced professional should be consulted if moisture penetration is a more significant concern. Further resistance to moisture vapor intrusion could be achieved with proper curing of the concrete, adding a sealant to the mix (e.g., Moxie), having a mix design with low slump (we suggest 2 to 4 inches), low water/cement ratio (we suggest not greater than 0.45), and high strength (we suggest at least 3000 psi).

The structural engineer/Architect and slab installation contractor should refer to ACI 302 and ACI 360 for procedures and cautions regarding the use and placement of a vapor barrier. In areas of exposed concrete, control joints should be saw-cut into the slab after concrete placement in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended). To control the width of cracking, continuous slab reinforcement should be considered in exposed concrete slabs.

Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement. Interior trench backfill placed beneath slabs should be compacted in accordance with recommendations outlined in the Earthwork section of this report and Appendix D. Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

5.11 Earth Pressures

Free draining retaining walls backfilled using generally select onsite soils per the preceding section of this report, may be designed using the equivalent fluid weights given in the table below. These values are also considered suitable for permanent shoring, if proposed.

TABLE 5.8
EQUIVALENT FLUID UNIT WEIGHTS
(pounds per cubic foot)

WALL TYPE	LEVEL BACKFILL	SLOPE BACKFILL 2:1 (H: V)
CANTILEVER WALL (YIELDING)	40	60
RESTRAINED WALL	60	90

Traffic surcharges on retaining walls should generally be equal to 1/3 of the vertical load of the traffic located within ten lateral feet of wall. Lateral pressures on cantilever retaining walls (yielding walls) due to earthquake motions may be calculated based on work by Seed and Whitman (1970). The total lateral thrust against a properly drained and backfilled cantilever retaining wall above the groundwater level can be expressed as:

$$P_{AE} = P_A + \Delta P_{AE}$$

For non-yielding (or "restrained") walls, the total lateral thrust may be similarly calculated based on work by Wood (1973):

$$P_{KE} = P_K + \Delta P_{KE}$$

Where P_A = Static Active Thrust (given previously Table 5.8)
P_K = Static Restrained Wall Thrust (given previously Table 5.8)
ΔP_{AE} = Dynamic Active Thrust Increment = $(3/8)\ k_h\ \gamma H^2$
ΔP_{KE} = Dynamic Restrained Thrust Increment = $k_h\ \gamma H^2$

k_h = ½ Peak Ground Acceleration = ½ (S_{DS}/2.5)
H = Total Height of the Wall
γ = Total Unit Weight of Soil ≈ 125 pounds per cubic foot

The increment of dynamic thrust in both cases should be based on a trapezoidal distribution (essentially an inverted triangle), with a line of action located at 0.6H above the bottom of the wall. The values above assume non-expansive backfill and free-draining conditions. Measures should be taken to prevent moisture buildup behind all retaining walls. Drainage measures should include free-draining backfill materials and sloped, perforated drains. These drains should discharge to an appropriate off-site location. Waterproofing should be as specified by the project architect.

5.12 Seismic Design Criteria

The seismic ground motion values presented below were determined using the USGS Ground Motion Parameter Calculator using project site coordinates Based on the site investigation and evaluations, the following design coefficients are considered suitable for design based on the project requirements. The parameters provided were derived from the 2013 California Building Code (CBC) and ASCE 7-10 Standard.

CODE BASED GROUND MOTION VALUES (CBC 2013)	
S_S = 0.543 g	S_1 = 0.261 g
S_{MS} = 0.742 g	S_{M1} = 0.490 g
S_{DS} = 0.494 g	S_{D1} = 0.327 g

5.13 Exterior Flatwork

To reduce the potential for distress to exterior flatwork caused by differential settlement of foundation soils, we recommend that such flatwork be installed with crack-control joints at appropriate spacing as designed by the project architect. Flatwork, which should be installed with crack control joints, includes driveways, sidewalks, and architectural features. All subgrade

should be prepared according to the earthwork recommendations previously given before placing concrete. Positive drainage should be established and maintained adjacent to all flatwork.

The moisture content of the slab subgrade materials comprised of low to moderately plastic clays should be verified by a geotechnical representative from CTE within 24 hours of slab concrete placement.

5.14 Pavement Section Alternatives

It is understood asphalt-concrete (A/C) pavement is proposed for the new access roads. In addition, driveway, curb, gutter and sidewalk areas are expected to be constructed of Portland cement concrete. The upper 12 inches of subgrade and all aggregate base materials should be compacted to 95% of laboratory determined maximum dry density, as per ASTM D1557, at moisture contents of between two to three percent above optimum moisture content. Pavements should be designed and constructed according to CALTRANS standards.

Preliminary pavement sections presented below are based on a Resistance ("R") Value of 22 obtained by exudation and assumed Traffic Indices presented below. Based on our previous experience on similar sites we have assumed traffic indices (TI's) ranging from 4.5 to 6 for the proposed roadway areas. The pavement design is based on California Department of Transportation (CalTrans) Highway Design Manual (except a factor of safety was not applied) and on anticipated traffic indices as indicated below. If these assumptions are incorrect, this office should be contacted to obtain further pavement recommendations.

TABLE 5.12
RECOMMENDED PAVEMENT ALTERNATIVE SECTIONS

Traffic Area	Assumed Traffic Index	Preliminary Subgrade "R"-Value	Asphalt Pavements		Portland Cement Concrete Pavements, On Subgrade Materials (inches)
			AC Thickness (inches)	Class II Aggregate Base Thickness (inches)	
Truck Drive Areas	6.0	22	3 4	10 8	5.5
Automobile Traffic Areas	4.5	22	2 3	8 5	4

* Caltrans Class 2 aggregate base, ** Concrete should have a modulus of rupture of at least 600 psi

Concrete pavements could be reinforced with nominal rebar, such as minimum #4 bars spaced no greater than 24 inches, on center, both ways, placed at above mid-slab height, but with proper concrete cover. Alternatively, concrete pavements can be unreinforced provided they are constructed with expansion/contraction and/or construction joints spaced no greater than 24 times the pavement thickness, both ways, in nearly square patterns, and are detailed in general accordance with ACI Guidelines. Doweling of concrete pavements at critical pathways is also recommended.

Asphalt concrete paved areas should be designed, constructed, and maintained in accordance with, for example, the recommendations of the Asphalt Institute, or other widely recognized authority. Concrete paved areas should be designed and constructed in accordance with the recommendations of the American Concrete Institute or other widely recognized authority, particularly with regard to thickened edges, joints, and drainage.

The Standard Specifications for Public Works construction ("Greenbook") or Caltrans Standard Specifications may be referenced for pavement materials specifications. Materials and construction of pavements for the project could be in accordance with the requirements and specifications of CalTrans. Asphalt concrete pavement should conform to the specifications of

Type A or B per section 39, and aggregate base should conform to the specifications of Class II per Section 26 of the referenced specifications.

Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade. The preliminary sections above should be reviewed and approved by the owner, his civil engineer, and the governing authorities prior to construction.

5.15 Drainage

Foundation and concrete-slab-on grade performance depends greatly on how well the runoff waters drain from the site. This is true both during construction and over the entire life of the structure. The ground surface around structures should be graded so that water flows rapidly away from the structures without ponding. The surface gradient needed to do this depends on the landscaping type. In general, the pavements and flowerbeds within five feet of buildings should slope away at gradients of at least two percent. Densely vegetated areas should have minimum gradients of five percent away from buildings if doing so is practical.

Planters should be constructed so that water from them will not seep into the foundation areas or beneath slabs and pavement. In any event, the site maintenance personnel should be instructed to limit irrigation to the minimum actually necessary to sustain the landscaping plants properly.

Should excessive irrigation, waterline breaks, or unusually high rainfall occur, saturated zones and groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscaped areas or cascading over slope faces. A potential source of water, such as water pipes, drains, and the like should be frequently examined for signs of leakage or damage. Any such leakage or damage should be repaired promptly. The project Civil Engineers should thoroughly evaluate the on-site drainage and make provisions as necessary to keep surface waters from affecting the site.

Generally, CTE recommends against allowing water to infiltrate building pads or adjacent to slopes. We understand that some agencies are encouraging the use of storm-water cleansing devices. Use of such devices tends to increase the possibility of high groundwater and slope instability. If storm-water cleansing devices must be used, then we recommend that they be underlain by an impervious barrier and that the infiltrate be collected via subsurface piping and discharged off site.

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the building perimeter should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective "trench plug" that extends at least 2 feet out from the face of the building exterior and beneath the perimeter footing. The plug material should consist of concrete or low plastic clay (Plasticity Index <15) compacted to 90 percent relative compaction (per ASTM D 1557) at a water content at slightly above the soil's optimum water content. The concrete or the clay fill should be placed to completely surround the utility line; and, if used, the clay should be placed and compacted in accordance with recommendations in this report.

5.16 Construction Observation

The recommendations provided in this report are based limited subsurface information observed, at locations, and within, exploratory borings performed for this project and preliminary concept design proposed construction as of the date of publication. The interpolated subsurface conditions, on which this report relies, should be checked in the field during construction to verify conditions described herein are as anticipated. Any changes which occur to preliminary information provided to this office as of the date of this publication, this office should be notified and afforded an opportunity to update information provided in this report.

Recommendations provided in this report are based on the understanding and assumption that CTE will provide the observation and testing services for the project. All earthworks should be observed and tested to verify that grading activity has been performed according to the

recommendations contained within this report. The project engineer should evaluate all footing trenches and aggregate piers before reinforcing steel placement.

5.17 Plan Review

CTE should review project grading and foundation plans before the start of earthworks to identify potential conflicts and to verify that the recommendations contained in the report are to be implemented.

6.0 LIMITATIONS OF INVESTIGATION

As indicated, the recommendations presented herein are based on the field exploration, laboratory testing and our geologic and engineering analysis. Following completion of testing, these recommendations will be confirmed and or modified, if necessary, based on the materials exposed and re-worked during grading. The field evaluation, laboratory testing and geotechnical analysis presented in this report have been conducted according to current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations and opinions expressed in this report.

Variations may exist and conditions not observed or described in this report may be encountered during construction. Our conclusions and recommendations are based on an analysis of the observed conditions. If conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if required, will be provided upon request. We appreciate this opportunity to be of service on this project. If you have any questions regarding this report, please do not hesitate to contact the undersigned.

We appreciate the opportunity to be of service on this project. Should you have any questions or need further information please do not hesitate to contact this office.

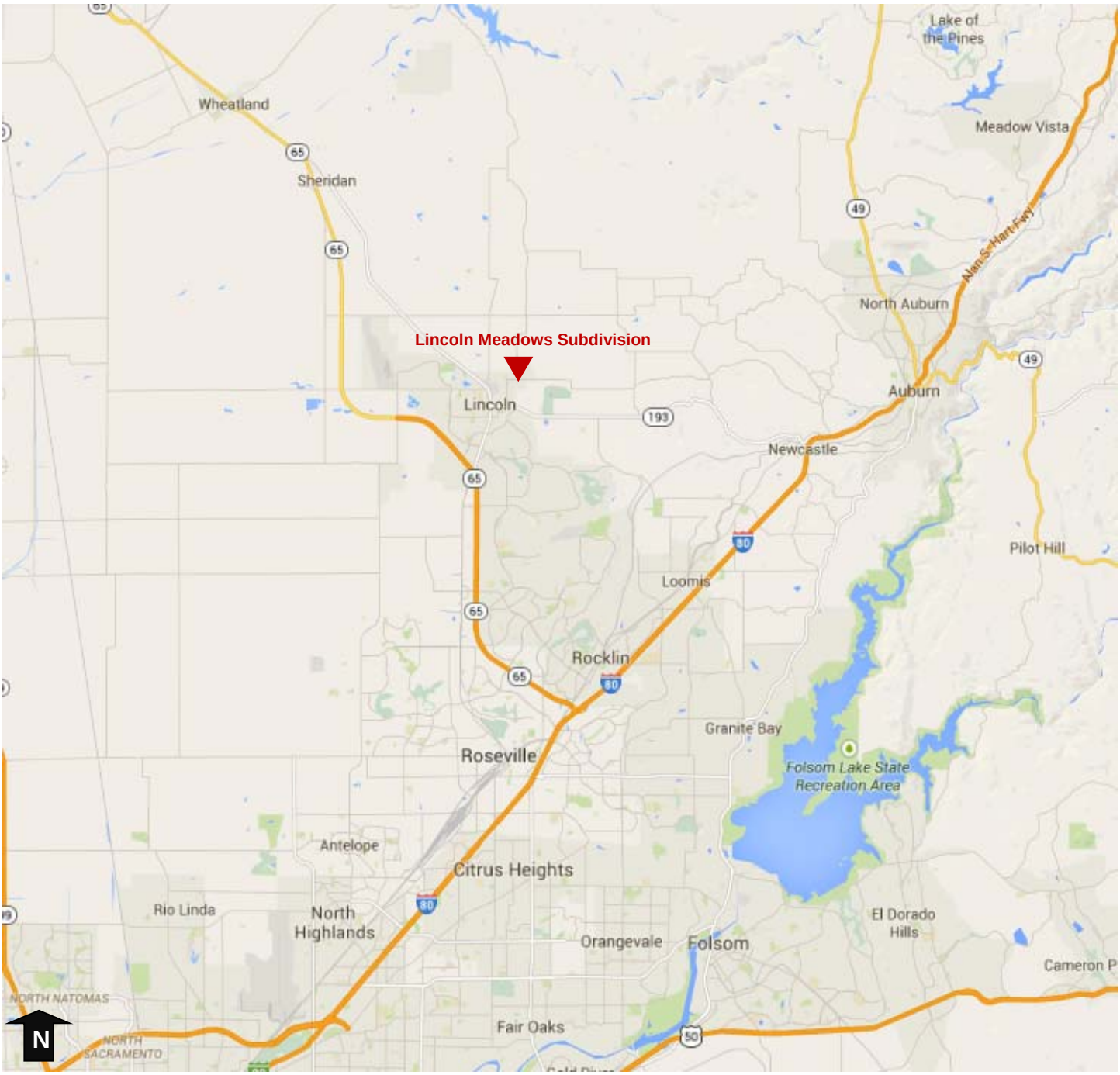
Respectfully submitted,

CTE CAL, INC.

Ed Hendrick

REGISTERED PROFESSIONAL ENGINEER
CURTIS EDWARD HENDRICK
No. GE 002021
GEOTECHNICAL
STATE OF CALIFORNIA

Ed Hendrick, GE 002021, CEG 1052
Senior Geotechnical Engineer / Engineering Geologist



+/- 2 miles

NOTES:

Base map from Google Maps © 2015 Google. Location of site is approximate.

3628 Madison Avenue, Suite 22
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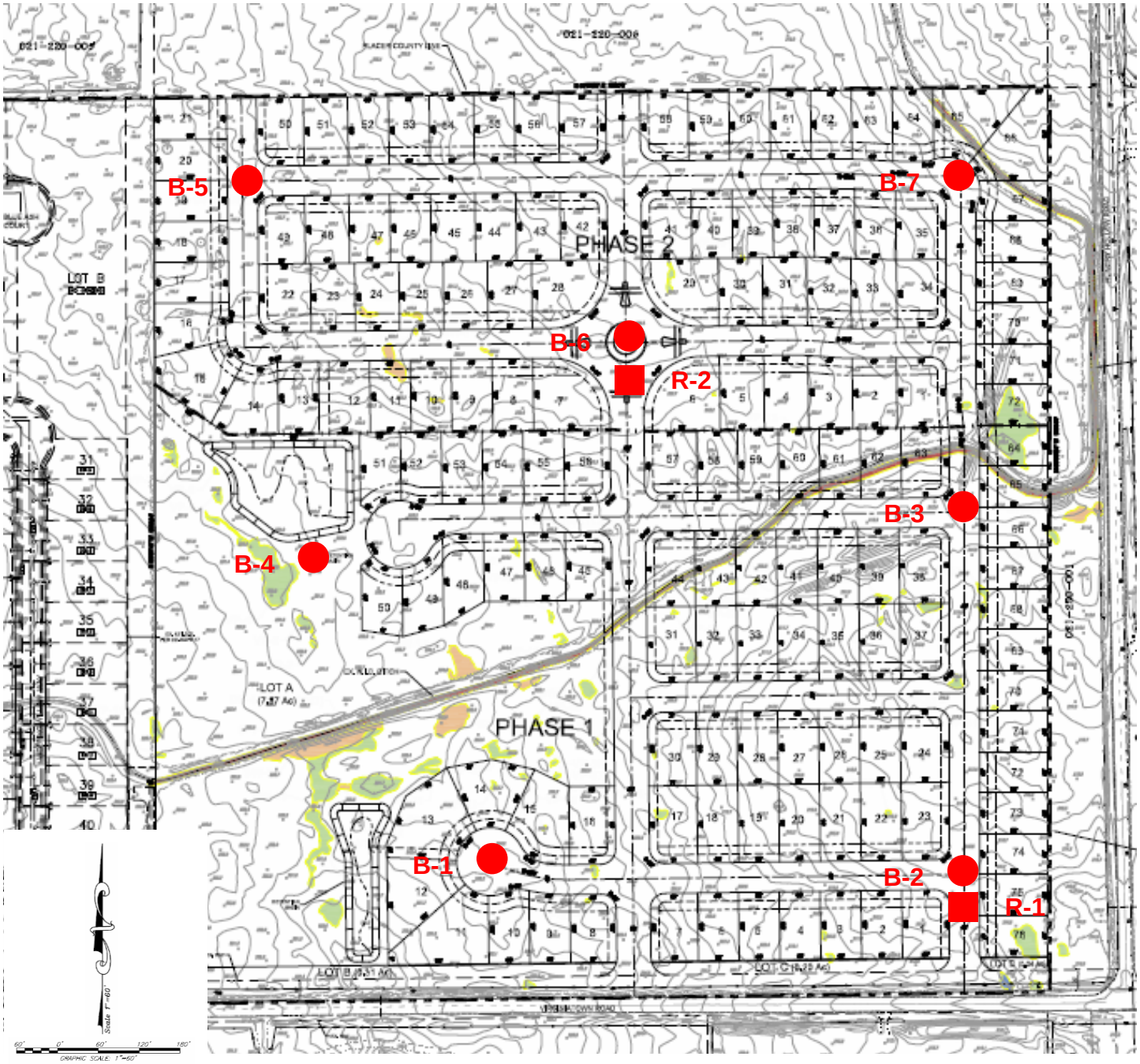
SITE INDEX MAP
Lincoln Meadows Subdivision
NWC Virginia Town And Hungry Hollows Roads
Lincoln, CA

CTE JOB NO.	
90-1100G	
SCALE	
As Shown Above	
DATE	FIGURE
02/25/15	1



NOTES:

Locations of test borings (shown as red dots with adjacent boring number) and of R-Value samples (shown as red squares with adjacent R-Value number) are approximate only. Base map from "Vesting Tentative Subdivision Map Lincoln Meadows, September 24, 2014" by Baker-Williams Group Sheet 1 of 2.

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EXPLORATION MAP
Lincoln Meadows Subdivision
NWC Virginia Town And Hungry Hollows Roads
Lincoln, CA

CTE JOB NO.	
90-1100G	
SCALE	
As Shown Above (reduced from original)	
DATE	FIGURE
02/25/15	2

APPENDIX A

REFERENCES CITED

APPENDIX A

REFERENCES CITED

1. American Society for Civil Engineers, 2013, “Minimum Design Loads for Buildings and Other Structures,” ASCE/SEI 7-10.

2. ASTM, “Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort,” Volume 04.08

3. California Building Code, 2013, “California Code of Regulations, Title 24, Part 2, Volume 2 of 2,” California Building Standards Commission, published by ICBO.

4. California Geological Survey (CGS), “Geologic Map of the Sacramento Quadrangle” (Regional Geologic Map No. 1A; 1:250,000; 1981), compiled by Wagner, D.L, Jennings, C.W., Bedrossian, T.L., and Bortugno, E.J.

5. CGS website (http://gmw.consrv.ca.gov/shmp/html/pdf_maps_no.html) for Regulatory Maps, Reports and GIS data that includes Earthquake Fault Zones, Landslide and Liquefaction Zones.

6. Hart, Earl W., Revised 1994, "Fault-Rupture Hazard Zones in California, Alquist Priolo, Special Studies Zones Act of 1972,” California Division of Mines and Geology, Special Publication 42.

7. Jennings, Charles W. and Bryant, William A., 2010, “Fault Activity Map of California” (scale 1: 750,000) published by CGS, Geologic Data Map No. 6.

8. United Stated Geological Survey (USGS) Earthquake Design Maps (http://ehp1-earthquake.cr.usgs.gov/designmaps/us/ - which utilizes USGS hazard data available in 2008), reference 2012 International Building Code/2013 California Building Code.

9. "VESTING TENTATIVE SUBDIVISION MAP, LINCOLN MEADOWS" (sheet 1 of 2, dated September 24, 2014) by Baker-Williams Engineering Group of Carmichael, California.

10. Google earth aerial photography of the subject site.

APPENDIX B

EXPLORATION LOGS

CTE CAL
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DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	**GRAVELS** MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS < 5% FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS OR GRAVEL SAND MIXTURES, LITTLE OF NO FINES
		GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS < 5% FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	**SILTS AND CLAYS** LIQUID LIMIT IS LESS THAN 50		ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, SLIGHTLY PLASTIC CLAYEY SILTS
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, SILTS OR LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTY CLAYS
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

GRAIN SIZES

BOULDERS	COBBLES	GRAVEL		SAND			SILTS AND CLAYS
		COARSE	FINE	COARSE	MEDIUM	FINE	

12" 3" 3/4" 4 10 40 200

CLEAR SQUARE SIEVE OPENING U.S. STANDARD SIEVE SIZE

ADDITIONAL TESTS

(OTHER THAN TEST PIT AND BORING LOG COLUMN HEADINGS)

MAX- Maximum Dry Density
GS- Grain Size Distribution
SE- Sand Equivalent
EI- Expansion Index
CHM- Sulfate and Chloride Content , pH, Resistivity
COR - Corrosivity
SD- Sample Disturbed

PM- Permeability
SG- Specific Gravity
HA- Hydrometer Analysis
AL- Atterberg Limits
RV- R-Value
CN- Consolidation
CP- Collapse Potential
HC- Hydrocollapse
REM- Remolded

PP- Pocket Penetrometer
WA- Wash Analysis
DS- Direct Shear
UC- Unconfined Compression
MD- Moisture/Density
M- Moisture
SC- Swell Compression
OI- Organic Impurities

FIGURE: BL1

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KEY TO SYMBOLS

PROJECT NAME Proposed VFAQ-94 Hangar Addition

DATE OF EXPLORATION 11/25/2014

PROJECT LOCATION Lemoore NAS, Lemoore, California

PROJECT NUMBER 25-0340G

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

	FILL
SW	WELL GRADED SAND
SP	POORLY GRADED SAND
SM	SILTY SAND
SC	CLAYEY SAND
PT	PEAT
OL	LOW PLASTICITY ORGANIC SILT
OH	HIGH PLASTICITY ORGANIC SILT
ML	LOW PLASTICITY SILT
MH	HIGH PLASTICITY SILT
GW	WELL GRADED GRAVEL
GP	POORLY GRADED GRAVEL
GM	SILTY GRAVEL
GC	CLAYEY GRAVEL
CL	LOW PLASTICITY CLAY
CH	HIGH PLASTICITY CLAY

SAMPLER SYMBOLS

- STANDARD PENETRATION TEST
- CALIFORNIA SAMPLER
- MODIFIED CALIFORNIA SAMPLER
- SHELBY TUBE SAMPLER
- ROCK CORE BARREL
- BULK SAMPLE

- Water Level at Time of Drilling
- Water Level at End of Drilling
- Water Level After 24 Hours
- Assumed stratum line
- Observed stratum line

Note 1: The degree of saturation shown on the boring logs is based on an assumed specific gravity of 2.65. The actual degree of saturation may vary.

Note 2: The stratum lines shown on the logs represent the approximate boundary between soil types; the actual in-situ transition may be gradual.

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
S - DEGREE OF SATURATION (%)
NP - NON PLASTIC
-200 PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
ORG - ORGANICS CONTENT (%)

KEY TO SYMBOLS 2 - TECHNICON.GDT - 5/17/13 15:11 - U:\TESDATA\PROJECTS\22000S\22600-22699\22688-WP5 HANGER 3 BUILDING ADDITION\22688_4_19_2013.GPJ

CTE CAL,INC.
PO BOX 3816 | MERCED, CA 95344 | 209.388.9933 | FAX 209.388.9939

PROJECT:	DRILLER:	SHEET: of
CTE JOB NO:	DRILL METHOD:	DRILLING DATE:
LOGGED BY:	SAMPLE METHOD:	ELEVATION:

BORING LEGEND

Depth (Feet)	Bulk Sample	Driven Type	Blows/Foot	Dry Density (pcf)	Moisture (%)	U.S.C.S. Symbol	Graphic Log	DESCRIPTION	Laboratory Tests
0									
								Block or Chunk Sample	
								Bulk Sample	
5									
								Standard Penetration Test	
10									
								Modified Split-Barrel Drive Sampler (Cal Sampler)	
								Thin Walled Army Corp. of Engineers Sample	
15									
								Groundwater Table	
								Soil Type or Classification Change	
20								? — ? — ? — ? — ? — ? — ? —	
								Formation Change [(Approximate boundaries queried (?)]	
						"SM"		Quotes are placed around classifications where the soils exist in situ as bedrock	
25									

FIGURE: BL2

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EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-1
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/26/15
Date Completed 1/26/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Medium Dense, Wet to Moist, Red Brown, Gravelly Clayey SAND (SC)	1		1	ST		70	GWT not encountered	20				22	14	E.I. = 4
Dense, Moist, Gray with Red Brown Discoloration, Clayey SAND / Sandy CLAY (SC/CL)	2	5	2	SS		80		39			19			
Very Dense, Moist, Gray Brown, Clayey SAND with trace Gravel (SC)	3	10	3	SS		70		83	110		9			
Boring completed at depth of approximately 11.5' below EGS. No free groundwater encountered. Layer lines are approximate and in-situ the transition may be gradual. Boring backfilled 1/26/15.		15 20												

Sample Type:
SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:
At Drilling
After Drilling

Boring Method:
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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Fax: (916) 331-6037

EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-2
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/26/15
Date Completed 1/29/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Very Dense, Damp, Red Brown, Gravelly Silty Clayey SAND (SM)	1		1	BG			GWT not encountered			32		21	14	R Value = 32; E.I. = 4
			2	ST		80		50/4"	123		9			
Very Dense, Damp, Red Brown, Silty Sandy Gravel (GC)	2	5	3	SS		70		88	109		9			
Very Dense, Dry, Light Brown, Gravelly Silty SAND with some Clay (SM)	3	10	4	SS		70		94			12			
Very Dense, Damp, Brown, Fine Gravelly Silty Coarse SAND with some Clay (SM)	4	15	5	SS		70		93			13			
		20	6	SS		7		98						

Boring completed at depth of approximately 21.5' below EGS. No free groundwater encountered. Layer lines are approximate and in-situ the transition may be gradual. Boring backfilled.

Sample Type:

SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:

At Drilling
After Drilling

Boring Method:

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-3
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/29/15
Date Completed 1/29/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Very Dense, Moist, Dark Brown, Gravelly Clayey Silty SAND (SM)	1		1	ST		80	GWT not encountered	94	112		10			
Dense to Very Dense, Damp, Brown, Gravelly Silty SAND (SM)	2	5	2	SS		70		49			22			
		10	3	SS		70		58			17			
Boring completed at depth of approximately 11.5' below EGS. No free groundwater encountered. Layer lines are approximate and in-situ the transition may be gradual. Boring backfilled 1/26/15.		15												
		20												

Sample Type:
SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:
At Drilling
After Drilling

Boring Method:
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-4
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/29/15
Date Completed 1/29/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Very Dense, Moist, Dark Brown, Gravelly Clayey SAND (SC)	1		1	ST		80	GWT not encountered	95+	118	30	13			
Very Dense to Dense, Damp, Light Brown with Gray, Clayey SAND with some Gravel (SC)	2	5	2	SS		70		58			10			
		10	3	SS		70		47						
Boring completed at depth of approximately 11.5' below EGS. No free groundwater encountered. Layer lines are approximate and in-situ the transition may be gradual. Boring backfilled 1/26/15.		15												
		20												

Sample Type:
SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:
At Drilling
After Drilling

Boring Method:
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-5
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/29/15
Date Completed 1/29/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Very Dense, Moist, Dark Brown, Clayey SAND (SC)	1		1	ST		70	GWT not encountered	100+		14	14			
Very Stiff, Moist, Red Brown, Silty Sandy CLAY with some Fine Gravel (CL)	2	5	2	SS		80		21			16			
Very Dense, Wet, Dark Brown, Silty Sandy GRAVEL (GW)	3	10	3	SS		70		49						
Medium Dense, Moist, Light Brown with Gray Silty, Clayey, Fine Coarse SAND (SC)	4	15	4	SS		70		26						
		20	5	SS		70		30			22			

Boring completed at depth of approximately 21.5' below EGS. Groundwater initially observed at about 9' below EGS. Layer lines are approximate and in-situ the transition may be gradual.

Sample Type:
SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:
At Drilling
After Drilling

Boring Method:
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-6
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/29/15
Date Completed 1/29/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Very Dense, Moist, Red Brown, Clayey SAND with some Fine to Coarse Gravel (SC)	1		1	BG			GW/T not encountered			40		28	15	R Value = 22; E.I. = 8
			2	ST		70		50/5"	90		21			
Very Dense, Damp, Red Brown with Gray, Sandy GRAVEL (GW)	2	5	3	SS		80		64			20			
Medium Dense, Damp, Red Brown with Gray, Gravelly SAND (SW)	3	10	4	SS		70		19			23			
Boring completed at depth of approximately 11.5' below EGS. Groundwater not observed. Layer lines are approximate and in-situ the transition may be gradual. Boring backfilled 1/26/15.		15 20												

Sample Type:
SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:
At Drilling
After Drilling

Boring Method:
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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EXPLORATION LOG

CLIENT McKim Homes
PROJECT NAME Lincoln Meadows Subdivision
PROJECT LOCATION Hungry Hollow & Virginia Town RD
Lincoln, CA

BORING # B-7
JOB NO. 90-1100
DRAWN BY RM
APPROVED BY EH

DRILLING and SAMPLING INFO

Date Started 1/29/15
Date Completed 1/29/15
Driller All Well Abandonment
Field Geologist R. Moore
Boring Method 6" HSA

Hammer Wt. 140 lb
Hammer Drop 30" (auto hammer)
Spoon Sampler OD 2.0", 3.0"

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION: EGS	Stratum	Depth Scale	Sample No.	Sample Type	Sample Graphics	Recovery (%)	Groundwater	Penetration Test (blows per foot)	Dry Density (pcf)	Pass No. 200 Sieve (%)	Moisture Content %	Liquid Limit (LL)	Plastic Limit (PL)	Remarks
Dense, Moist, Red Brown, Clayey SAND with some Fine to Coarse Gravel (SC)	1		1	ST		70	GWT not encountered	40	110		14			
Dense to Very Dense, Damp, Red Brown, Clayey SAND with some Fine to Coarse Gravel (SC)	2	5	2	SS		70		41			11			
		10	3	SS		80		50/6"						
		15	4	SS		70		82+			15			
Boring completed at depth of approximately 11.5' below EGS. Groundwater not observed. Layer lines are approximate and in-situ the transition may be gradual. Boring backfilled 1/26/15.		20												

Sample Type:
SS - Standard Split Spoon
ST - Mod. Calif. SS (2.5" OD)
BG - Bag Sample
RC - Rock Core
CU - Cuttings
CT - 3" OD SS Tube Sampler

Depth of Ground Water:
At Drilling
After Drilling

Boring Method:
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

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APPENDIX C

LABORATORY METHODS AND RESULTS

APPENDIX C

LABORATORY METHODS AND RESULTS

Laboratory tests were performed on representative soil samples to detect their relative engineering properties. Tests were performed following test methods of the American Society for Testing Materials or other accepted standards. The following presents a brief description of the various test methods used. Laboratory results are presented in the following section of this Appendix and/or on the test boring logs.

Classification

Soils were classified visually according to the Unified Soil Classification System. Visual classifications were supplemented by laboratory testing of selected samples according to ASTM D2487.

Natural Moisture Content / Dry Density

The procedure of ASTM D 2216 was used to measure the moisture content and the dry density was also determined of representative samples.

Particle-Size Analysis

Particle-size analyses were performed on selected representative samples according to ASTM D422.

Atterberg Limits

The procedure of ASTM D4318-84 was used to measure the liquid limit, plastic limit and plasticity index of representative samples.

Expansion Index

Expansion testing was performed on selected samples of the matrix of the onsite soils according to Building Code Standard No. 29-2.

Resistance (“R”) value

A R-value test was performed on a bulk sample of anticipated pavement subgrade soil per CalTrans Test Method CTM301.

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EXPANSION INDEX TEST

ASTM D-4829 -95

Project Name: **Lincoln Meadows**
Project Number: **90-1100G**
Sample Date: **1/29/2015**
Lab Number: **3901**
Sample ID: **B-1 at 1-2'**

		Initial	Saturated
WET WEIGHT	(g)	329.4	458.6
DRY WEIGHT	(g)	305.7	408.6
% MOISTURE	(%)	7.8%	12.2%
WEIGHT OF RING & SOIL	(g)	**642.3**	**660.6**
WEIGHT OF RING	(g)	202.0	202.0
WEIGHT OF SOIL	(g)	440.3	458.6
WEIGHT OF SOIL	(lbs.)	0.9707	1.0110
VOLUME OF SOIL	(cf)	0.00731	0.00732
WET DENSITY	(pcf)	132.8	138.2
DRY DENSITY	(pcf)	123.2	123.1
% SATURATION	(%)	**57.4%**	**89.7%**

EXPANSION READING

		INCH		
DATE	TIME: INITIAL READING	0.317	**VERY LOW**	**0-20**
			LOW	**21-50**
			MEDIUM	**51 -90**
	FINAL READING	0.318	**HIGH**	**91-130**
	EXPANSION INDEX =	1	**VERY HIGH**	**130>**
	EXPANSION INDEX50 =	**4**		

NOTES:
1.- 2.7 SP. GR. = 1/2.7= 0.3704
2.- % SATURATION MUST BE BETWEEN 45% AND 55%

EI at saturation between 40-60%

Measured EI: 1
Measured Saturation: 57.4

EI at 50% Saturation: **4**

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EXPANSION INDEX TEST

ASTM D-4829 -95

Project Name: **Lincoln Meadows**
Project Number: **90-1100G**
Sample Date: **1/29/2015**
Lab Number: **3901**
Sample ID: **R1 @ 1'-2'**

		Initial	Saturated
WET WEIGHT	(g)	314.9	449.3
DRY WEIGHT	(g)	291.0	402.4
% MOISTURE	(%)	8.2%	11.7%
WEIGHT OF RING & SOIL	(g)	**637.5**	**651.3**
WEIGHT OF RING	(g)	202.0	202.0
WEIGHT OF SOIL	(g)	435.5	449.3
WEIGHT OF SOIL	(lbs.)	0.9601	0.9905
VOLUME OF SOIL	(cf)	0.00731	0.00732
WET DENSITY	(pcf)	131.3	135.4
DRY DENSITY	(pcf)	121.4	121.3
% SATURATION	(%)	**57.5%**	**80.8%**

EXPANSION READING

		INCH		
DATE	TIME: INITIAL READING	0.297	**VERY LOW**	**0-20**
			LOW	**21-50**
			MEDIUM	**51 -90**
	FINAL READING	0.298	**HIGH**	**91-130**
	EXPANSION INDEX =	1	**VERY HIGH**	**130>**

EXPANSION INDEX50 = **4**

NOTES:
1.- 2.7 SP. GR. = 1/2.7= 0.3704
2.- % SATURATION MUST BE BETWEEN 45% AND 55%

EI at saturation between 40-60%

Measured EI: 1
Measured Saturation: 57.5

EI at 50% Saturation: **4**

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EXPANSION INDEX TEST

ASTM D-4829 -95

Project Name: **Lincoln Meadows**
Project Number: **90-1100G**
Sample Date: **1/29/2015**
Lab Number: **3901**
Sample ID: **R-2 @ 1'-2'**

		Initial	Saturated
WET WEIGHT	(g)	308.7	448.3
DRY WEIGHT	(g)	289.2	398.1
% MOISTURE	(%)	6.7%	12.6%
WEIGHT OF RING & SOIL	(g)	**626.9**	**650.3**
WEIGHT OF RING	(g)	202.0	202.0
WEIGHT OF SOIL	(g)	424.9	448.3
WEIGHT OF SOIL	(lbs.)	0.9367	0.9883
VOLUME OF SOIL	(cf)	0.00731	0.00738
WET DENSITY	(pcf)	128.1	133.9
DRY DENSITY	(pcf)	120.0	118.9
% SATURATION	(%)	**45.4%**	**81.7%**

EXPANSION READING

		INCH		
DATE	TIME: INITIAL READING	0.298	**VERY LOW**	**0-20**
			LOW	**21-50**
			MEDIUM	**51 -90**
	FINAL READING	0.308	**HIGH**	**91-130**
	EXPANSION INDEX =	10	**VERY HIGH**	**130>**

EXPANSION INDEX50 = **8**

NOTES:
1.- 2.7 SP. GR. = 1/2.7= 0.3704
2.- % SATURATION MUST BE BETWEEN 45% AND 55%

EI at saturation between 40-60%

Measured EI: 10
Measured Saturation: 45.4

EI at 50% Saturation: **8**

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Report of Soil Testing

To:
Project Name: Lincoln Meadows
Gov. Contract #
Project Number: 90-1100G

Sample Data:
Date Sampled: January 29, 2015

Lab #: 3901

SampleID:	B-2 at 1-3'	B-4 at 2'	B-5 at 2'	B-6 at 1-3'	
Wet Wt:	190.2	200.7	181.0	215.8	
Dry Wt (before wash):	173.3	179.1	159.1	191.9	
Dry Wt (after wash):	117.9	124.8	137.6	114.9	
In-Place Moisture %:	9.8	12.1	13.8	12.5	
	% Passing	% Passing	% Passing	% Passing	
1 1/2inch					
1inch					
3/4inch					
1/2inch					
3/8inch					
#4					
#8					
#16					
#30					
#50					
#100					
#200	**32**	**30**	**14**	**40**	

All Sampling and Testing Done In Accordance With ASTM C117, C136, D1557, D4318, and D2487.

Reviewed By: Kevin Magnusson Date: February 17, 2015

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MOISTURE & DENSITY TEST

Client:

Sample Date: 1/29/2015

Project Name: Lincoln Meadows

Lab Number: 3901

Project Number: 90-1100G

Sample No.	B-1	B-1	B-2	B-2	B-2
DEPTH FT	5'	10'	2'	5'	10'
SAMPLE HT		5.99	0.99	6.00	
TUBE DIA.		1.42	2.40	1.42	
SOIL+RING		418.0	202.1	416.9	
RING		119.2	45.6	121.0	
SOIL WET		298.8	156.5	295.9	
SOIL LB		0.65873	0.34502	0.65234	
VOL SOIL		0.00549	0.00259	0.00550	
WET DENS		120.0	133.1	118.6	
SOIL WET	88.0	298.5	298.5	295.9	94.8
SOIL DRY	74.2	274.6	274.6	272.0	84.4
% MOIST	18.6%	8.7%	8.7%	8.8%	12.3%
DRY DENS		110.4	122.5	109.0	

Reviewed By: Ken Magnuson
Laboratory Manager

Date: February 17, 2015

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MOISTURE & DENSITY TEST

Client:

Sample Date: 1/29/2015

Project Name: Lincoln Meadows

Lab Number: 3901

Project Number: 90-1100G

Sample No.	B-2	B-3	B-3	B-3	B-4
DEPTH FT	15'	2'	5'	10'	2'
SAMPLE HT		1.00			1.00
TUBE DIA.		2.41			2.41
SOIL+RING		192.9			202.2
RING		44.9			42.5
SOIL WET		148.0			159.7
SOIL LB		0.32628			0.35207
VOL SOIL		0.00264			0.00264
WET DENS		123.6			133.4
SOIL WET	75.2	148.0	111.5	105.5	159.6
SOIL DRY	66.3	134.0	91.3	90.2	141.5
% MOIST	13.4%	10.4%	22.1%	17.0%	12.8%
DRY DENS		111.9			118.2

Reviewed By: Ken Magnuson
Laboratory Manager

Date: February 17, 2015

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MOISTURE & DENSITY TEST

Client:

Sample Date: 1/29/2015

Project Name: Lincoln Meadows

Lab Number: 3901

Project Number: 90-1100G

Sample No.	B-4	B-5	B-5	B-5	B-5
DEPTH FT	5'	2'	5'	10'	20'
SAMPLE HT		1.00			
TUBE DIA.		2.42			
SOIL+RING					
RING					
SOIL WET					
SOIL LB					
VOL SOIL		0.00266			
WET DENS					
SOIL WET	110.6	159.0	163.2	135.9	246.2
SOIL DRY	100.9	139.4	140.2	122.9	202.1
% MOIST	9.6%	14.1%	16.4%	10.6%	21.8%
DRY DENS					

Reviewed By: Ken Magnuson
Laboratory Manager

Date: February 17, 2015

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MOISTURE & DENSITY TEST

Client:

Sample Date: 1/29/2015

Project Name: Lincoln Meadows

Lab Number: 3901

Project Number: 90-1100G

Sample No.	B-6	B-6	B-6	B-7	B-7
DEPTH FT	2'	5'	10'	2'	5'
SAMPLE HT	1.00			1.00	
TUBE DIA.	2.41			2.40	
SOIL+RING	173.3			194.4	
RING	42.2			45.7	
SOIL WET	131.1			148.7	
SOIL LB	0.28902			0.32782	
VOL SOIL	0.00264			0.00262	
WET DENS	109.5			125.2	
SOIL WET	131.0	48.3	167.8	148.6	51.1
SOIL DRY	107.9	40.4	136.0	130.6	45.9
% MOIST	21.4%	19.6%	23.4%	13.8%	11.3%
DRY DENS	90.2			110.1	

Reviewed By: Ken Magnuson
Laboratory Manager

Date: February 17, 2015

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MOISTURE & DENSITY TEST

Client:

Sample Date: 1/29/2015

Project Name: Lincoln Meadows

Lab Number: 3901

Project Number: 90-1100G

Sample No.	B-7				
DEPTH FT	15'				
SAMPLE HT					
TUBE DIA.					
SOIL+RING					
RING					
SOIL WET					
SOIL LB					
VOL SOIL					
WET DENS					
SOIL WET	97.2				
SOIL DRY	84.8				
% MOIST	14.6%				
DRY DENS					

Reviewed By: Ken Magnuson
Laboratory Manager

Date: February 17, 2015

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CONSTRUCTION INSPECTION AND TESTING | GEOTECHNICAL | ENVIRONMENTAL | CIVIL ENGINEERING

REPORT OF RESISTANCE 'R' VALUE-EXPANSION PRESSURE

Job Name: Lincoln Meadows
Job No. 90-1100G
Lab No. 3901
Sample No. B2 at 1-3'

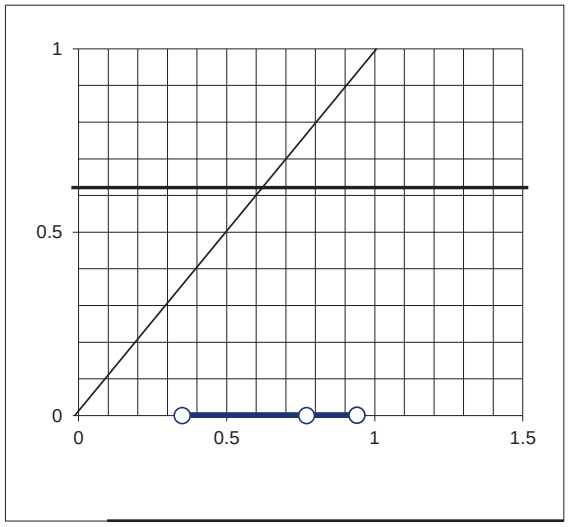
Date: 2/16/2015
Submitted By: KEM
Tested/ Calc.By: KEM
Type of Material:

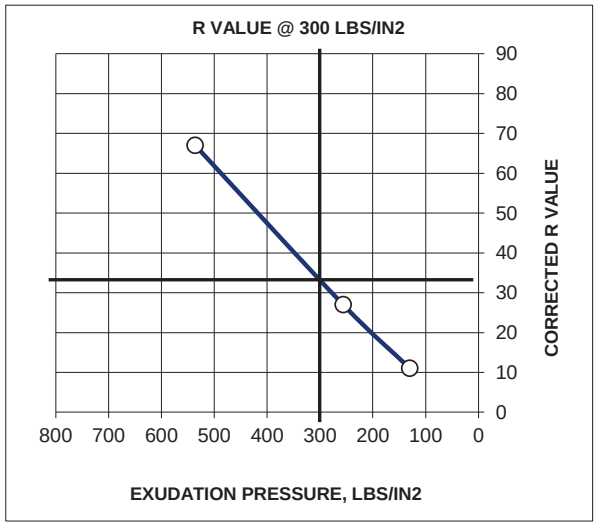
Test Procedure: ASTM D2844

Specimen/ Mold No.	1	2	3
Compactor Air Pressure, - ft.lbs.	120	250	350
Initial Moisture, - %	9.7%	9.7%	9.7%
Sample Size - g	1200	1200	1200
Water Added, - ml	10	0	-15
Moisture at Compaction, - %	0.9%	0.1%	-1.2%
Wt. Of Briquette and Mold, - g	3286	3351	3306
Wt. Of Mold, - g	2086	2086	2092
Wt. Of Briquitte, - g	1200	1265	1214
Height of Briquette, - in	2.37	2.67	2.51
Dry Density, - pcf	152.0	143.4	148.2
Stabilometer PH @ 2000 lbs	135	105	45
Displacement	4.07	3.82	3.12
R' Value	10	25	67
Corrected 'R' Value	11	27	67
Exudation Pressure, - lbs	1620	3200	6700
Exudation Pressure, - psi	130	256	536
Stabilometer Thickness - ft	0.94	0.77	0.35
Expansion - in.	0	0	0
Expansion Pressure - Pascals	0	0	0
Expansion Press, Thick-ft	0	0	0

TI	5
Expansion	100

R-value **32**





Cover Thickness by Expansion Pressure-Feet

Expansion From Graph:	

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REPORT OF RESISTANCE 'R' VALUE-EXPANSION PRESSURE

Job Name: Lincoln Meadows
Job No. 90-1100G
Lab No. 3901
Sample No. B6 at 1-3'

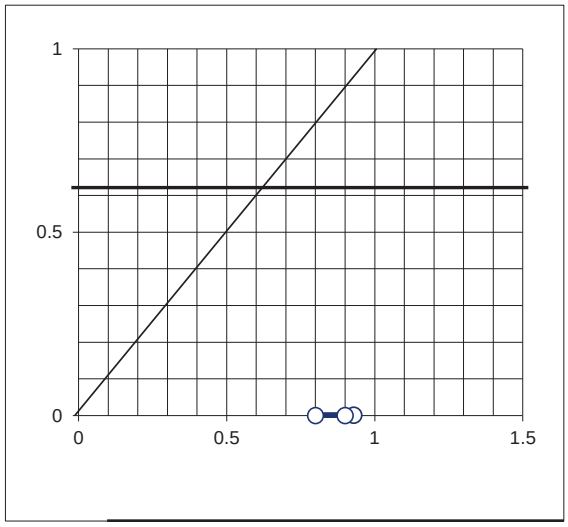
Date: 2/16/2015
Submitted By: KEM
Tested/ Calc.By: KEM
Type of Material:

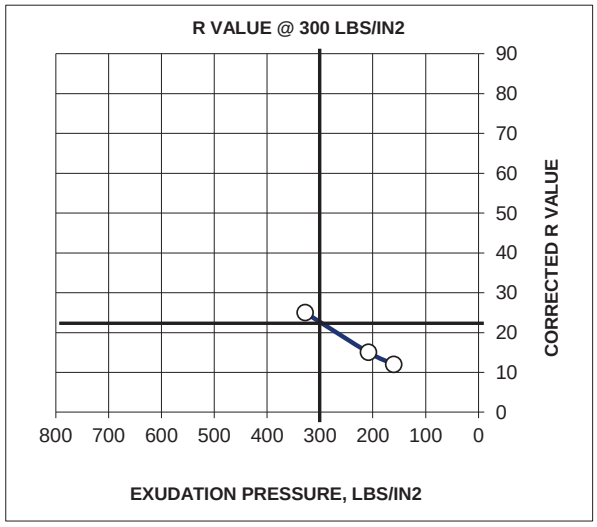
Test Procedure: ASTM D2844

Specimen/ Mold No.	1	2	3
Compactor Air Pressure, - ft.lbs.	60	90	200
Initial Moisture, - %	12.4%	12.4%	12.4%
Sample Size - g	1200	1200	1200
Water Added, - ml	15	0	-15
Moisture at Compaction, - %	13.7%	12.4%	11.2%
Wt. Of Briquette and Mold, - g	3226	3273	3347
Wt. Of Mold, - g	2087	2096	2086
Wt. Of Briquitte, - g	1139	1177	1261
Height of Briquette, - in	2.38	2.47	2.66
Dry Density, - pcf	127.5	128.4	129.1
Stabilometer PH @ 2000 lbs	134	128	107
Displacement	3.58	3.45	3.22
R' Value	11	15	27
Corrected 'R' Value	12	15	25
Exudation Pressure, - lbs	2000	2600	4100
Exudation Pressure, - psi	160	208	328
Stabilometer Thickness - ft	0.93	0.9	0.8
Expansion - in.	0	0	0
Expansion Pressure - Pascals	0	0	0
Expansion Press, Thick-ft	0	0	0

TI	5
Expansion	100

R-value 22





Cover Thickness by Expansion Pressure-Feet

Expansion From Graph:	

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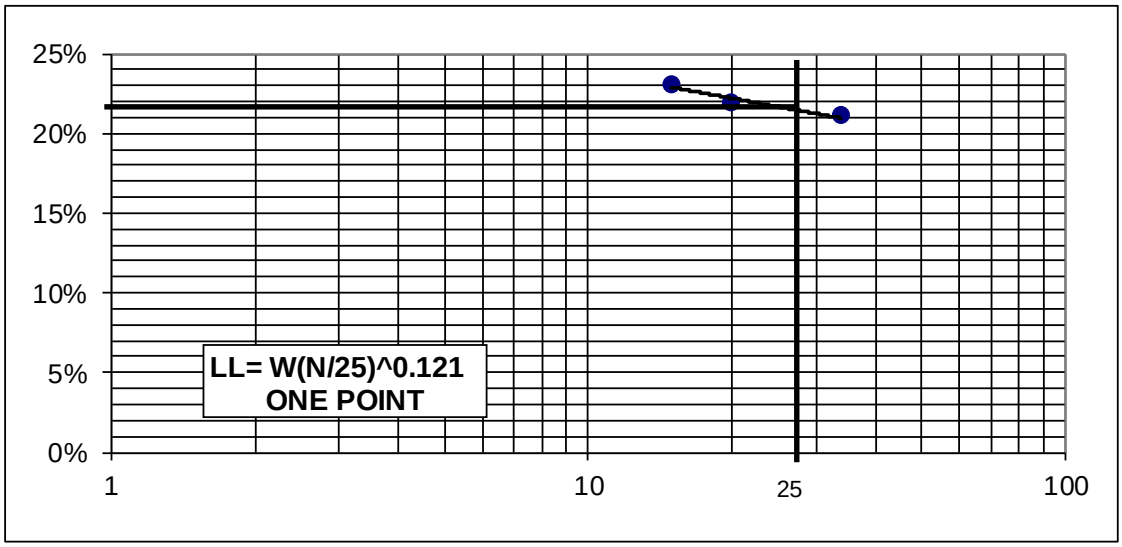
Job Name: Lincoln Meadows **Date:** 02/18/15

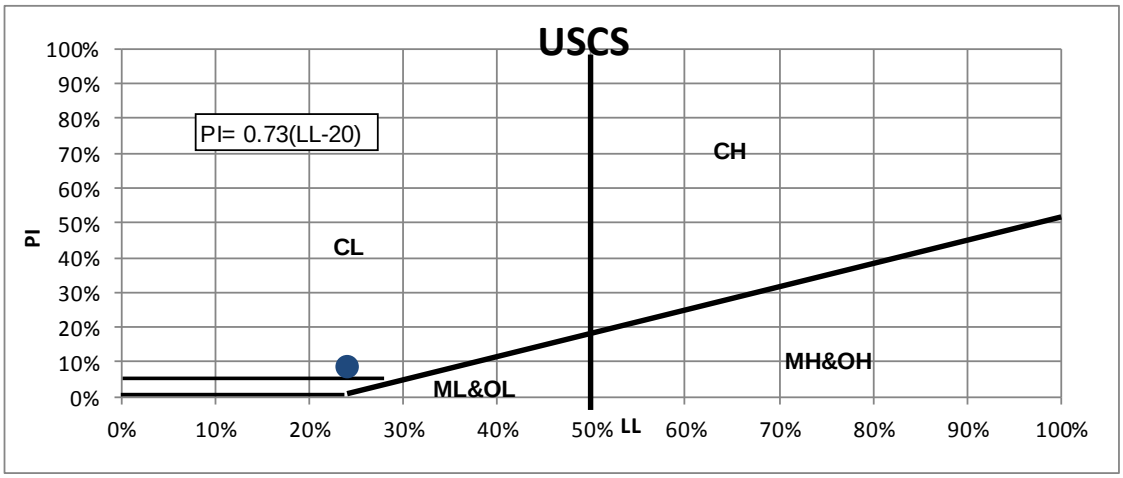
Job Number: 90-1100G

Sample Nr. : B-1 at 1-2'

ATTERBERG

	LIQUID LIMITS					PLASTIC LIMIT	
WET SOIL	9.03	8.67	4.11			7.66	6.80
DRY SOIL	7.46	7.11	3.34			6.72	5.98
WATER	1.57	1.56	0.77	0.00		0.94	0.82
# BLOWS	**34**	**20**	**15**				
% MOIST	**21.05%**	**21.94%**	**23.05%**			**13.99%**	**13.71%**
					LL	**PL**	**PI**
ONE POINT	**21.8%**	**21.4%**	**21.7%**		**22**	**14**	**8**





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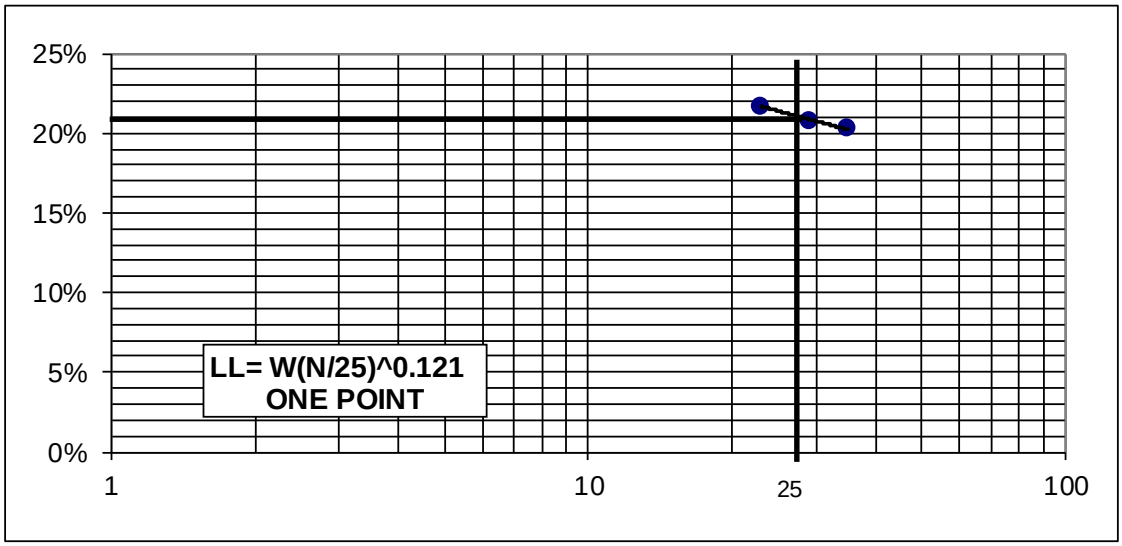
Job Name: Lincoln Meadows **Date:** 2-126-15

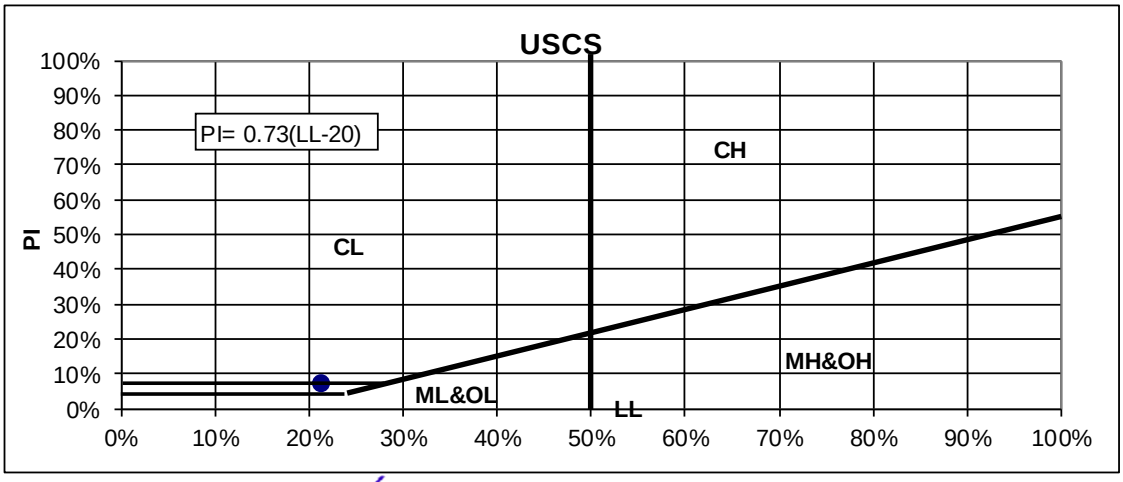
Job Number: 90-1100G

Sample Nr: R-1 @ 1'-2'

ATTERBERG

	LIQUID LIMITS					PLASTIC LIMIT	
WET SOIL	8.84	8.48	7.79			10.78	7.81
DRY SOIL	7.35	7.02	6.40			9.45	6.82
WATER	1.49	1.46	1.39	0.00		1.33	0.99
# BLOWS	**35**	**29**	**23**				
% MOIST	**20.27%**	**20.80%**	**21.72%**			**14.07%**	**14.52%**
					LL	**PL**	**PI**
ONE POINT	**21.1%**	**21.2%**	**21.5%**		**21%**	**14%**	**7%**





REVIEWED BY: Ken Magnuson **DATE:** 2/26/2015

Ken Magnuson, Lab Manager

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CIVIL ENGINEERING | GEOTECHNICAL | ENVIRONMENTAL | CONSTRUCTION INSPECTION AND TESTING

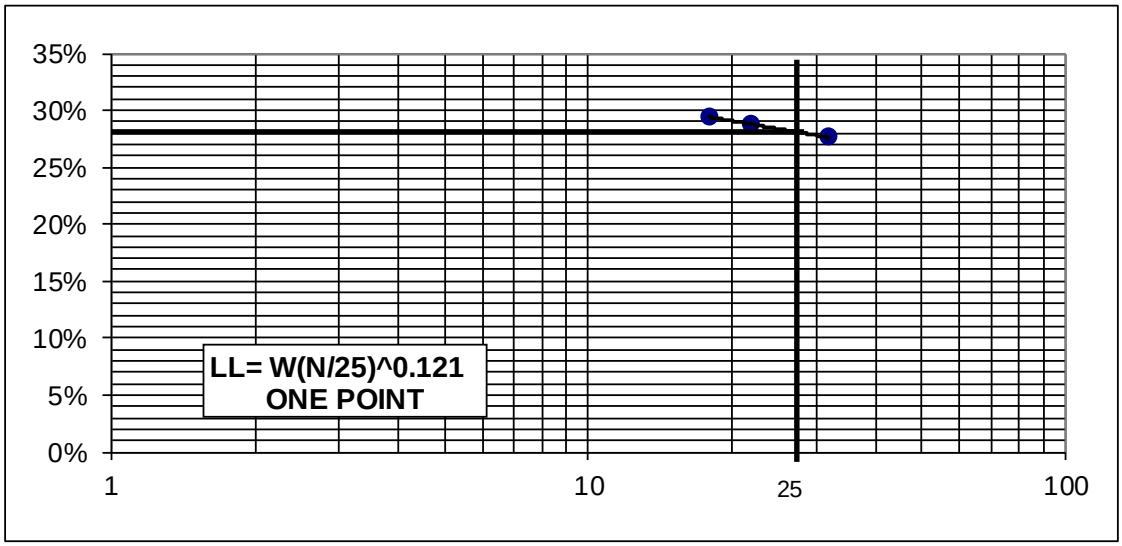
Job Name: Lincoln Meadows **Date:** 01/29/15

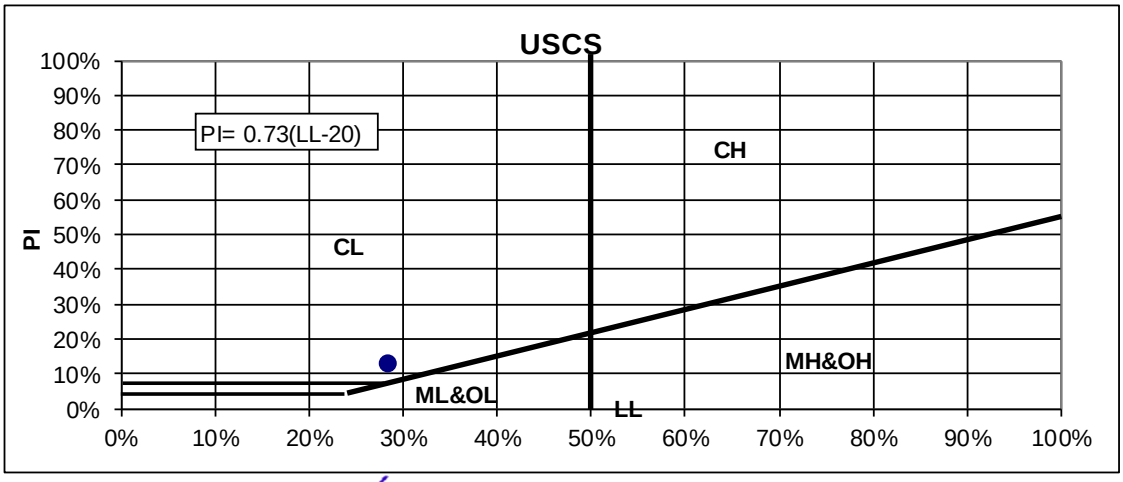
Job Number: 90-1100G

Sample Nr.: R-2 @ 1'-2'

ATTERBERG

	LIQUID LIMITS					PLASTIC LIMIT	
WET SOIL	6.05	9.51	8.57			8.03	6.36
DRY SOIL	4.74	7.39	6.62			6.95	5.52
WATER	1.31	2.12	1.95	0.00		1.08	0.84
# BLOWS	**32**	**22**	**18**				
% MOIST	**27.64%**	**28.69%**	**29.46%**			**15.54%**	**15.22%**
					LL	**PL**	**PI**
ONE POINT	**28.5%**	**28.2%**	**28.3%**		**28%**	**15%**	**13%**





REVIEWED BY: Ken Magnuson **DATE:** 2/26/2015

Ken Magnuson, Lab Manager

APPENDIX D

STANDARD GUIDE SPECIFICATIONS FOR GRADING

Section 1 - General

CTE, Cal, Inc. (CTE) presents the following standard recommendations for grading and other associated operations on construction projects. These guidelines should be considered a portion of the project specifications. Recommendations contained in the body of the previously presented soils report shall supersede the recommendations and or requirements as specified herein. The project geotechnical consultant shall interpret disputes arising out of interpretation of the recommendations contained in the soils report or specifications contained herein.

Section 2 - Responsibilities of Project Personnel

The geotechnical consultant should provide observation and testing services sufficient to general conformance with project specifications and standard grading practices. The geotechnical consultant should report any deviations to the client or his authorized representative.

The Client should be chiefly responsible for all aspects of the project. He or his authorized representative has the responsibility of reviewing the findings and recommendations of the geotechnical consultant. He shall authorize or cause to have authorized the Contractor and/or other consultants to perform work and/or provide services. During grading the Client or his authorized representative should remain on-site or should remain reasonably accessible to all concerned parties in order to make decisions necessary to maintain the flow of the project.

The Contractor is responsible for the safety of the project and satisfactory completion of all grading and other associated operations on construction projects, including, but not limited to, earth work in accordance with the project plans, specifications and controlling agency requirements.

Section 3 - Preconstruction Meeting

A preconstruction site meeting should be arranged by the owner and/or client and should include the grading contractor, design engineer, geotechnical consultant, owner's representative and representatives of the appropriate governing authorities.

Section 4 - Site Preparation

The client or contractor should obtain the required approvals from the controlling authorities for the project prior, during and/or after demolition, site preparation and removals, etc. The appropriate approvals should be obtained prior to proceeding with grading operations.

Clearing and grubbing should consist of the removal of vegetation such as brush, grass, woods, stumps, trees, root of trees and otherwise deleterious natural materials from the areas to be graded. Clearing and grubbing should extend to the outside of all proposed excavation and fill areas.

Demolition should include removal of buildings, structures, foundations, reservoirs, utilities (including underground pipelines, septic tanks, leach fields, seepage pits, cisterns, mining shafts, tunnels, etc.) and other man-made surface and subsurface improvements from the areas to be graded. Demolition of utilities should include proper capping and/or rerouting pipelines at the project perimeter and cutoff and capping of wells in accordance with the requirements of the governing authorities and the recommendations of the geotechnical consultant at the time of demolition.

Trees, plants or man-made improvements not planned to be removed or demolished should be protected by the contractor from damage or injury.

Debris generated during clearing, grubbing and/or demolition operations should be wasted from areas to be graded and disposed off-site. Clearing, grubbing and demolition operations should be performed under the observation of the geotechnical consultant.

Section 5 - Site Protection

Protection of the site during the period of grading should be the responsibility of the contractor. Unless other provisions are made in writing and agreed upon among the concerned parties, completion of a portion of the project should not be considered to preclude that portion or adjacent areas from the requirements for site protection until such time as the entire project is complete as identified by the geotechnical consultant, the client and the regulating agencies.

Precautions should be taken during the performance of site clearing, excavations and grading to protect the work site from flooding, ponding or inundation by poor or improper surface drainage. Temporary provisions should be made during the rainy season to adequately direct surface drainage away from and off the work site. Where low areas cannot be avoided, pumps should be kept on hand to continually remove water during periods of rainfall.

Rain related damage should be considered to include, but may not be limited to, erosion, silting, saturation, swelling, structural distress and other adverse conditions as determined by the geotechnical consultant. Soil adversely affected should be classified as unsuitable materials and should be subject to overexcavation and replacement with compacted fill or other remedial grading as recommended by the geotechnical consultant.

The contractor should be responsible for the stability of all temporary excavations. Recommendations by the geotechnical consultant pertaining to temporary excavations (e.g., backcuts) are made in consideration of stability of the completed project and, therefore, should not be considered to preclude the responsibilities of the contractor. Recommendations by the geotechnical consultant should not be considered to preclude requirements that are more restrictive by the regulating agencies. The contractor should provide during periods of extensive rainfall plastic sheeting to prevent unprotected slopes from becoming saturated and unstable. When deemed appropriate by the geotechnical consultant or governing agencies the contractor shall install checkdams, desilting basins, sand bags or other drainage control measures.

In relatively level areas and/or slope areas, where saturated soil and/or erosion gullies exist to depths of greater than 1.0 foot; they should be overexcavated and replaced as compacted fill in accordance with the applicable specifications. Where affected materials exist to depths of 1.0 foot or less below proposed finished grade, remedial grading by moisture conditioning in-place, followed by thorough recompaction in accordance with the applicable grading guidelines herein may be attempted. If the desired results are not achieved, all affected materials should be overexcavated and replaced as compacted fill in accordance with the slope repair recommendations herein. If field conditions dictate, the geotechnical consultant may recommend other slope repair procedures.

Section 6 - Excavations

6.1 Unsuitable Materials

Materials that are unsuitable should be excavated under observation and recommendations of the geotechnical consultant. Unsuitable materials include, but may not be limited to, dry, loose, soft, wet, organic compressible natural soils and fractured, weathered, soft bedrock and nonengineered or otherwise deleterious fill materials.

Material identified by the geotechnical consultant as unsatisfactory due to its moisture conditions should be overexcavated; moisture conditioned as needed, to a uniform at or above optimum moisture condition before placement as compacted fill.

If during the course of grading adverse geotechnical conditions are exposed which were not anticipated in the preliminary soil report as determined by the geotechnical consultant additional exploration, analysis, and treatment of these problems may be recommended.

6.2 Cut Slopes

Unless otherwise recommended by the geotechnical consultant and approved by the regulating agencies, permanent cut slopes should not be steeper than 2:1 (horizontal: vertical).

The geotechnical consultant should observe cut slope excavation and if these excavations expose loose cohesionless, significantly fractured or otherwise unsuitable material, the materials should be overexcavated and replaced with a compacted stabilization fill. If encountered specific cross section details should be obtained from the Geotechnical Consultant.

When extensive cut slopes are excavated or these cut slopes are made in the direction of the prevailing drainage, a non-erodible diversion swale (brow ditch) should be provided at the top of the slope.

6.3 Pad Areas

All lot pad areas, including side yard terrace containing both cut and fill materials, transitions, located less than 3 feet deep should be overexcavated to a depth of 3 feet and replaced with a uniform compacted fill blanket of 3 feet. Actual depth of overexcavation may vary and should be delineated by the geotechnical consultant during grading, especially where deep or drastic transitions are present.

For pad areas created above cut or natural slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm drainage swale and/or an appropriate pad gradient. A gradient in soil areas away from the top-of-slopes of 2 percent or greater is recommended.

Section 7 - Compacted Fill

All fill materials should have fill quality, placement, conditioning and compaction as specified below or as approved by the geotechnical consultant.

7.1 Fill Material Quality

Excavated on-site or import materials which are acceptable to the geotechnical consultant may be utilized as compacted fill, provided trash, vegetation and other deleterious materials are removed prior to placement. All import materials anticipated for use on-site should be sampled tested and approved prior to and placement is in conformance with the requirements outlined.

Rocks 12 inches in maximum and smaller may be utilized within compacted fill provided sufficient fill material is placed and thoroughly compacted over and around all rock to effectively fill rock voids. The amount of rock should not exceed 40 percent by dry weight passing the 3/4-inch sieve. The geotechnical consultant may vary those requirements as field conditions dictate.

Where rocks greater than 12 inches but less than four feet of maximum dimension are generated during grading, or otherwise desired to be placed within an engineered fill, special handling in accordance with the recommendations below. Rocks greater than four feet should be broken down or disposed off-site.

7.2 Placement of Fill

Prior to placement of fill material, the geotechnical consultant should observe and approve the area to receive fill. After observation and approval, the exposed ground surface should be scarified to a depth of 6 to 8 inches. The scarified material should be conditioned (i.e. moisture added or air dried by continued discing) to achieve a moisture content at or slightly above optimum moisture conditions and compacted to a minimum of 90 percent of the maximum density or as otherwise recommended in the soils report or by appropriate government agencies.

Compacted fill should then be placed in thin horizontal lifts not exceeding eight inches in loose thickness prior to compaction. Each lift should be moisture conditioned as needed, thoroughly blended to achieve a consistent moisture content at or slightly above optimum and thoroughly compacted by mechanical methods to a minimum of 90 percent of laboratory maximum dry density. Each lift should be treated in a like manner until the desired finished grades are achieved.

The contractor should have suitable and sufficient mechanical compaction equipment and watering apparatus on the job site to handle the amount of fill being placed in consideration of moisture retention properties of the materials and weather conditions.

When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal: vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area. Keying and benching should be sufficient to provide at least six-foot wide benches and a minimum of four feet of vertical bench height within the firm natural ground, firm bedrock or engineered compacted fill. No compacted fill should be placed in an area after keying and benching until the geotechnical consultant has reviewed the area. Material generated by the benching operation should be moved sufficiently away from

the bench area to allow for the recommended review of the horizontal bench prior to placement of fill.

Within a single fill area where grading procedures dictate two or more separate fills, temporary slopes (false slopes) may be created. When placing fill adjacent to a false slope, benching should be conducted in the same manner as above described. At least a 3-foot vertical bench should be established within the firm core of adjacent approved compacted fill prior to placement of additional fill. Benching should proceed in at least 3-foot vertical increments until the desired finished grades are achieved.

Prior to placement of additional compacted fill following an overnight or other grading delay, the exposed surface or previously compacted fill should be processed by scarification, moisture conditioning as needed to at or slightly above optimum moisture content, thoroughly blended and recompacted to a minimum of 90 percent of laboratory maximum dry density. Where unsuitable materials exist to depths of greater than one foot, the unsuitable materials should be over-excavated.

Following a period of flooding, rainfall or overwatering by other means, no additional fill should be placed until damage assessments have been made and remedial grading performed as described herein.

Rocks 12 inch in maximum dimension and smaller may be utilized in the compacted fill provided the fill is placed and thoroughly compacted over and around all rock. No oversize material should be used within 3 feet of finished pad grade and within 1 foot of other compacted fill areas. Rocks 12 inches up to four feet maximum dimension should be placed below the upper 10 feet of any fill and should not be closer than 15 feet to any slope face. These recommendations could vary as locations of improvements dictate. Where practical, oversized material should not be placed below areas where structures or deep utilities are proposed. Oversized material should be placed in windrows on a clean, overexcavated or unyielding compacted fill or firm natural ground surface. Select native or imported granular soil (S.E. 30 or higher) should be placed and thoroughly flooded over and around all windrowed rock, such that voids are filled. Windrows of oversized material should be staggered so those successive strata of oversized material are not in the same vertical plane.

It may be possible to dispose of individual larger rock as field conditions dictate and as recommended by the geotechnical consultant at the time of placement.

The contractor should assist the geotechnical consultant and/or his representative by digging test pits for removal determinations and/or for testing compacted fill. The contractor should provide this work at no additional cost to the owner or contractor's client.

Fill should be tested by the geotechnical consultant for compliance with the recommended relative compaction and moisture conditions. Field density testing should conform to ASTM Method of Test D 1556-00, D 2922-04. Tests should be conducted at a minimum of approximately two vertical feet or approximately 1,000 to 2,000 cubic yards of fill placed. Actual test intervals may vary as field conditions dictate. Fill found not to be in conformance with the grading recommendations should be removed or otherwise handled as recommended by the geotechnical consultant.

7.3 Fill Slopes

Unless otherwise recommended by the geotechnical consultant and approved by the regulating agencies, permanent fill slopes should not be steeper than 2:1 (horizontal: vertical).

Except as specifically recommended in these grading guidelines compacted fill slopes should be over-built two to five feet and cut back to grade, exposing the firm, compacted fill inner core. The actual amount of overbuilding may vary as field conditions dictate. If the desired results are not achieved, the existing slopes should be overexcavated and reconstructed under the guidelines of the geotechnical consultant. The degree of overbuilding shall be increased until the desired compacted slope surface condition is achieved. Care should be taken by the contractor to provide thorough mechanical compaction to the outer edge of the overbuilt slope surface.

At the discretion of the geotechnical consultant, slope face compaction may be attempted by conventional construction procedures including backrolling. The procedure must create a firmly compacted material throughout the entire depth of the slope face to the surface of the previously compacted firm fill intercore.

During grading operations, care should be taken to extend compactive effort to the outer edge of the slope. Each lift should extend horizontally to the desired finished slope surface or more as needed to ultimately established desired grades. Grade during construction should not be allowed to roll off at the edge of the slope. It may be helpful to elevate slightly the outer edge of the slope. Slough resulting from the placement of individual lifts should not be allowed to drift down over previous lifts. At intervals not

exceeding four feet in vertical slope height or the capability of available equipment, whichever is less, fill slopes should be thoroughly dozer trackrolled.

For pad areas above fill slopes, positive drainage should be established away from the top-of-slope. This may be accomplished using a berm and pad gradient of at least two percent.

Section 8 - Trench Backfill

Utility and/or other excavation of trench backfill should, unless otherwise recommended, be compacted by mechanical means. Unless otherwise recommended, the degree of compaction should be a minimum of 90 percent of the laboratory maximum density.

Within slab areas, but outside the influence of foundations, trenches up to one foot wide and two feet deep may be backfilled with sand and consolidated by jetting, flooding or by mechanical means. If on-site materials are utilized, they should be wheel-rolled, tamped or otherwise compacted to a firm condition. For minor interior trenches, density testing may be deleted or spot testing may be elected if deemed necessary, based on review of backfill operations during construction.

If utility contractors indicate that it is undesirable to use compaction equipment in close proximity to a buried conduit, the contractor may elect the utilization of light weight mechanical compaction equipment and/or shading of the conduit with clean, granular material, which should be thoroughly jetted in-place above the conduit, prior to initiating mechanical compaction procedures. Other methods of utility trench compaction may also be appropriate, upon review of the geotechnical consultant at the time of construction.

In cases where clean granular materials are proposed for use in lieu of native materials or where flooding or jetting is proposed, the procedures should be considered subject to review by the geotechnical consultant. Clean granular backfill and/or bedding are not recommended in slope areas.

Section 9 - Drainage

Where deemed appropriate by the geotechnical consultant, canyon subdrain systems should be installed in accordance with CTE’s recommendations during grading.

Typical subdrains for compacted fill buttresses, slope stabilization or sidehill masses, should be installed in accordance with the specifications.

Roof, pad and slope drainage should be directed away from slopes and areas of structures to suitable disposal areas via non-erodible devices (i.e., gutters, downspouts, and concrete swales).

For drainage in extensively landscaped areas near structures, (i.e., within four feet) a minimum of 5 percent gradient away from the structure should be maintained. Pad drainage of at least 2 percent should be maintained over the remainder of the site.

Drainage patterns established at the time of fine grading should be maintained throughout the life of the project. Property owners should be made aware that altering drainage patterns could be detrimental to slope stability and foundation performance.

Section 10 - Slope Maintenance

10.1 - Landscape Plants

To enhance surficial slope stability, slope planting should be accomplished at the completion of grading. Slope planting should consist of deep-rooting vegetation requiring little watering. Plants native to the southern California area and plants relative to native plants are generally desirable. Plants native to other semi-arid and arid areas may also be appropriate. A Landscape Architect should be the best party to consult regarding actual types of plants and planting configuration.

10.2 - Irrigation

Irrigation pipes should be anchored to slope faces, not placed in trenches excavated into slope faces.

Slope irrigation should be minimized. If automatic timing devices are utilized on irrigation systems, provisions should be made for interrupting normal irrigation during periods of rainfall.

10.3 - Repair

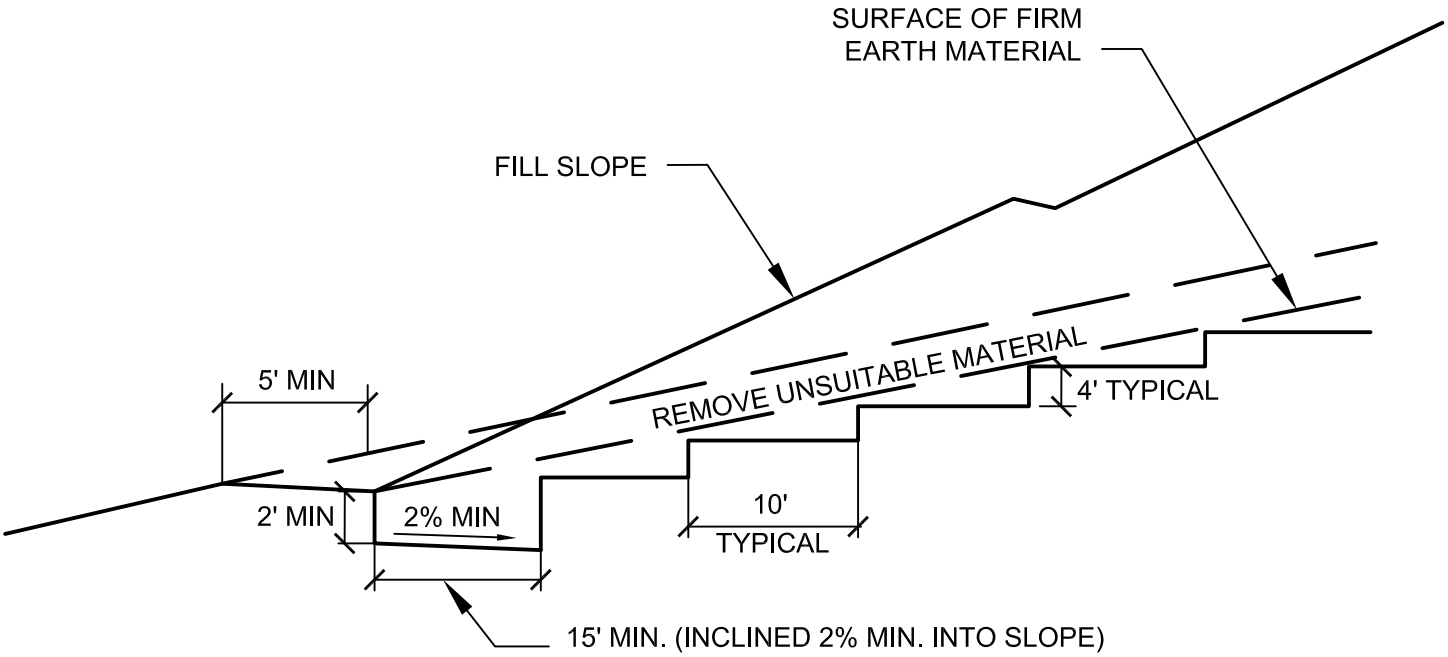
As a precautionary measure, plastic sheeting should be readily available, or kept on hand, to protect all slope areas from saturation by periods of heavy or prolonged rainfall. This measure is strongly recommended, beginning with the period prior to landscape planting.

If slope failures occur, the geotechnical consultant should be contacted for a field review of site conditions and development of recommendations for evaluation and repair.

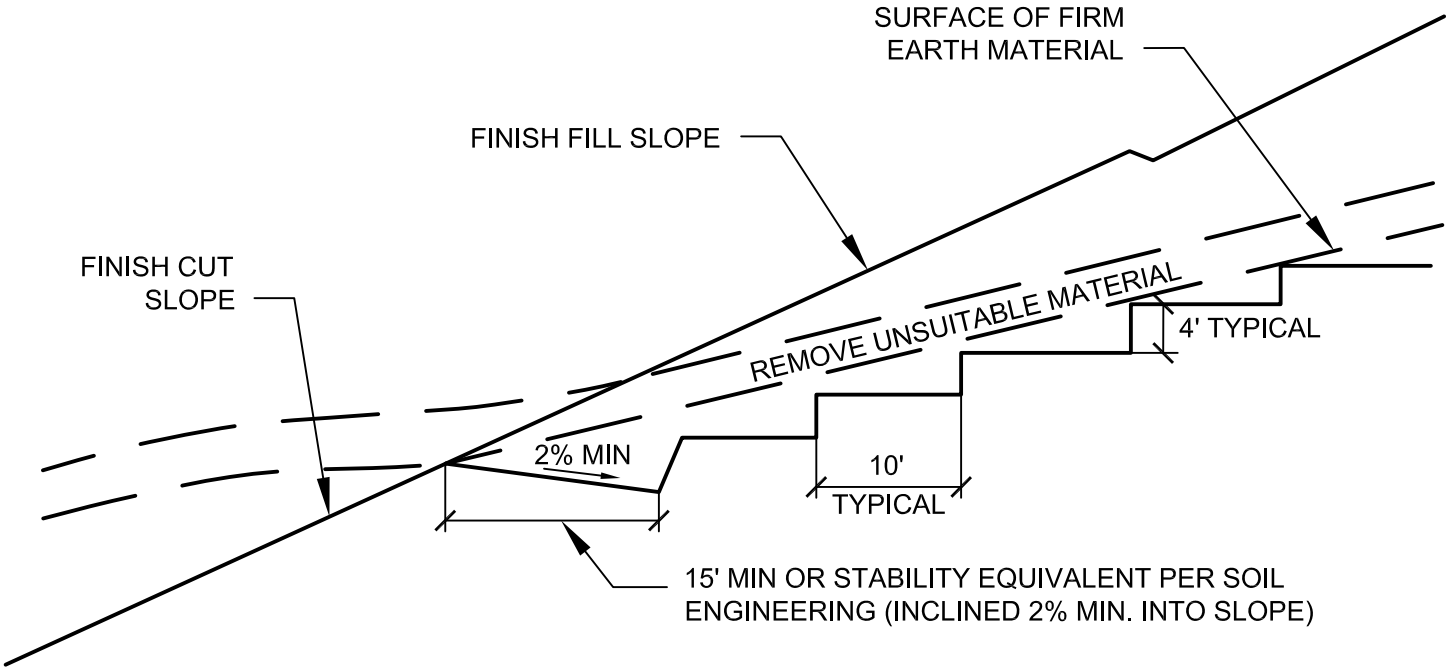
If slope failures occur as a result of exposure to period of heavy rainfall, the failure areas and currently unaffected areas should be covered with plastic sheeting to protect against additional saturation.

In the accompanying Standard Details, appropriate repair procedures are illustrated for superficial slope failures (i.e., occurring typically within the outer one foot to three feet of a slope face).

BENCHING FILL OVER NATURAL

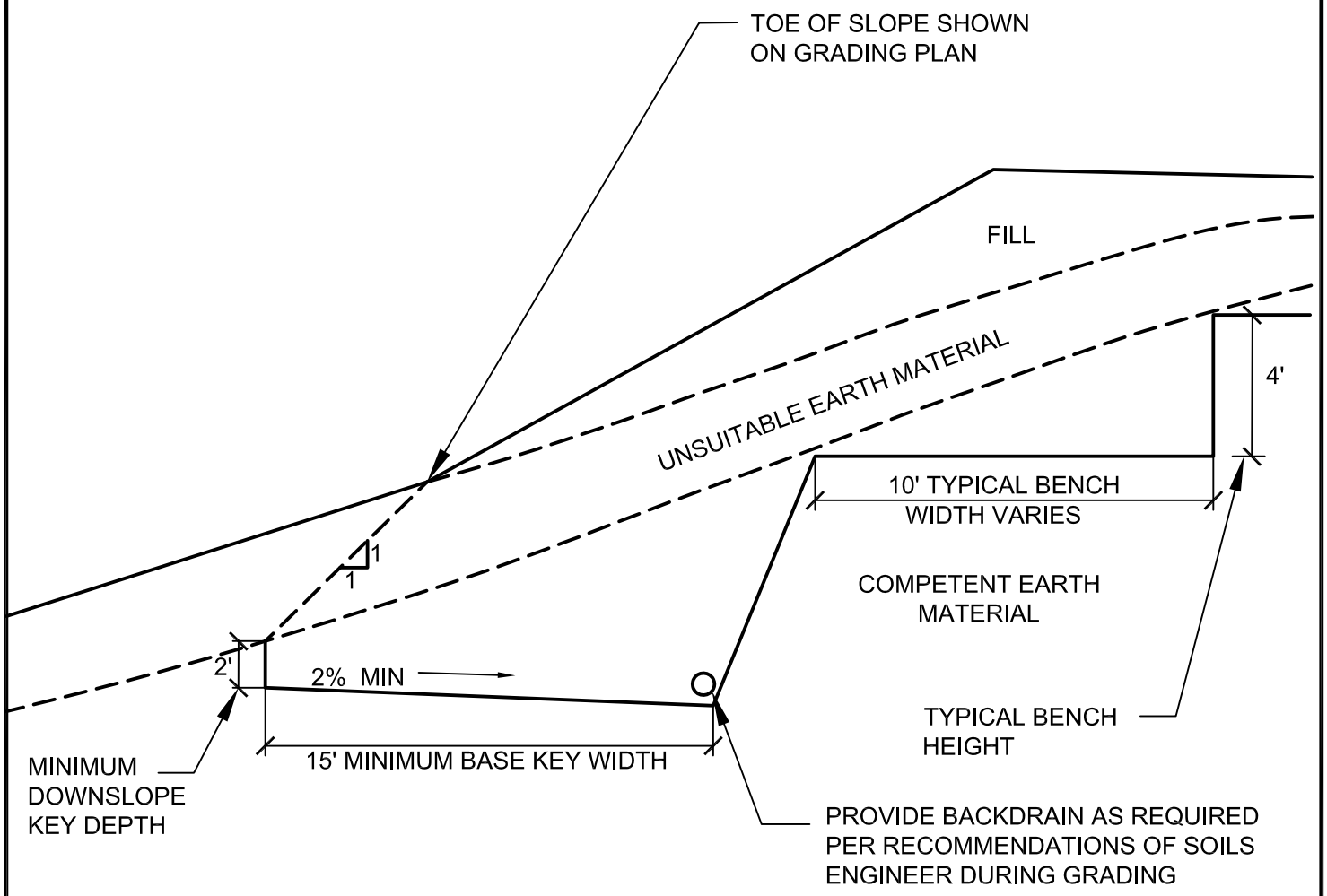


BENCHING FILL OVER CUT



NOT TO SCALE

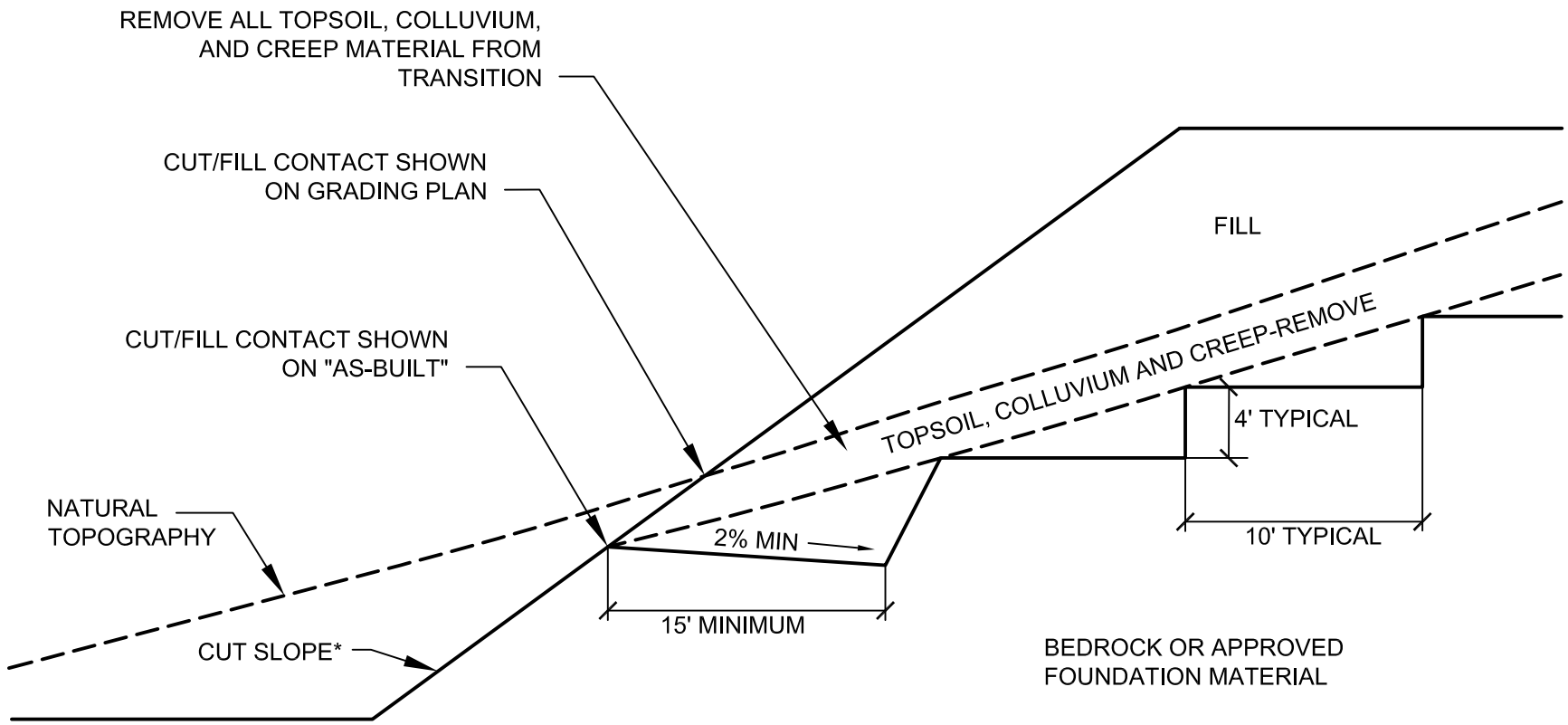
BENCHING FOR COMPACTED FILL DETAIL



WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS, BENCHING IS NOT NECESSARY. FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.

NOT TO SCALE

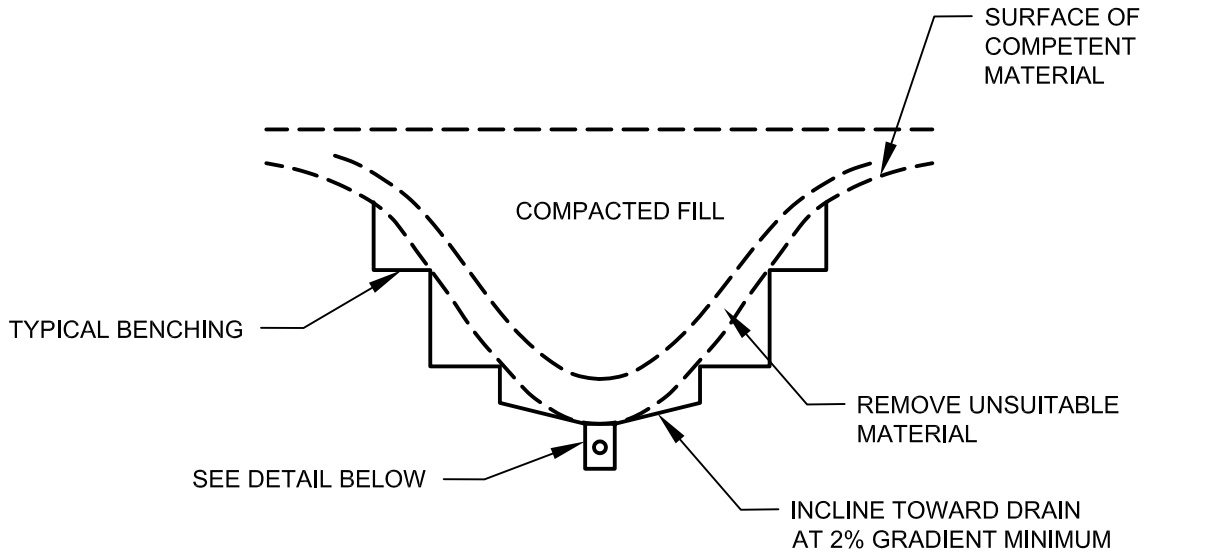
FILL SLOPE ABOVE NATURAL GROUND DETAIL



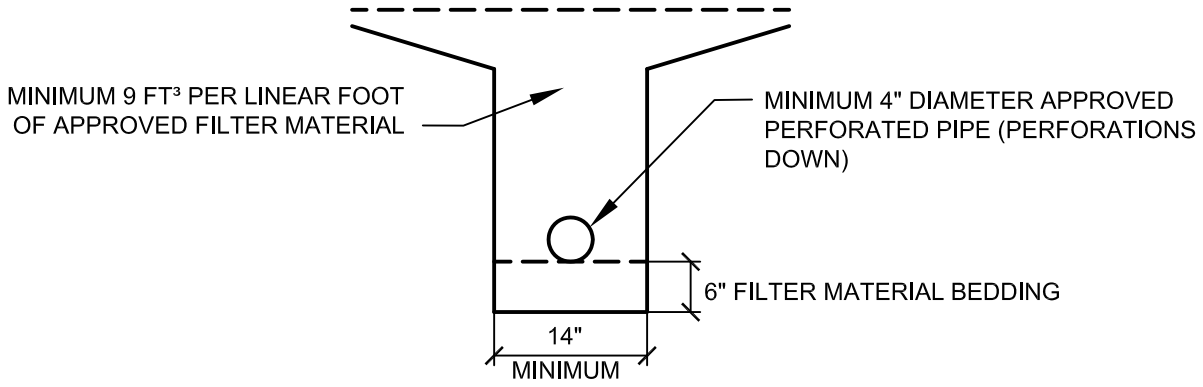
*NOTE: CUT SLOPE PORTION SHOULD BE MADE PRIOR TO PLACEMENT OF FILL

NOT TO SCALE

FILL SLOPE ABOVE CUT SLOPE DETAIL



DETAIL



FILTER MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1"	100
¾"	90-100
⅜"	40-100
NO. 4	25-40
NO. 30	18-33
NO. 8	5-15
NO. 50	0-7
NO. 200	0-3

APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYL-CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 psi

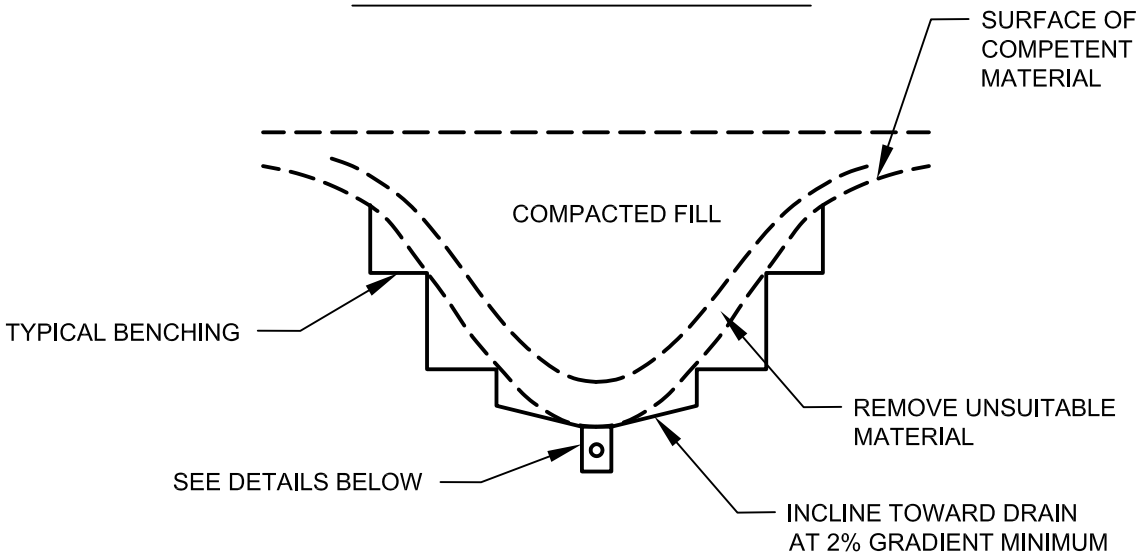
PIPE DIAMETER TO MEET THE FOLLOWING CRITERIA, SUBJECT TO FIELD REVIEW BASED ON ACTUAL GEOTECHNICAL CONDITIONS ENCOUNTERED DURING GRADING

LENGTH OF RUN	PIPE DIAMETER
INITIAL 500'	4"
500' TO 1500'	6"
> 1500'	8"

NOT TO SCALE

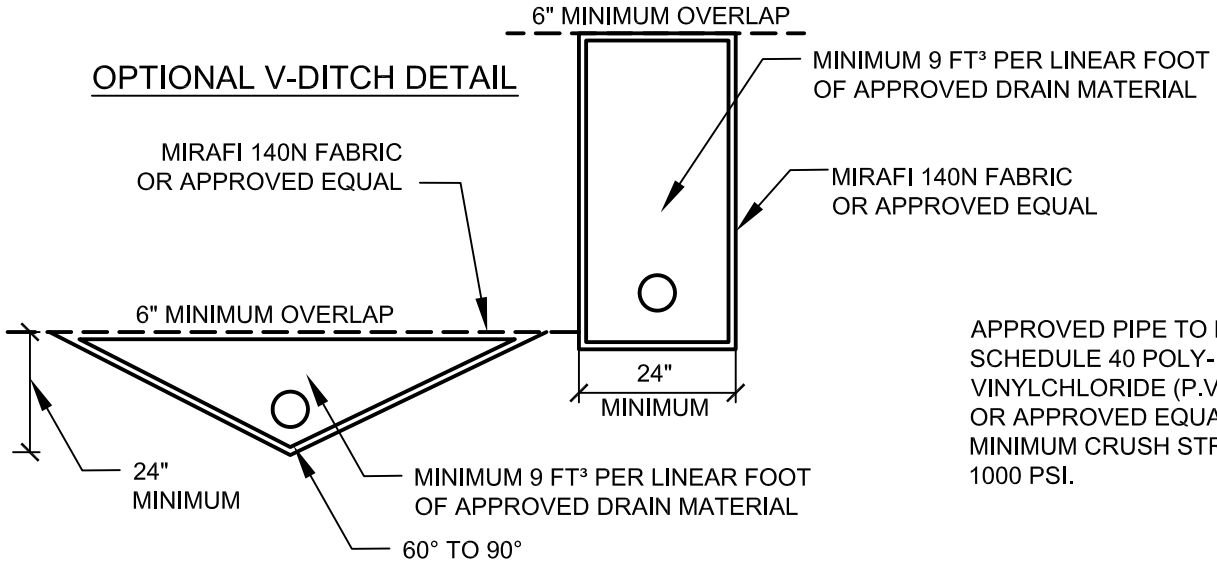
TYPICAL CANYON SUBDRAIN DETAIL

CANYON SUBDRAIN DETAILS



TRENCH DETAILS

OPTIONAL V-DITCH DETAIL



APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYLCHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 PSI.

DRAIN MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1 ½"	88-100
1"	5-40
¾"	0-17
⅜"	0-7
NO. 200	0-3

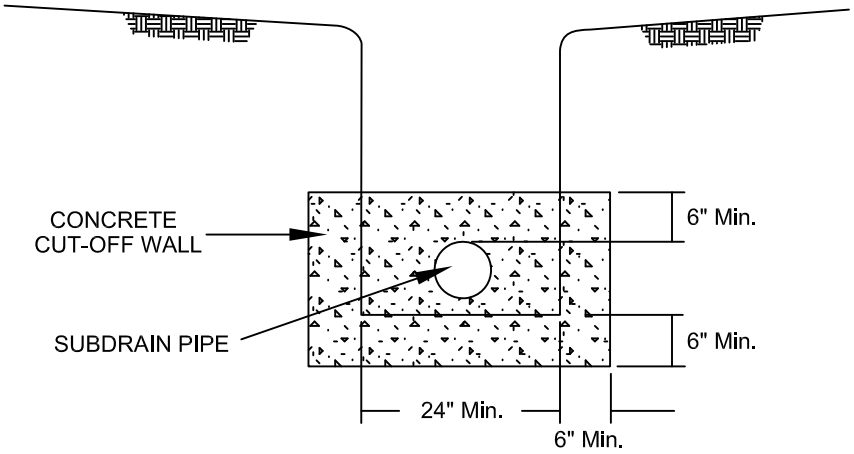
PIPE DIAMETER TO MEET THE FOLLOWING CRITERIA, SUBJECT TO FIELD REVIEW BASED ON ACTUAL GEOTECHNICAL CONDITIONS ENCOUNTERED DURING GRADING

LENGTH OF RUN	PIPE DIAMETER
INITIAL 500'	4"
500' TO 1500'	6"
> 1500'	8"

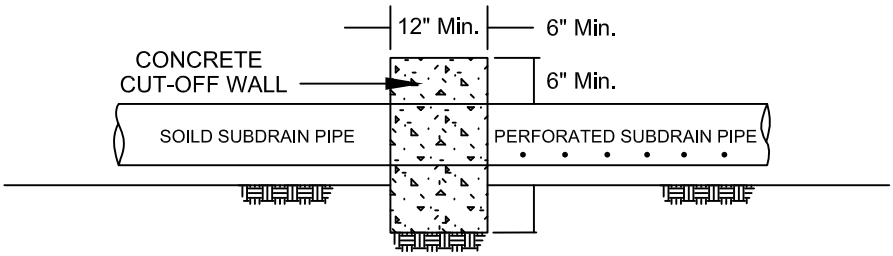
NOT TO SCALE

GEOFABRIC SUBDRAIN

FRONT VIEW



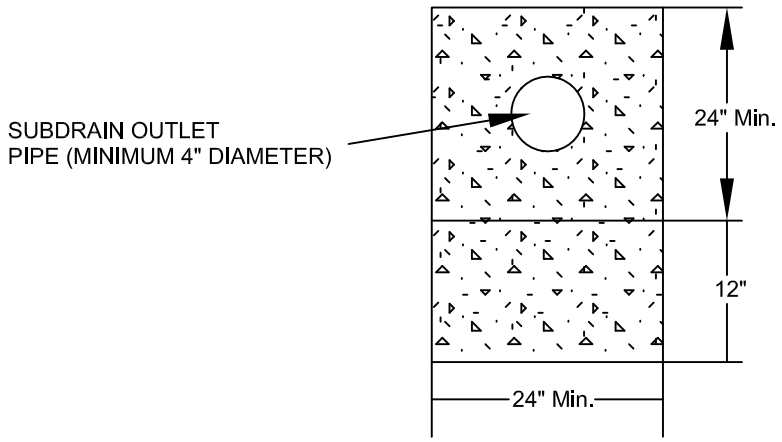
SIDE VIEW



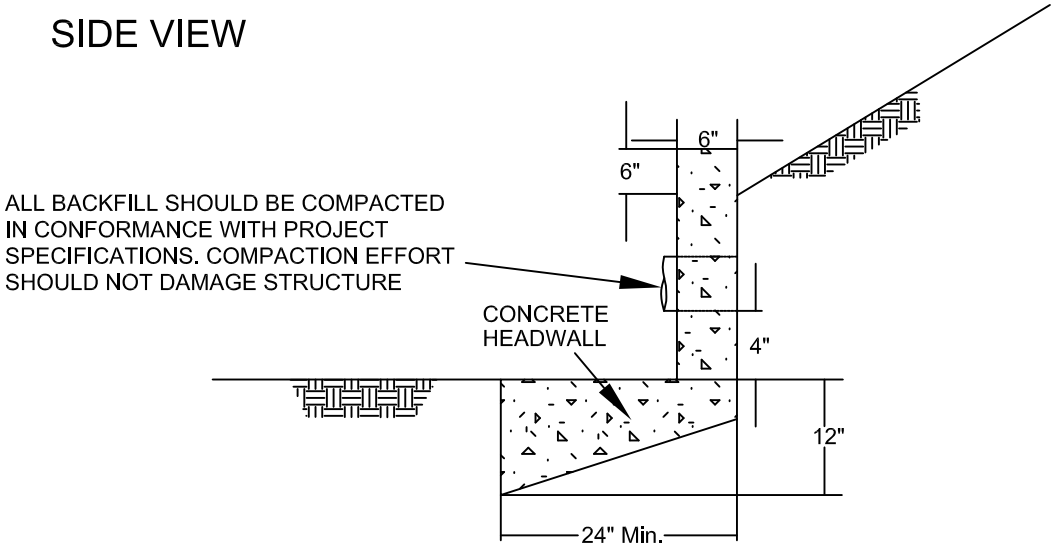
NOT TO SCALE

RECOMMENDED SUBDRAIN CUT-OFF WALL

FRONT VIEW



SIDE VIEW



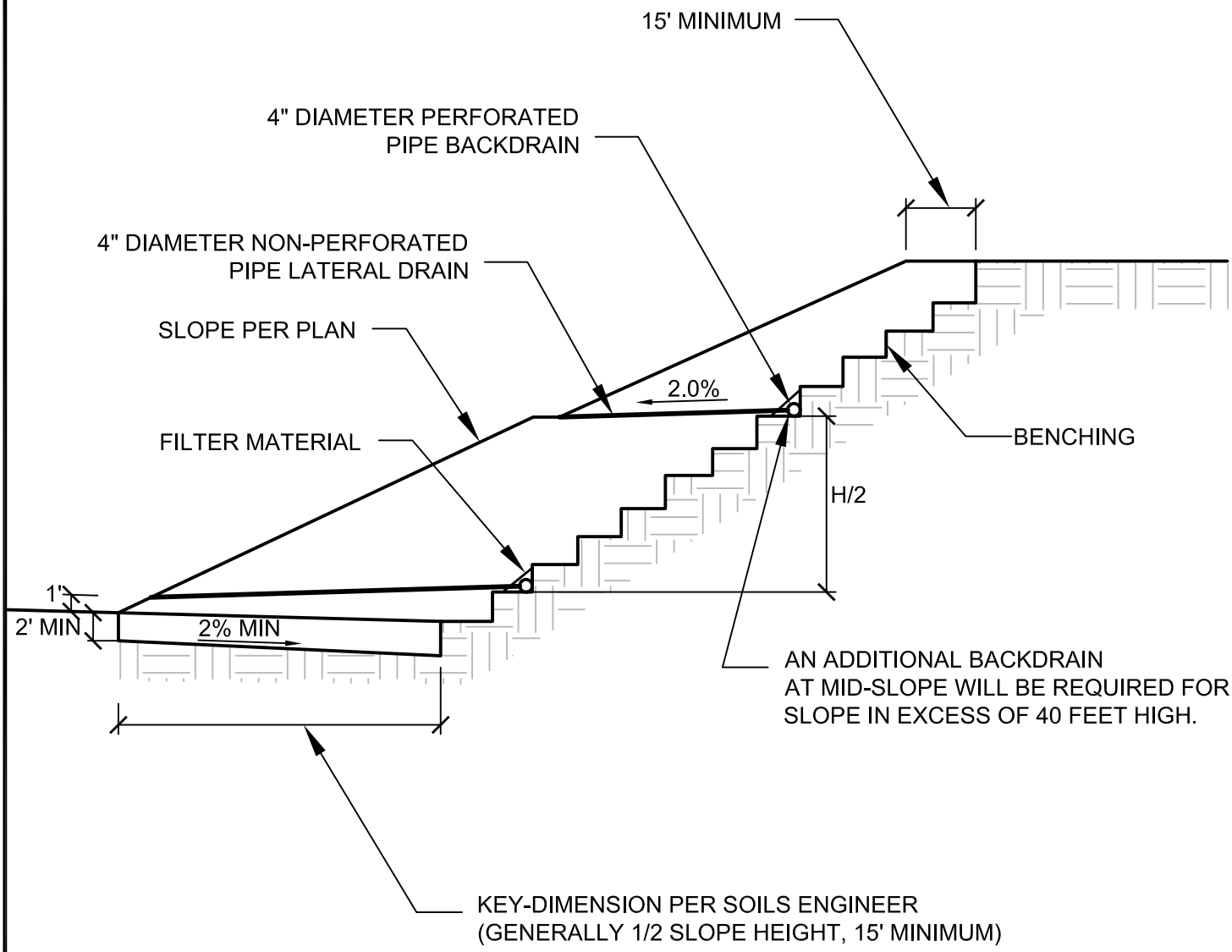
NOTE: HEADWALL SHOULD OUTLET AT TOE OF SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE DEVICE

ALL DISCHARGE SHOULD BE CONTROLLED

THIS DETAIL IS A MINIMUM DESIGN AND MAY BE
MODIFIED DEPENDING UPON ENCOUNTERED
CONDITIONS AND LOCAL REQUIREMENTS

NOT TO SCALE

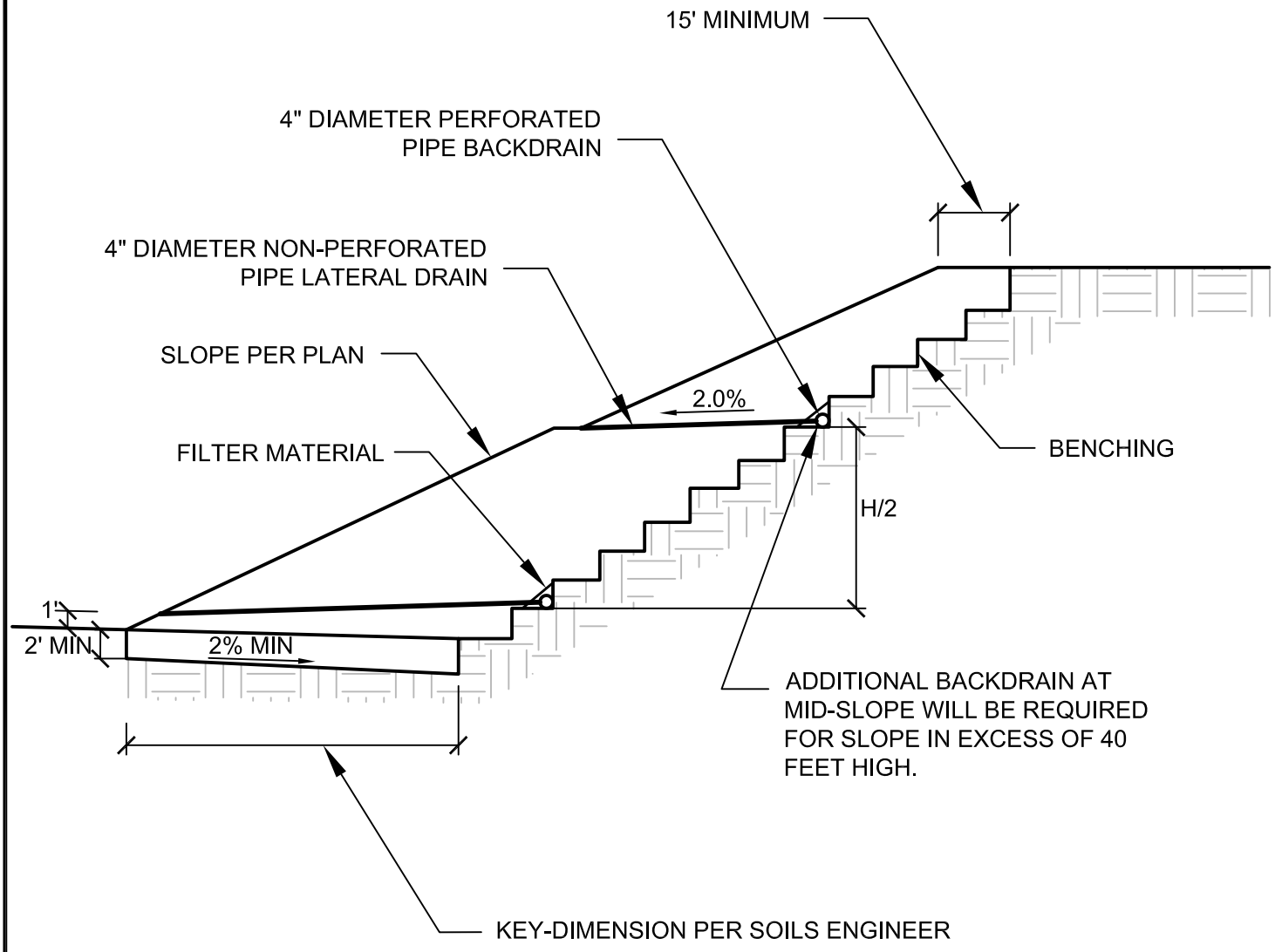
TYPICAL SUBDRAIN OUTLET HEADWALL DETAIL



DIMENSIONS ARE MINIMUM RECOMMENDED

NOT TO SCALE

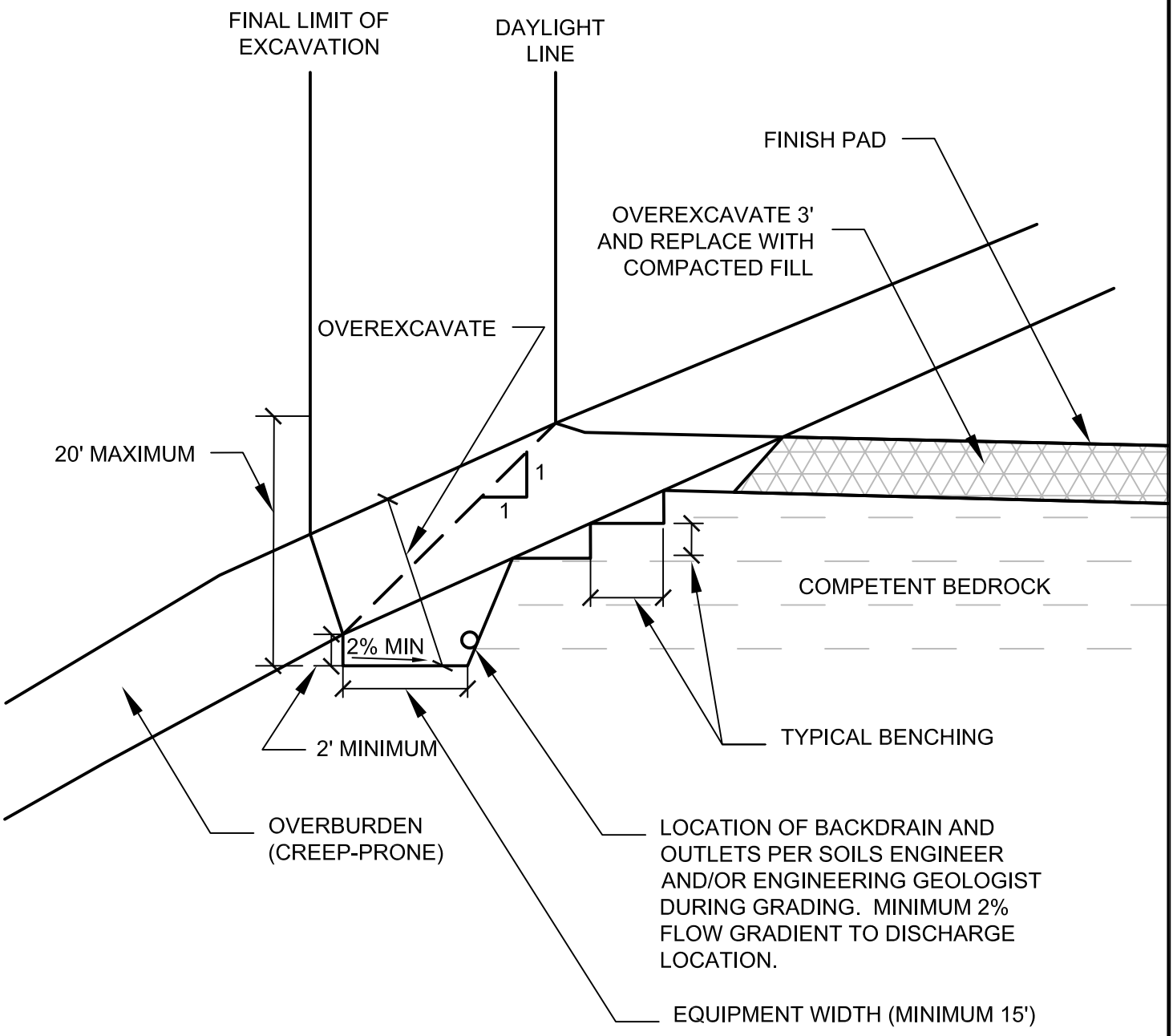
TYPICAL SLOPE STABILIZATION FILL DETAIL



DIMENSIONS ARE MINIMUM RECOMMENDED

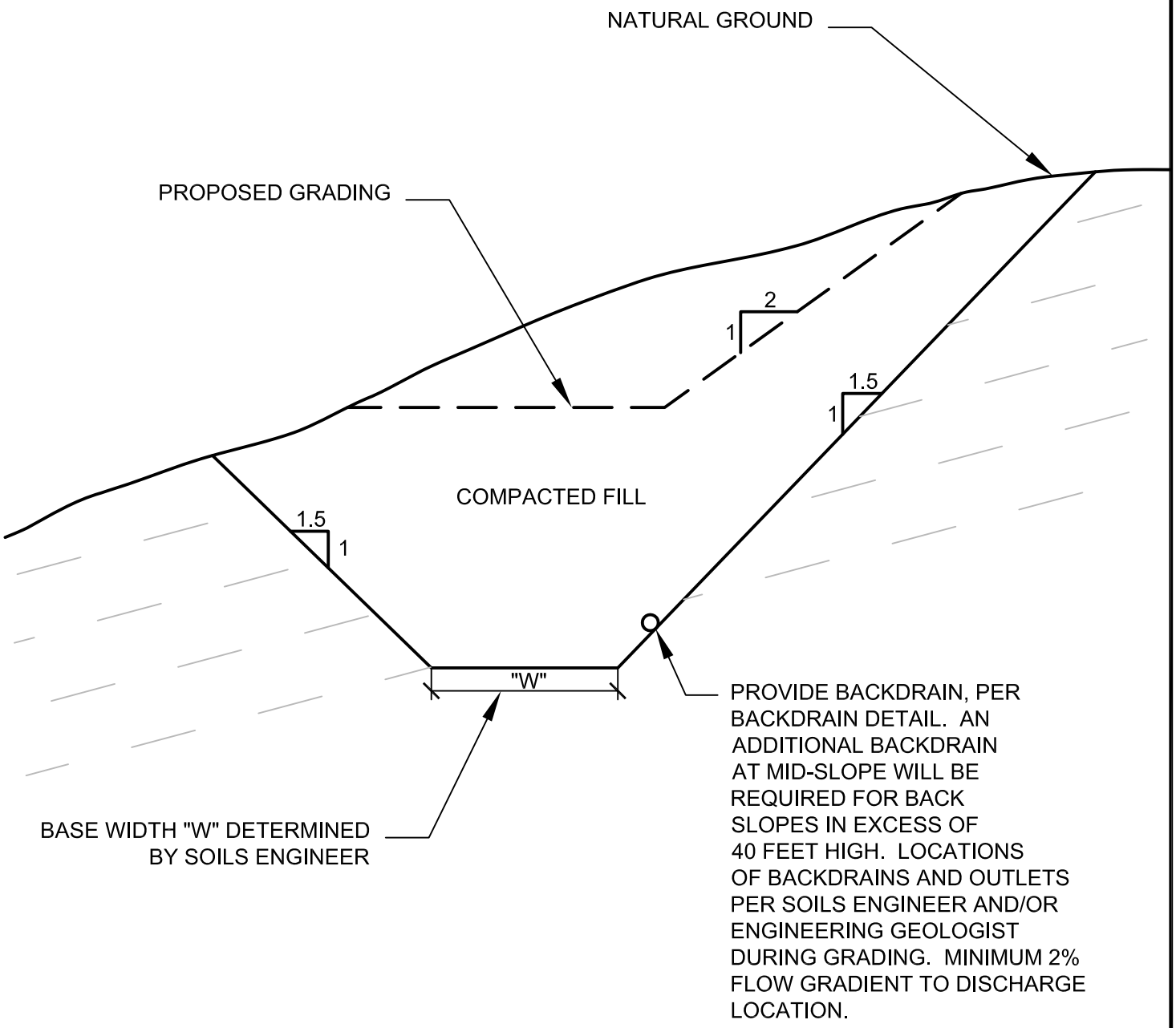
NOT TO SCALE

TYPICAL BUTTRESS FILL DETAIL



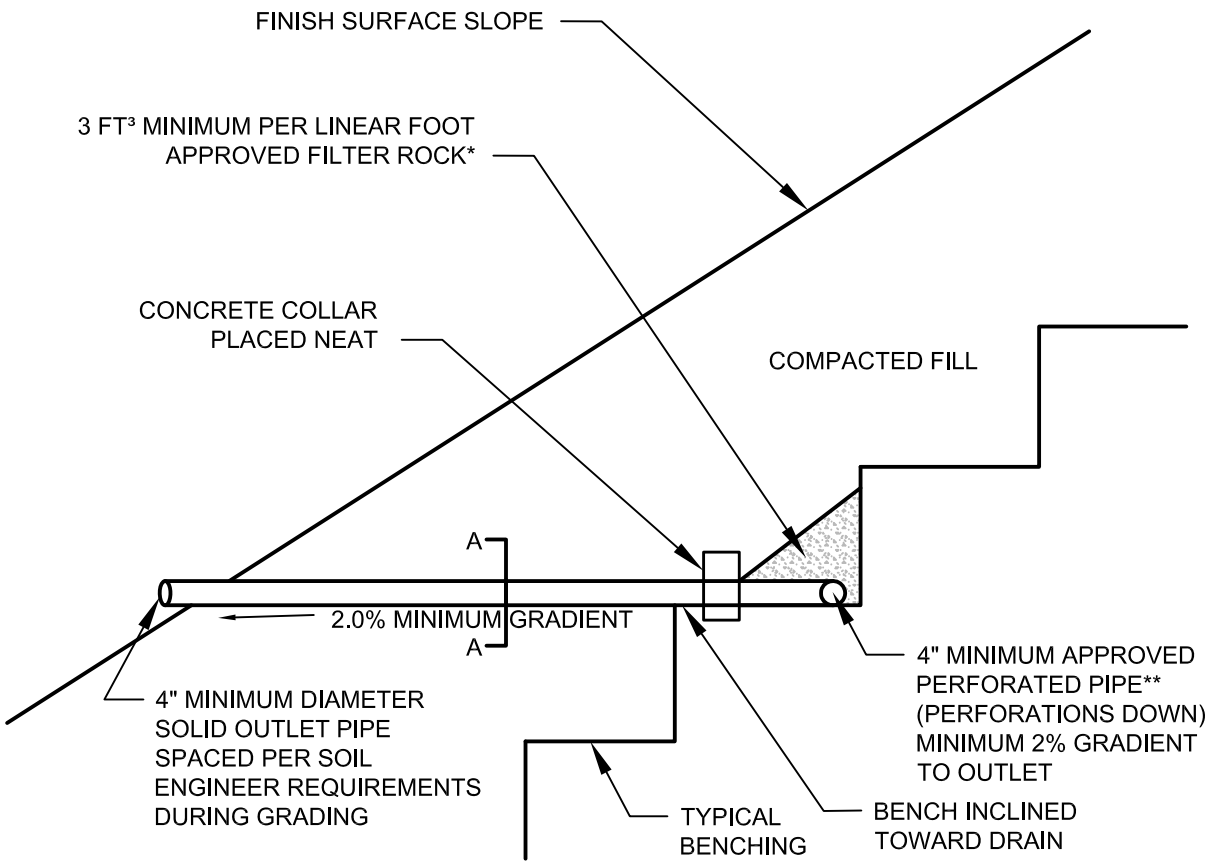
NOT TO SCALE

DAYLIGHT SHEAR KEY DETAIL

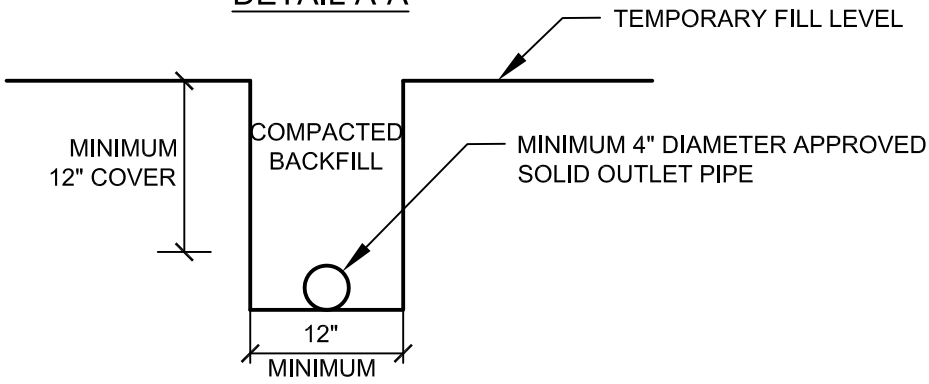


NOT TO SCALE

TYPICAL SHEAR KEY DETAIL



DETAIL A-A



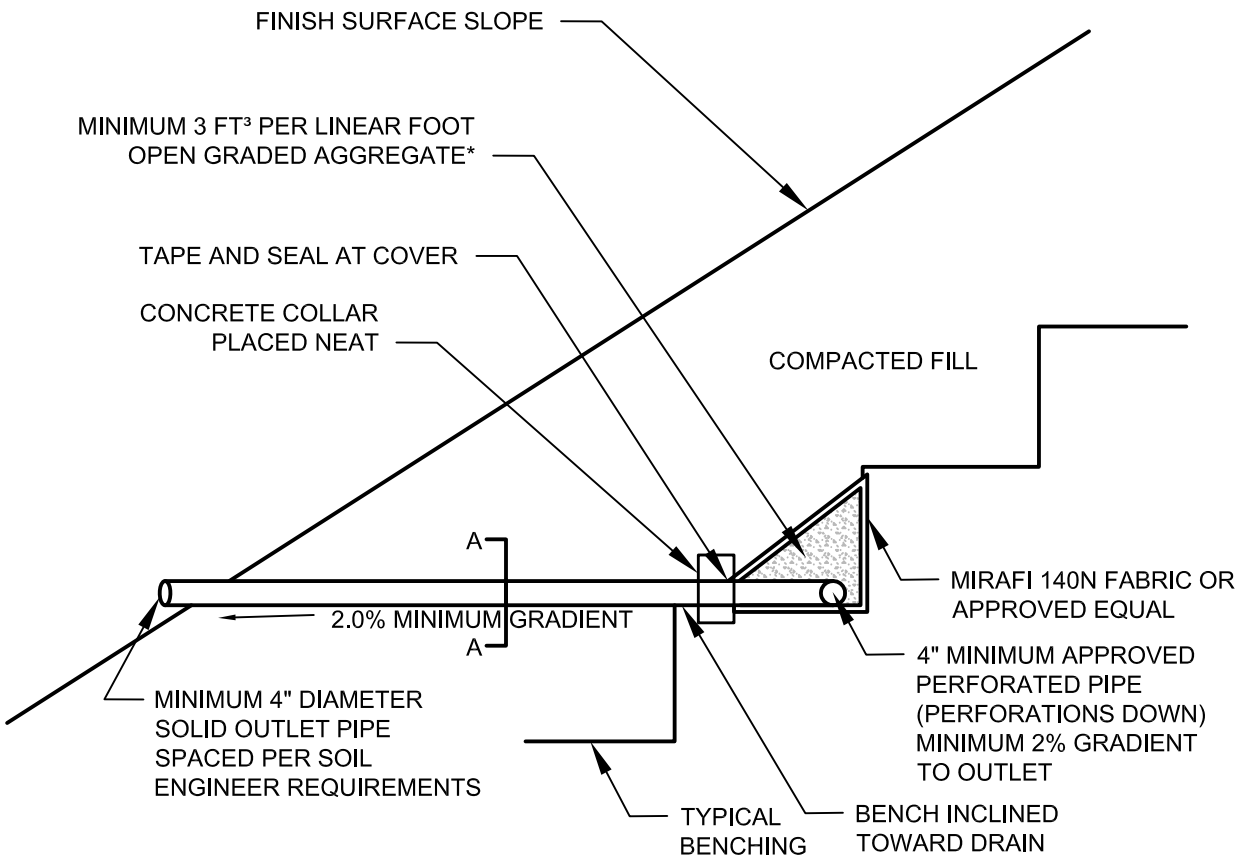
**APPROVED PIPE TYPE:
SCHEDULE 40 POLYVINYL CHLORIDE
(P.V.C.) OR APPROVED EQUAL.
MINIMUM CRUSH STRENGTH 1000 PSI

*FILTER ROCK TO MEET FOLLOWING
SPECIFICATIONS OR APPROVED EQUAL:

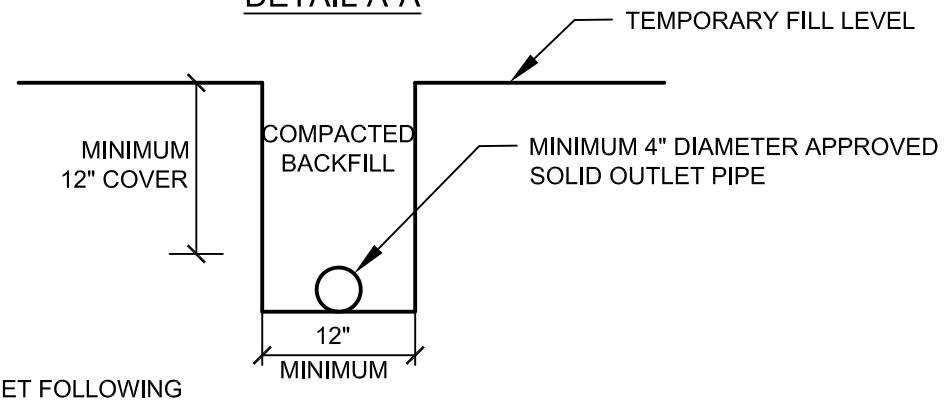
SIEVE SIZE	PERCENTAGE PASSING
1"	100
¾"	90-100
⅜"	40-100
NO. 4	25-40
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

NOT TO SCALE

TYPICAL BACKDRAIN DETAIL



DETAIL A-A

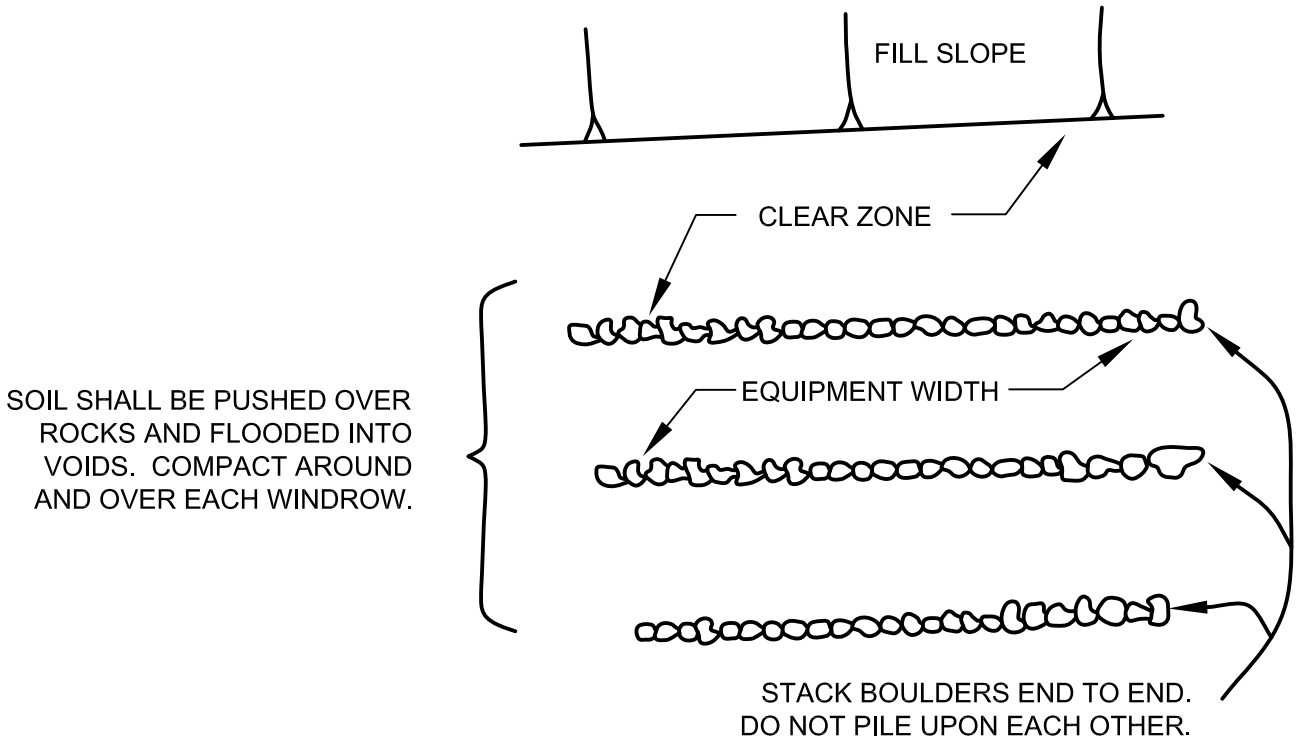


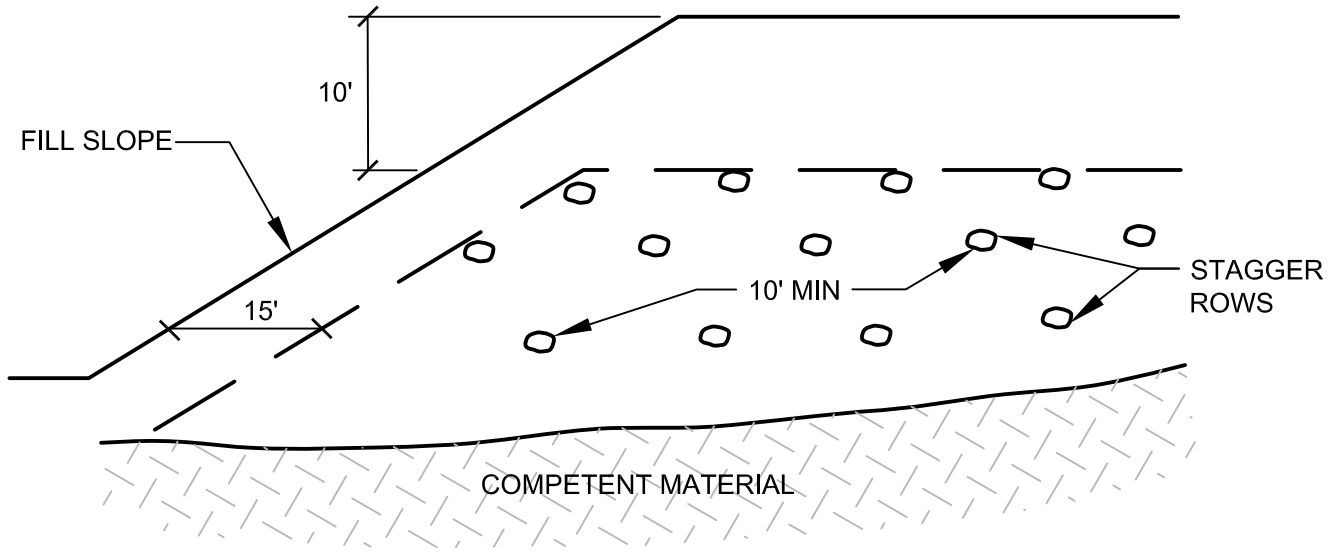
*NOTE: AGGREGATE TO MEET FOLLOWING SPECIFICATIONS OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1 ½"	100
1"	5-40
¾"	0-17
⅜"	0-7
NO. 200	0-3

NOT TO SCALE

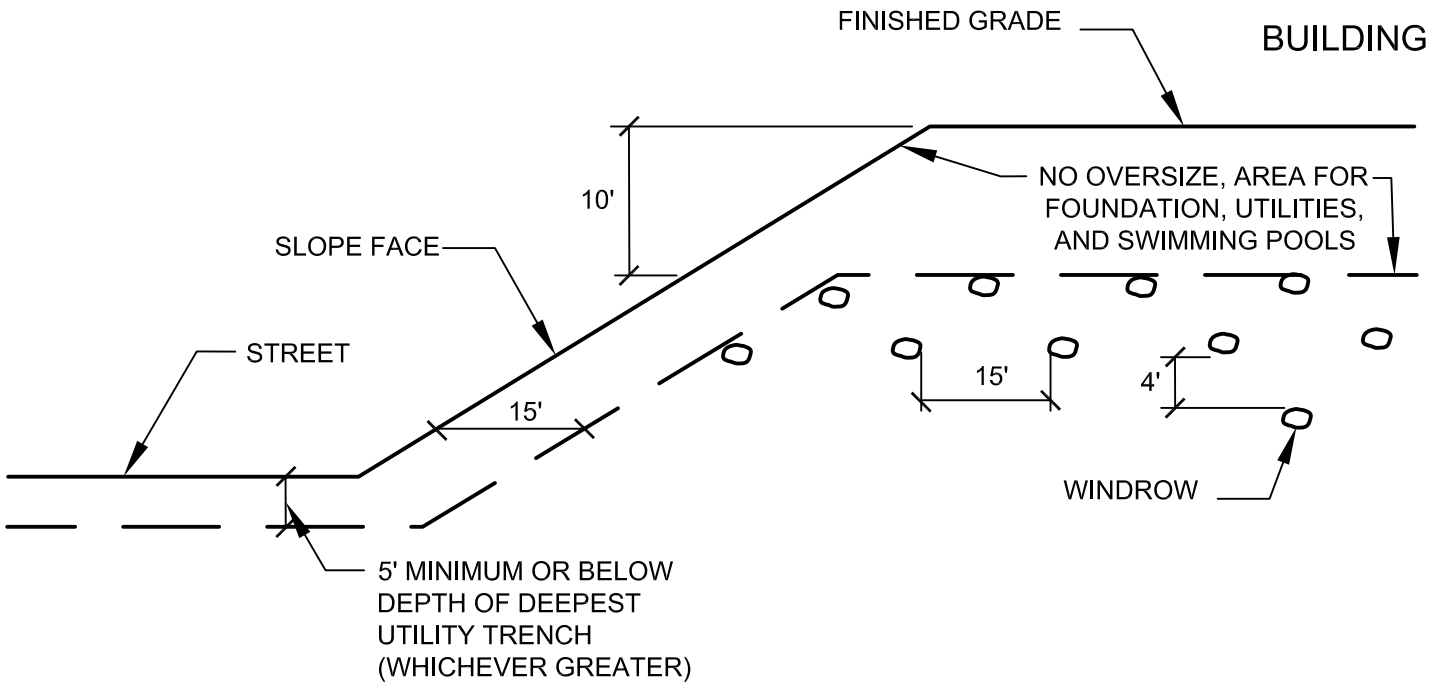
BACKDRAIN DETAIL (GEOFRABIC)



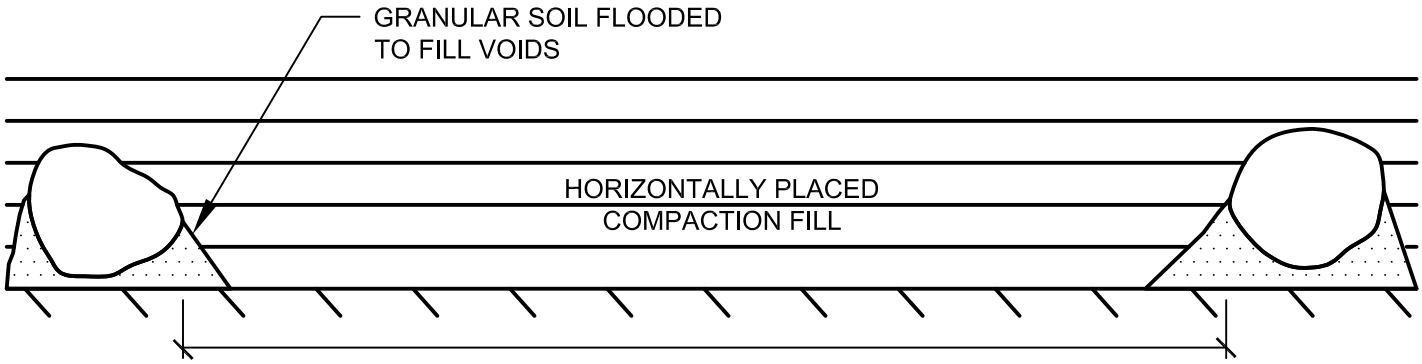


NOT TO SCALE

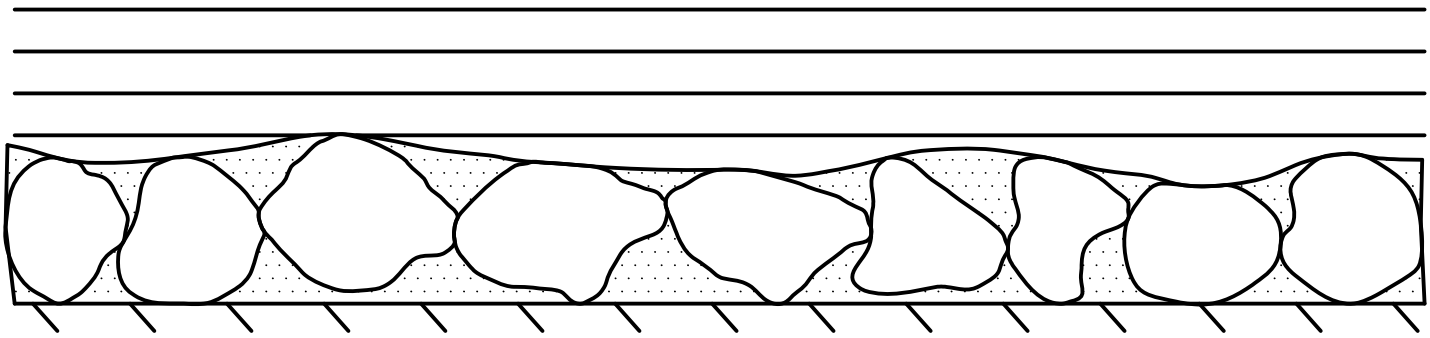
ROCK DISPOSAL DETAIL



TYPICAL WINDROW DETAIL (EDGE VIEW)



PROFILE VIEW

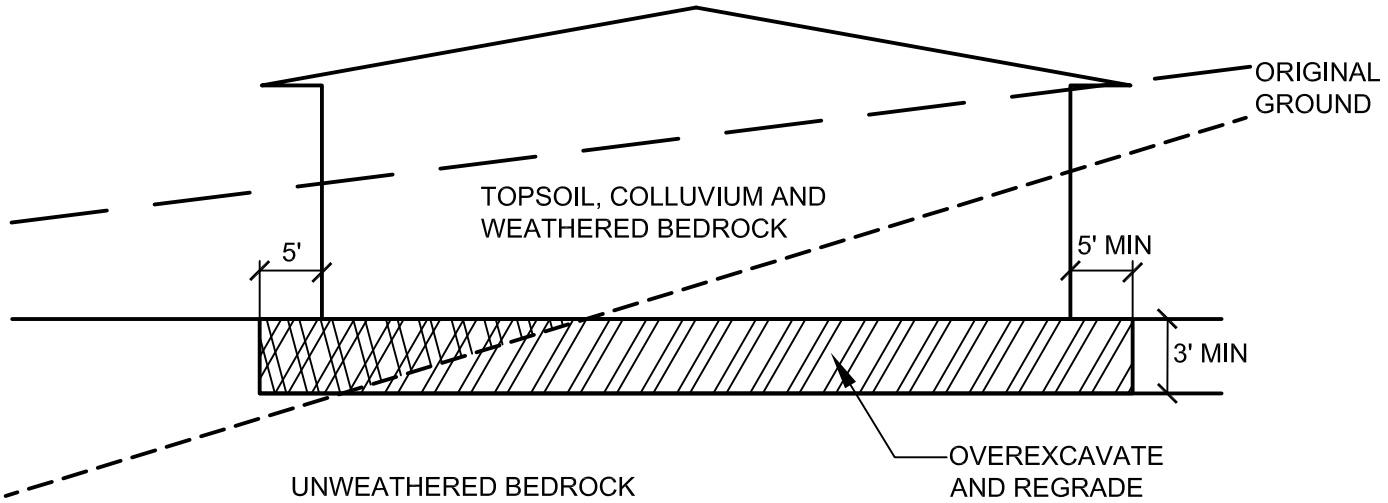


NOT TO SCALE

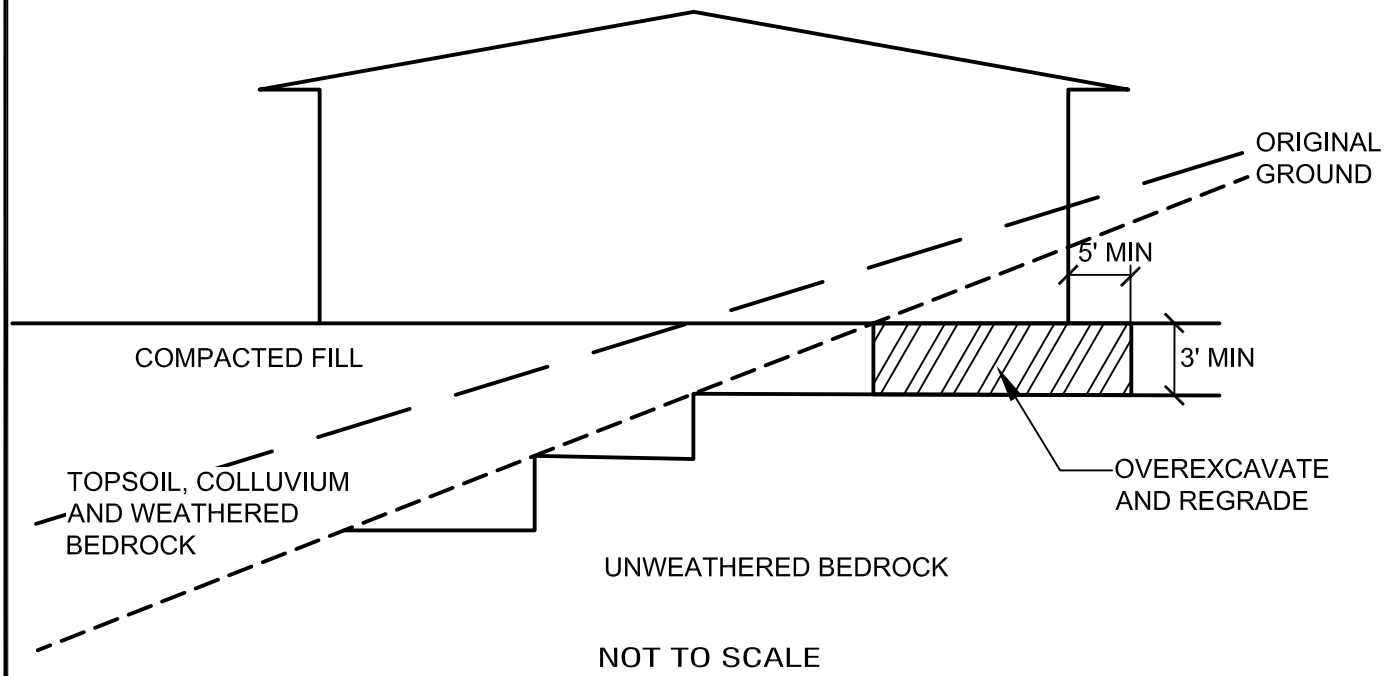
ROCK DISPOSAL DETAIL

GENERAL GRADING RECOMMENDATIONS

CUT LOT



CUT/FILL LOT (TRANSITION)



NOT TO SCALE

TRANSITION LOT DETAIL