Appendix G –
Geotechnical Report
Prepared by American Geotechnical, Inc. dated August 2013

EXECUTIVE SUMMARY

American Geotechnical, Inc. conducted a review of geotechnical engineering, engineering geologic and geo-environmental impacts relating to current conceptual design plans for the subject project and assessed the use of applicable mitigation measures based on data collected to date. Based on review findings we conclude that implementation of the development is feasible, and reasonable mitigation measures can be employed to reduce impacts to a less than significant level.

One important "primary" geotechnical impact relates to the stability of natural slopes along development margins. These slopes typically exist either beyond the property boundaries or in areas of designed open space adjacent to remedial mass grading. The slopes are a concern as they may be subject to potential surficial slope failures and/or larger landslides which could impact the development from a gross/surficial slope stability standpoint. Where improvements will daylight above descending natural slope conditions their design will not only need to achieve an adequate factor-of-safety but also withstand a potential loss of lateral support associated with slope failure. In cases where unstable natural slopes ascend from improvements, mitigation measures designed to prevent damaging mud/debris flows or shallow slide impacts will be required.

The gross stability of graded (cut and fill) slopes and/or use of mid-slope retaining walls pose another potential primary impact. Although underlying bedrock structure may be favorably oriented and design gradients no steeper than 2:1 horizontal:vertical, the relatively significant height of some slopes may require use of specialized slope stabilization measures to achieve proper safety factors. Slopes designed at steeper gradients (1.5:1 horizontal:vertical) are likely to require a combination of remedial grading and/or supplemental reinforcement treatment(s) in order to achieve safety factors. Where the slopes abut grading margins and encroachment of remedial grading must avoid off-site areas, special grading methodologies may be necessary.

We recently completed a study of the Whittier Fault along the southerly margin of the property (submitted to and approved by the County of Orange in 2013). A seismic setback zone was established along the active fault trace between 50 and 120 feet wide based on findings of the fault study. The conceptual design plan was modified to avoid construction of residential building lots within the setback zone. Where.

other “non-habitable” design plan elements are proposed within the limits of the setback zone or cross over the main fault trace, such as certain access roads or utility lines, mitigation measures will be required to minimize possible damages relating to potential surface-rupture rupture during a large earthquake

Mitigation may require additional geotechnical studies to constrain specific fault locations in areas of more critical structures such as the bridge proposed to span Blue Mud Canyon under the Option 1 design. Identification of fault hazards in such areas could be incorporated into structural design and/or special grading procedures in order to establish adequate safety factors and minimize this impact.

Other potential “secondary” impacts were identified where mitigation measures are likely to consist of more conventional grading and structural design options. These relate to surficial slope stability, strong ground shaking, deep fill settlement, ground movement from steep cut/fill transitions, compressible soils, possible liquefaction, corrosion of steel and concrete, groundwater control, harder sandstone bed rippability, disposal of over-size rock and the effects of expansive clay soils and bedrock heave. Protecting the integrity of existing transmission towers and buried natural gas lines may be an impact if it is determined during grading or pre-grading testing that the stability of these structures are impacted by grading and or project design.

Other potential geo-environmental impacts relate to the presence of active and abandoned oil wells within the limits of conceptual design plans. An assessment of these impacts is required to confirm the presence/absence of associated soil contaminants and formulate recommendations for proper destruction/abandonment and mitigation in compliance with regulatory protocol.

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American Geotechnical, Inc.
GEOTECHNICAL ENGINEERING / MATERIALS TESTING & INSPECTION

August 1, 2013 F.N. 33366-03

Yorba Linda Estates, LLC
7441 E. Stetson, Suite 350
Scottsdale, Arizona 95251

Attention: Mr. Doug G. Wymore

Subject: **GEOTECHNICAL REVIEW OF CONCEPTUAL DESIGN PLANS**
(Options 1, 2, and 2A) for EIR
Proposed Esperanza Hills Residential Development
Southeastern Puente Hills, Orange County, California

INTRODUCTION

American Geotechnical, Inc. (AG) has conducted a review of geotechnical/geologic engineering and geo-environmental impacts relating to conceptual design plans for the proposed Esperanza Hills residential development, located in unincorporated Orange County east of the City of Yorba Linda, California. Presented herein is a summary of identified impacts and mitigation measure alternatives relating to project implementation.

Geologic feasibility studies were conducted on the subject property by different consultants in the past. These studies were variable in scope, covered limited areas of the property and surrounding properties, and did not specifically evaluate the current conceptual design plans. A comprehensive subsurface geotechnical evaluation addressing the proposed design is on-going. This work includes subsurface drilling, logging, mapping, soil and bedrock sampling, laboratory testing, engineering analysis of pertinent geotechnical hazards, and formulation of remedial grading recommendations specifically addressing the current design.

The findings and conclusions presented herein are based on our knowledge of existing geotechnical engineering and engineering geologic conditions of the property to date.

22725 Old Canal Road, Yorba Linda, CA 92887 - (714) 685-3900 - FAX (714) 685-3909
2640 Financial Court, Suite A, San Diego, CA 92117 - (858) 450-4040 - FAX (858) 457-0814
3100 Fite Circle, Suite 103, Sacramento, CA 95827 - (916) 368-2088 - FAX (916) 368-2188
5600 Spring Mountain Road, Suite 201, Las Vegas, NV 89146 - (702) 562-5046 - FAX (702) 562-2457

Purpose and Scope of Work

The purpose of the subject review was to evaluate the feasibility of proposed conceptual design plans from a geologic/geotechnical and geo-environmental perspective, assess the significance of identified potential impacts and outline reasonable mitigation measures to minimize these impacts. Primary impacts are defined herein as those likely to require use of special engineering construction practices or installation of supplemental geotechnical structures to achieve stability which cannot be achieved using normal grading and construction practices. Secondary impacts are defined as less significant impacts which can be mitigated using more conventional construction grading practices.

The following specific tasks were performed as part of this review:

- Review of three currently proposed conceptual design plans (Options 1, 2, and 2A) on a 100-scale topographic map base.
- Review of available site-specific geotechnical reports and regional published geologic reports, maps, cross sections and other pertinent literature to ascertain the relationship between conceptual plans and geologic conditions.
- Review of prior reports of geotechnical investigation and interviews with geologists involved in that work, as well as photographs of the trenching or potholing where available (Seward, 2002).
- Review of processed 3-D LIDAR imagery flown specifically for the site and the surrounding area in 2008.
- Review of available active fault report archives for the Whittier Fault on file with the California Geologic Survey for areas on or adjacent to the site.
- Surface mapping and the logs of subsurface trenches and borings on the property during our recent fault study for the Whittier Fault, including excavation of 2,500 lineal feet of trenching up to 30 feet deep.
- Field-consultation with other professional geologists within our fault trenches.
- Stereographic review of high-altitude oblique and vertical aerial photo pairs taken from fixed-wing aircraft and low-altitude helicopter flight.
- Excavation of a series of shallow hand-dug and mini-excavator test pits in 2013 (work on-going).
- Advancement of several large-diameter bucket-auger borings in 2013 (work on-going).

- Preliminary geotechnical analysis of the design plans including assessment of significant design elements such as significant cut and fill slopes, general cut and canyon fill areas and the layout of proposed detention basins and their design relationship with known underlying geologic conditions.
- Review of several cross-section profiles in areas of potential significant impacts.
- Identify potentially unstable natural slopes and evaluate possible gross and surficial impacts to adjacent areas.
- Prepare report illustrations including cross sections and diagrammatic details of certain hazards.
- Prepare this report which summarizes identified potential and known impacts, mitigation measures, and/or design alternatives.

Site Description

The Esperanza Hills Development is a low-impact luxury master-planned residential community proposed along the southeasterly flank of the Puente Hills at the northwesterly end of the Peninsular Ranges Geomorphic Province of California. Boundaries of the property straddle both the Yorba Linda and Prado Dam 7.5-Minute Topographic Quadrangle Maps. The property consists of approximately 469 total acres with an irregular to linear-shaped border. Except for existing local access roads and graded pads associated with crude oil production and Southern California Edison (SCE) overhead transmission lines that cross the property in a northerly trend, the parcels remain in a natural undisturbed condition.

The property is divided into three contiguous parcels consisting of the 279 acre Yorba Linda Estates (YLE) parcel on the east, 33 acre Yorba Trails (YT) parcel on the west, and the 157 acre Nicholas/Long (NL) parcel on the northeast. The grading is designed for two separate areas, one to the southwest containing 218 lots and one to the northeast containing up to 122 lots. The areas are separated by an unnamed east-west to southeasterly trending canyon (referred to as Canyon “A”).

Active crude oil production and related facilities exist on the southerly portion of the YLE/YT parcels, in close proximity to the Whittier fault zone. A network of unimproved access roads, active pumping wells, aboveground storage tanks and shallow small diameter above ground/underground pipelines are associated with the facilities. Operations are conducted in accordance with lease agreements between parcel owners and oil companies.

Topographic relief across the property is manifest as a series of ridges and intervening canyons (or drainage areas). Elevations range from approximately 600 feet above mean sea level (MSL) in Blue Mud Canyon near the southern margin of the property to around 1,540 feet at the northern perimeter of the N/L parcel. The path of surface drainage within the canyons generally flows from east to west. For reference purposes the major canyons on the property are referred to herein as Canyon "A" on the north (which separates the N/L and YLE/YT parcels), Canyon "B" which crosses the western portion of the YLE/YT parcels and Blue Mud Canyon which forms the southern margin of the YLE parcel.

Description of Adjacent Offsite Areas

Areas beyond the property boundaries include similar undeveloped hilly terrain to the north, east, and west, and the undeveloped Chino Hills State Park property to the north and east. Abutting the N/L parcel to the west are undeveloped Yorba Linda Land (YLL) and Bridal Hills (BH) parcels from north to south. Abutting the YT parcel on the west and the south is the proposed Cielo Vista project, a parcel owned by the Amos Travis Trust which is modified only locally by minor oil/gas production activities. There is a regional natural gas easement bordering the western margin of the Cielo Vista project which will be crossed locally by each of the proposed Option 2 and Option 2A access road alignments.

Further west of the YLL/BH/Sage parcels are areas of existing residential tracts incorporated within the City of Yorba Linda. These include Tract (TR) 16186 (Casino Ridge) to the west of YLL/BH, TR 15501 to the north of Sage and TR 9813 and TR 10519 to the west of Sage. South and east of the YLE parcel, from west to east respectively, are residential tracts TR 10455, TR 13800, TR 12850 and TR 12877.

Major neighboring residential streets bordering the property vicinity include Stonehaven Drive and Via De Agua to the south and San Antonio Drive to the west. Aspen Way is a branch street extending easterly from San Antonio Drive that terminates at the western margin of the proposed Cielo Vista project on the parcel owned by the Amos Travis Trust.

Current vehicular access to the property is from the south off Stonehaven Drive. A narrow paved 20-foot wide access road (Yorba Linda Water District easement) extends northward from Stonehaven to intersect with a single-lane paved road (Metropolitan Water District [MWD] easement) used to access the Hidden Hills subdivision to the east. The access road from Stonehaven continues northward into Blue Mud Canyon and other areas of the subject property. The MWD road extends in an east-west trend away from the intersection following the southern boundary of the property.

Previous Site Studies

Geologic studies conducted prior to 1998 were mainly associated with exploration for petroleum resources within the Puente Hills. Various generations of large scale regional geologic maps were published that encompassed the subject property (Bjorklund, 2003). The nearby Esperanza Oil field was also a source of deep subsurface well-log information. The first geologic/geotechnical work relating directly to development of the property for residential use included preparation of a 200-scale geotechnical constraints map (ECI, 1998). The ECI map outlined locations of possible landslides and faults on the property as well as estimated thicknesses of alluvium in canyon areas. A later site-specific study was performed to evaluate geologic conditions for another conceptual design plan including excavation of over 30 shallow exploratory trenches across the YLE/YT parcels to assess conditions of geologic structure and resolve some of the major landslide conditions (Seward, 2002).

More recent work included an active fault study conducted by AG within the limits of the southerly YLE/YT boundaries (AG, 2013). The study included excavation and detailed logging of approximately 2,500 linear feet of exploratory trenches within the southern portions of the YLE/YT parcels, mainly confined to the boundaries of the Alquist-Priolo Earthquake Study Zone established by the State of California for the Whittier Fault. The boundaries of the principal Whittier fault trace and a 50 to 120-foot wide seismic setback zone to the north of the fault were established as a result of the study. The AG fault report was approved by the County of Orange in March 2013, and peer-reviewed by Seward prior to submission. The report findings were and also reviewed by geologists on staff with the California Geologic Survey (CGS). Professional geologists from Seward, the CGS and County of Orange personally inspected open fault trenches during the investigation. No setback zone was established south of the Whittier Fault as there are no lots or habitable structures designed south of the fault. However, a setback zone of 50 feet for habitable structures is required by State law.

It is the results of the recent AG fault study, on-going exploratory drilling and trenching work and review of the extensive body of previous geologic reports and maps pertinent to the property which has permitted the drafting of this EIR document. More detailed descriptions of geologic units, geologic structure and faulting are contained within the AG fault study and are incorporated by reference herein. Figures 1, 2 and 2A depict the surveyed location of the principal Whittier fault trace, its relationship to 100-scale conceptual design plan elements, and two generalized cross sections (modified from the fault report).

AG also completed a recent Phase I Environmental Site Assessment for the subject property and submitted it to the County of Orange for review (AG, 2012). According to the findings of this report there are a total of three active and four abandoned oil wells present within the boundaries of the development on the YLE/YT parcels. Figure 3 depicts the location of pertinent oil wells on the property (modified from the Phase I report). A discussion of impacts and mitigation measures associated with these wells is presented in the Geo-environmental Impacts/Mitigation Measures section of this review. More detailed information pertaining to geo-environmental conditions is contained in the Phase I report, which is incorporated by reference herein.

General Site Geology

Quaternary to recent age geologic units occur at the surface of the property including deposits of alluvium, colluvium, older elevated stream terraces and landslide debris. Shallow slides up to several feet in thickness include localized debris flows, earthflows and minor slumps. Bedrock units underlying the property are assigned to a series of deep-water marine sedimentary rocks of the Puente Formation. This upper Miocene age formation is further divided into Soquel, Yorba and Sycamore Canyon Members which outcrop across the property from north to south.

Thinly bedded silt and clay shales comprising the Yorba Member can be the source of moderate to large translational and/or rotational type landslides where bedding within hillside terrain is oriented out-of-slope or other adverse conditions exist. Existing geologic maps indicate areas of the property may be underlain by larger landslides, mostly within areas of steeply sloping canyon walls. A stereoscopic review of historical air photo pairs, LIDAR imagery, fault trench exposures, geologic surface mapping, field reconnaissance and the subsurface exploration findings of Seward (2002) suggest that if many of the larger landslides exist, they have a significant degree of surface erosion, may largely be eroded and masking of morphologic landslide characteristics.

General Geologic Structure

Geologic structure underlying the property can be defined as a generally consistent pattern of alternating anticlinal and synclinal folds with local areas of tight folding and high angle to overturned bedding. Cross sections A-A' and B'B' depicting certain existing structural conditions are presented herein as Figure 4 (modified from the AG fault report). The structure tends to be closely related to the orientation and morphology of major canyons and ridges. With increasing proximity to the Whittier fault zone, many axial folds are bent into a more northwesterly strike.

Faulting

The active Whittier fault zone transects directly through the southern YLE/YT parcel along a well-defined and continuous west-northwesterly trend. The fault represents the northern 36 to 40 kilometers of the more regionally well-known Whittier-Elsinore Fault Zone (W-EFZ) that stretches from the Mexican border on the southeast to Whittier Narrows northwest of the property. The occurrence of a large earthquake along the Whittier fault is expected to not only result in severe ground shaking but up to around 4 to 7 feet of lateral (horizontal) surface rupture displacement in a right-lateral strike-slip motion sense. Given its location and earthquake potential the Whittier fault poses the most significant seismic threat to the proposed development. The principal fault strand within the zone is expected to accommodate a majority of anticipated horizontal offset, while secondary faults may or may not experience sympathetic movement on the order of a few inches.

CONCEPTUAL DESIGN PLAN SUMMARY

There are presently three conceptual design plan options (Options 1, 2 and 2A) under consideration for the development. Construction of 334 and 340 single-family lots are proposed as part of the Option 1, 2 and 2A plans, respectively. Associated infrastructure will include internal roadways, parks, graded cut and fill slopes, bio-retention basins, underground water reservoirs, booster-pump pads, retaining walls, and multi-use trails for hiking, biking and equestrian use. Grading volumes are presently estimated to range from approximately 15 to 16 million cubic yards of raw earthwork cut.

The N/L parcel shows no discernible design changes for either of the Options 1, 2, or 2A plans. The differences in Options 1, 2, and 2A occur primarily on the western portion of the YLE and YT parcels. Primary design differences are the location of the primary and secondary routes proposed for access/egress, which affects the number of lots, locations of emergency fire roads and the use of retaining walls. The Option 1 plan depicts use of a greater amount of retaining walls than the Option 2 plan. The Option 2A plan utilizes a longer access road to connect with San Antonio to the south, which will require retaining walls as part of the design.

Grading for the development will be accomplished through conventional cut and fill methods including cuts and canyon fills exceeding 150 feet in some locations. Generally anticipated, as-built lot conditions are depicted on Figure 5. A majority of proposed slopes will be constructed at gradients of 2:1 (horizontal:vertical). The only slope designed at a ratio steeper that 2:1 (horizontal:vertical) within the development is a 280-foot high cut slope for installation of an access road extending northward of a large estate lot on the Nicholas/Long parcel. This slope has a design gradient of 1.5:1 (horizontal: vertical).

Conceptual design plan elements for each plan option are presented below by parcel area.

N/L Parcel – All Options

Maximum design cuts will range up to around 190 feet within the vicinity of "JJ" Street on the northwest portion of the parcel. The most significant fills will be on the order of 160 feet within Canyon "A" along the south N/L parcel boundary. A maximum design cut slope height of around 330 feet is proposed at the extreme northern edge of the parcel. The maximum fill slope height will be around 120 feet in height ascending to "Z" Street. The overall thickness of fill can be expected to increase by as much as 20 feet or greater following removal of compressible alluvium deposits in canyon areas.

Several existing natural slopes will remain adjacent to parcel margins following development, both ascending and descending away from the improvements. The natural slope with the greatest overall height will descend approximately 340 feet into a canyon off the northwestern margin of the parcel. A retaining wall is proposed across the axis of a tributary canyon that descends from building lots along the northwest development margin. The wall is of varying height, up to 23 feet, but may be designed as a series of tiered walls to support at least two building pads to the northwest of "GG" Street.

YLE/YT Parcels - Option 1

One prominent difference in design proposed under the Option 1 plan is conversion of the existing access road within Blue Mud Canyon for use as Esperanza Hills Parkway and the main route of development access/egress. The new road will be approximately 50 feet wide and closely follow the existing road alignment. Like the existing road it will descend northeasterly into the canyon bottom and exit northwesterly out of the canyon. A prefabricated bridge span with graded earth-fill abutments and perimeter retaining walls are proposed to accommodate the canyon crossing. The road will be supported by retaining walls with variable heights up to 45 feet high along the south canyon wall and up to 25 to 30 feet in sections along the north. Grading within the canyon will be avoided where possible so natural slope areas below the walls remain as open space. The roadway alignment will be constructed within the boundaries of the seismic setback zone and crisscross the principal trace of the active Whittier fault as it ascends the north canyon wall. A portion of the bridge structure will also encroach into the seismic setback zone as well. A fill slope will be constructed north of the road that ascends to and supports a series of residential building lots along "A" Street.

The Option I plan depicts construction of an emergency access road extending from the southern property line of the YT parcel through the Richards Trust parcel (a part of the Cielo Vista project), which connects other easements and dedicated roads to Via del Agua through the lower reaches of Blue Mud Canyon. Road grades will be achieved by construction of retaining walls along roadway margins of varying heights up to 35 feet. The roadway alignment will serve an easement for underground sewer and water utility lines.

A large bio-filtration reservoir is planned at the south end of the YT parcel, just south of the seismic setback zone for the Whittier fault.

Maximum design cuts will be on the order of 150 feet within the large ridge-cut near the vicinity of "O" Street. Maximum design fills will be up to around 160 feet within Canyon "A" separating the N/L and YLE/YT parcels. A switchback equestrian trail will transect a section of the slope across its entire height, and two WQMB basins and a booster-pump station are proposed near the top of the slope. Another major fill is designed within Canyon "B" across the central area of the YLE/YT parcels where up to around 150 feet of fill is planned. The highest cut slope will descend approximately 270 feet from the eastern parcel margin to "V" Street. The highest planned fill slope will ascend approximately 200 feet southward out of Canyon "A" to design grades along proposed Esperanza Hills Drive. The overall thickness of fill may increase by as much as 35 feet or greater following removal of compressible alluvium deposits in canyon areas.

Natural slopes will ascend and descend away from development margins following grading. The most significant will descend around 260 feet southward into Blue Mud Canyon from a series of lots along "J" Street.

The Option I design depicts the abrupt termination of a fill slope along the western YT parcel boundary which will require a series of tiered retaining walls. A series of residential building pads are proposed at higher elevations upslope from the wall/slope to the east.

A retaining wall of varying heights up to a maximum of 32 feet is proposed across the axis of a tributary canyon that descends from the rear of lots along "J" Street on the southerly YLE parcel.

YLE/YT Parcels - Option 2 & 2A

The design for Options 2 and 2A differ from Option 1 as far as the location of their main access/egress routes and use of substantially fewer retaining walls to achieve design grades. The Option 2 roadway will enter the western side of the development as an extension of Aspen Way, crossing two large diameter natural gas pipelines and the axis of Canyon "B" located on the proposed Cielo Vista project on the parcel owned by the Amos Travis Trust. The new 70-foot wide roadway would be accomplished by placement of fill within the canyon. A fill slope is to ascend out of the canyon to achieve roadway grades and beyond to a series of residential building lots along "C" Street.

Access to the development under the Option 2A design will be via Esperanza Hills Parkway. The road alignment will extend northward from San Antonio Road up the east side of Canyon "A" a distance of approximately 1,200 feet, then eastward into Canyon "B" another 1,200 feet to intersect proposed "G" Street. The Canyon "B" segment of this road will cross a portion of the Cielo Vista project (parcel owned by the Amos Travis Trust). The alignment will pass within approximately 350 feet of Aspen Way at its nearest point, and cross the Whittier Fault Zone within Canyon "B". Within Canyon "A" the road will generally parallel (but not cross) two natural gas pipelines existing within a Southern California Gas easement. Construction of the roadway would require use of a series of retaining walls along the route.

The unimproved roadway presently serving as access at the southerly area of the YLE parcel would be improved for emergency fire access use under both Options 2 and 2A. The roadway crosses the trend of the active fault near the bottom of Blue Mud Canon and parallels it along its northwestward ascent. No bridge or retaining walls are shown within Blue Mud Canyon. The roadway alignment will serve an easement for underground sewer and water utility lines.

A bio-filtration reservoir is planned at the south end of the YT parcel within the boundaries of the seismic setback zone for the Whittier fault zone. Storm drain runoff will discharged into Canyon "A" in at least two locations along the western YT parcel margin.

Proposed cut/fill slopes, cut/fill depths and construction of the tributary canyon retaining wall for support of lots along "J" Street are all consistent with those depicted as part of the Option 1 conceptual plan design (see above).

GEOTECHNICAL CONDITIONS BY PARCEL AREA

Western YLE/YT Parcels

Based on existing geologic mapping, the findings of our field reconnaissance and review of remote imagery (aerial photos and LIDAR files), the moderately steep westerly-facing natural slope (wall of Canyon "A") forming a majority of the western YLE/YT parcel boundary may be underlain by a moderate to large complex of ancient landslides. Bedrock within the slope and underlying the slides is assigned to the Yorba Member of the Puente Formation. The structure of the bedrock observed near

Street “C” is northwesterly striking, steeply dipping and tightly folded. Other mapping in the area indicates a northeasterly strike in closer orientation to Canyon “A”. The confluence of two major drainage areas (intersection of Canyons “A” and “B”) occurs in the adjacent low-lying area to the southwest. Lower canyon areas are underlain here by up to approximately 35 feet of soft, porous, compressible and likely saturated modern to Pleistocene age alluvial deposits. The active Whittier fault and adjacent seismic setback zone transect the canyon area along a northwesterly path immediately south of the existing terminus of Aspen Way.

Northern YLE/YT Parcels

Past studies suggest the presence of a moderate size landslide complex within the steep north-facing wall of Canyon “A”. Bedrock underlying the area is assigned to the Yorba Member of the Puente Formation. The lower areas of Canyon “A” are underlain by around 10 to 20 feet of compressible alluvium deposits.

Eastern YLE/YT Parcels

The ridges and canyons of this area are underlain by the Yorba Member of the Puente Formation and manifest in locally tight folds and high angle bedding. Plans for the area from north to south include a varied 140 to 270 foot-high composite fill/cut slope which descend to terraced building pads and streets. A buried water tank is proposed within the upper elevations of the slope. A new SCE access road will ascend the slope in a switchback alignment.

“K” Street and opposing building pads lie further to the south along the axis of Canyon “B”. Proposed canyon fills range up to around 100 feet in thickness. A flow-by catch basin is proposed at the head of Canyon “B”. Existing geologic mapping suggests the presence of narrow linear graben features across the southern ridge-top area of Canyon “B”. Previous trenching indicates the thickness of soil infill deposits may be around 15-feet deep (Reference 4). “I” Street and opposing building lots are proposed further south, bounded by a planned cut slope on the order of 190 feet in height. The existing SCE access road will be eliminated by its construction.

Southern YLE/YT Parcels

The southern margins of the YLE/YT parcels roughly coincide with Blue Mud Canyon. The trend of the canyon axis closely parallels that of the Whittier fault zone. Bedrock underlying the area is assigned to the Yorba and Sycamore Canyon Members of the Puente Formation. In general, the Yorba Member occurs on both sides of the fault while the Sycamore Canyon Member is mainly mapped to its south. As indicated on existing geologic maps and identified in recent AG fault trenches, a series of recent and potentially deeper ancient landslides occur along the northern wall of Blue Mud Canyon. A few anomalous depression-like graben features similar to those described above transect this area. Some investigators suspect these features consist of in-filled tensional grabens developed in response to large earthquakes and ridge-top shaking (ECI, 1998). The Whittier fault transects the northerly wall of Blue Mud Canyon.

An old stream terrace with eroded/dissected margins exists within the southern portions of the YT parcel which extends southward across the Sage parcel and into Blue Mud Canyon. The alluvial deposits underlying the terrace are dense, competent and strongly weathered. Deposits within the adjacent Blue Mud Canyon contain up to around 50 feet of soft, porous alluvium. Given their down-gradient hydrologic location at an enclosed depression and lush vegetation, it is possible that the alluvium here is compressible and saturated.

Western N/L Parcel

The western margin of the N/L parcel consists of a moderately steep natural slope that descends westerly into the adjacent canyon. A 340-foot high section of this slope will remain following grading. Geologic mapping indicates interbeds of sandstone and siltstone bedrock assigned to the Soquel Member of the Puente Formation strike northeasterly and dip steeply southeast. Local small to moderate-sized recent and ancient landslides are mapped within side-canyon swales in the area.

Northern N/L Parcel

The northern margin of the N/L parcel lies astride a prominent topographic ridge line situated approximately 1,540 feet elevation above MSL. Geologic mapping indicates the area is underlain by steeply dipping interbeds of sandstone to siltstone bedrock assigned to the Soquel Member of the

Puente Formation that have a northeasterly strike and steep southeasterly dip. A southerly facing cut slope is planned beneath the peak. Construction of a large buried water tank and nearby 2-acre estate lot are designed within the upper portion of the slope.

Eastern N/L Parcel

The eastern margin of the N/L parcel coincides with the upper northeasterly trending reach of Canyon "A". Geologic mapping indicates the area is underlain by interbedded sandstone and siltstone bedrock assigned to the Soquel Member of the Puente Formation with a northeasterly strike and steep southeasterly dip. Daylight fill lots are proposed along the easterly side of the canyon. A fill slope is proposed to ascend northwesterly out of the canyon to a location around "JJ" Street, where it will transition into a cut slope in its continued ascent to the north parcel margin. A potential moderate size landslide is mapped within the lower portions of the fill slope area. Flow-by debris basins are proposed at the heads of canyons at the northerly margin of the development. Removal of compressible alluvium and placement of fill will be required within the canyon to achieve design grades. The slope ascending from the daylight fill lots will remain natural following development.

The extreme southeast area of the N/L parcel consists of a moderately steep north-facing slope that descends into a major side canyon. Mapping presently indicates this area of the property is underlain by the Yorba Member of the Puente Formation consisting of northward dipping silty shales on the order of approximately 30 degrees. An analysis of LIDAR and aerial photographs suggest the slope area is underlain by a landslide. Plans call for construction of a 21-acre estate lot pad atop a combination 1.5:1 (horizontal:vertical) cut/fill slope. The slope will descend into and toe-out along the axis of the side canyon. A switchback access driveway will transect the face of the proposed slope. Proposed within the side canyon near the slope toe on the north side of the slope away from the lot are debris/detention and WQMP basins, an OCFA emergency staging area and a park area. The canyon contains an estimated thickness of alluvium of approximately 10 feet. Construction of these improvements will require removal of compressible alluvium and placement of fill within the canyon.

Southern N/L Parcel

The southern area of the N/L parcel consists of a moderately steep south-facing slope that descends into an east-west trending segment of Canyon "A". Existing maps indicate the slope is underlain by a major landslide complex and bedrock assigned to the Soquel Member of the Puente Formation. The canyon contains on the order of 10 to 15 feet of alluvial deposits.

Offsite Western Amos Travis Trust Parcel (Access Road for Option 2A)

Our geologic mapping along the eastern margin of Canyon "A" (western limits of the Amos Travis Trust Parcel and proposed Cielo Vista project) reveal the area is underlain at depth by conglomerates, sandstones and shales assigned to the Sycamore Canyon Member of the Puente Formation. This resistant and competent bedrock unit outcrops at the surface locally within the east wall of the canyon. In other sloping areas the bedrock is mantled by deposits of surficial slope wash, colluviums, and artificial fill. A modern flat-lying stream terrace borders the eastern channel margin within the lower reaches of the canyon and general area of the existing SCE easement. The eroded remnant of an Older Quaternary Terrace Deposit lies elevated in outcrop along the southeast portion of Canyon "A", composed of competent conglomerates and sand material supportive of steep slopes.

Geologic structure of the underlying bedrock exhibits bedding that ranges from vertical to very steep and northwesterly striking. Lower canyon areas are underlain by an undetermined thickness of alluvium that is likely dense to soft, porous, compressible, and possibly saturated.

GEOTECHNICAL IMPACTS & MITIGATION MEASURES

For the purposes of this review, geotechnical and engineering geologic impacts and mitigation measures relating to the development are designated as "Primary" or "Secondary" depending upon their significance.

Primary Concerns

Geotechnical and engineering geologic hazards posing the most significant impact to conceptual design plan implementation are categorized as "Primary" impacts herein. They are considered more significant as they are likely to require use of supplemental engineering structures to achieve adequate factors-of-safety in excess of conventional costs and practices commonly associated with remedial grading operations. Impacts within this category relate to the stability of proposed slopes including graded fill and/or cut slopes, slopes steeper than 2:1 (horizontal:vertical) and slopes to remain natural following grading. Slope stability is a particular concern where daylight cut and fill lots are proposed above or below natural slopes. Additional impacts include the stability of retaining walls to be constructed on sloped areas. Other primary impacts relate to surface rupture associated with a major earthquake along the Whittier fault. Elements of the conceptual plan could be damaged by right-lateral strike-slip and/or vertical offset anticipated within the seismic setback zone.

A discussion of "Primary" impacts and their relationship to conceptual design plans are presented below by project area.

Gross Slope Stability

Large graded cut, fill, or cut/fill combination slopes are to be constructed as part of the development. Most are designed at gradients of 2:1 (horizontal:vertical). Some are designed at steeper gradients up to 1.5:1 (horizontal:vertical). Other slopes of significant concern are natural slopes which will remain along project margins in descending or ascending configurations.

Both graded and natural slopes may be underlain by thinly bedded and tectonically folded sedimentary bedrock structure with adversely oriented bedding planes of low shear strength. Depending upon these and other factors there is a potential for the occurrence of translational (bedding plane) or rotational type landslide failures. Examples of translational and rotations landslides are depicted on Figures 6 and 7. Such failures pose a significant "Primary" impact to the development.

For description purposes a slope is considered to be in equilibrium where it is determined to possess a factor-of-safety of 1.0. Slopes calculated as having safety factors less than 1.0 are considered to be either failing or on the precipice of failure. In order to satisfy regulatory code requirements it will be necessary to demonstrate that a minimum 1.5 factor-of-safety can be achieved, either through remedial grading methods or installation of supplemental engineering structures.

Natural slope impacts relate to their overall height, gradient, unstable nature and requirements that they remain undisturbed by remedial grading. Where proposed building lots will daylight above or below natural slopes, gross stability will have a direct impact on the integrity of adjacent lots and associated improvements. Many of these slopes may not meet safety factors in their present configuration.

IMPACT: Design cut, fill and fill-over-cut slopes, and slopes to remain natural following grading may not meet minimum 1.5 factors-of-safety standards and pose a hazard to planned improvements and areas beyond the boundaries of the development from a gross slope stability standpoint. Design slopes steeper than 2:1 (horizontal:vertical) will not satisfy minimum grading code requirements, are likely to possess an even greater slope stability hazard, and may require more difficult grading measures and/or use of engineering structures to achieve minimum factor-of-safety requirements.

MITIGATION: Geologic conditions underlying design slopes and those to remain natural in areas adjacent to the development perimeter should be investigated and analyzed for gross stability in accordance with current geotechnical engineering practice. Design slopes determined to be grossly unstable can be stabilized by construction of buttresses or stabilization fills, flattening gradients, lowering overall heights, improving stability through use of tie-back/grade-beam systems, use of geogrid, use of cement-treated-soil or similar supplemental stabilization measures or combinations of these methods. Examples of graded slope stabilization measures which could be employed are depicted in Figures 8a, 8b, and 8c. Zones of weathered bedrock should be removed from back cuts and/or areas upon which new fill is to be placed. Where unstable slopes cannot be stabilized, building setback limits are likely to be imposed. Where larger landslides are suspected to exist, mainly in natural slope areas bordering the development, their presence, distribution and dimension must be investigated and conditions of gross stability analyzed.

Ground Rupture

Current earthquake magnitude estimates are such that M6.7 quakes could occur every 700 years and M7.2 quakes every 1,000 to 1,500 years (ECI, 1997) along the Whittier fault. Paleo-seismic studies in the nearby area indicate the last large earthquake along this fault segment resulted in around 4 to 7

feet of right-lateral offset and occurred more than 1,600 years ago. Movement is reportedly purely strike-slip along the fault, so a component of horizontal offset would mainly be expected. Depending upon surface topography however, a certain degree of relative vertical offset could be manifest.
In accordance with California law, construction of habitable residential structures will be avoided across the trace of the active Whittier fault or within the limits of an adjacent seismic setback zone. Other elements of the conceptual design plan can and will be constructed across or astride the fault within the setback zone. If not designed and constructed properly, structures could be damaged, destroyed, or rendered inoperable where affected by ground rupture. Other hazards include possible settlement in areas underlain by different earth materials or minor co-seismic slip along bedding planes.

IMPACT: Access roadways, retaining walls, and other infrastructure are proposed within the established seismic setback zone for the Whittier fault zone on the property which would be subject to a severe ground rupture hazard during a major earthquake. A majority of the ground rupture would be focused along the principal fault trace, but it is also possible that nearby bedding planes could also accommodate minor movement. The anticipated effects of ground rupture could destroy or severely damage improvements and infrastructure and are thus considered to be a significant impact. It is possible that the exact location of the main fault trace may need to be further constrained in areas of more critical design elements.

MITIGATION: Construction across the trace of active faults and/or outside the limits of the setback zone will be avoided where possible, and no residential lots are designed within the setback zone established for the Whittier Fault. Where access roads, retaining walls, bridge structures, or structural fills are planned within the setback zone the direction and magnitude of anticipated fault offset and severity of anticipated ground shaking should be incorporated into their design.

In the case of fault crossings, the number of times the active fault is transected should be limited by design, and the trend in which crossings are made oriented as nearly perpendicular (20 degrees east of north) to the trend of the fault as possible. These measures will help to focus the effects of expected fault displacement and reduce the overall area that measures of strengthened engineering design may be applied. Placement of structurally rigid or stiff structures should be avoided across faults. The prefabricated bridge structure to span Blue

Mud Canyon under Option 1 should not be positioned directly above an active fault trace if possible, or positioned to better accommodate expected fault offset.

Utility lines should incorporate flexible joints into their design to accommodate anticipated ground rupture in a right-lateral strike-slip sense.

Retaining Wall Stability

Conceptual design plans indicate use of a few retaining walls on the order of 15 to 50 feet high as part of the development. Some of these more significant walls will support access roads within Blue Mud Canyon or accommodate changes in grade along the western YT parcel boundary. The walls will mainly be constructed across the face of significantly high natural slopes with ratios steeper than 2:1 and result in combined wall+slope heights up to around 200 feet in height. Some will span side-hill swales. Existing mapping suggests the presence of local landslides and surficial failures within the above slope area.

IMPACT: Retaining walls with significant combined wall/slope heights to be constructed across steep and unstable natural slopes may not meet minimum factors-of-safety for gross stability. Some slopes may also be underlain by landslides where gross stability is not possible without grading. These impacts would be considered significant.

MITIGATION: Geotechnical investigations and engineering analyses will be necessary to evaluate retaining wall design and stability, establish foundation design recommendations and determine conditions of gross and surficial stability of overall wall/slope combinations. In surficially unstable slopes, where no remedial grading is permitted, wall foundations may need to be strengthened to accommodate a potential loss of lateral support. Where grading is possible, it may be possible to grade a slope to establish acceptable wall foundation conditions. Alternatively, it may be possible to grade potentially unstable slopes incorporating soil reinforcement. Where natural slopes are grossly unstable, possible relating to the presence of a larger landslide, it would likely be necessary to stabilize or buttress the slope through grading methods. Where grading is not permitted under these conditions, structural stabilization is possible through the design of retaining walls and/or soldier pile walls, tie backs, or some combination of both.

There are several employable options to stabilize and/or retain earth materials on the property to implement the design. These can include mechanically stabilized earth (MSE) systems, geogrid reinforced fills, soldier pile walls, use of tie-back anchors and/or combinations of these methods. Geogrid-reinforced Loffelstein or similar walls could also be used mid-slope to help flatten overall slope gradients. Examples of typical soldier pile/tie-back retaining wall systems that could be employed to stabilize the access road in Blue Mud Canyon under the Option 1 plan are depicted on Figures 9a and 9b.

Secondary Concerns

"Secondary" impacts are those which can be mitigated by more conventional construction grading practices and costs. These impacts relate to surficial slope stability, strong ground shaking associated with earthquakes, deep fill settlement in canyon areas, differential settlement across steep cut/fill transitions, and compressible soils in areas of proposed fill. Additional impacts listed under this category relate to the effects of potential liquefaction, problematic soils, the control of groundwater (either from natural and/or expected future irrigation sources), rippability of harder sandstone bedding and disposal of oversize materials, the effects of expansive soil and differential bedrock heave, corrosivity of soils to metal and concrete elements and problematic existing infrastructure are also designated under this category.

A discussion of these constraints by project area and how they relate to the conceptual design plans is presented below.

Surficial Slope Stability

Surficial slope failures have occurred and may occur on natural slopes across the property in the future. Earth materials involved in these failures typically include loose accumulations of soil, vegetation and other debris mantling the slope surface or shallow fractured bedrock that is weakened by weathering. Failures are typically local in scale and on the order of a few feet thick. Failures involving unstable soils include debris flows, earthflows and slumps. Examples of typical surficial slump and mud-debris flow failures are depicted on Figures 10 and 11. Failures involving bedrock include wedge or block-rock falls where planar geologic structures (bedding, joints, faults, etc.) intersect, or shallow landslides involving zones of weathered bedrock.

The occurrence of slope creep or rock creep can be categorized as a type of surficial failure, as the slow movement of rock or soil down-slope in response to gravity can progressively affect improvements such as property-line or screen walls, swimming pools and hardscaping or flatwork located within its sphere of influence. The occurrence of environmental slope creep is depicted diagrammatically on Figure 12.

Related impacts are more commonly associated with natural slopes but may also occur within engineered fill slopes that are buttressed or stabilized as part of a finished development. Of particular concern are areas where natural drainage swales exist above or below the development. Other impacts can include accumulations of mud and debris along the base of a slope or the destabilization of adjacent upslope areas where the scar of these failures encroach into existing building lots. Impacts from surficial slope failures are considered to be potentially significant and categorized herein as a "Secondary" impact.

> IMPACT: The occurrence of surficial slope failures within natural slopes abutting the development could pose a significant impact to graded areas. To a lesser degree these failures can also occur within finished graded slopes. While the failures have the potential to undermine improvements constructed along the rear of lots that daylight above natural slopes, the same types of failures could also impact graded areas where natural slopes ascend away from the development. The occurrence of such surficial failures is categorized herein as a potentially significant "Secondary" impact.
>
> MITIGATION: Natural slope areas to remain adjacent to the development should be investigated from the perspective of potential surficial failure hazards, analyzed for stability and estimated volumes of failure material determined. Impacts to graded areas abutting descending natural slopes can be mitigated through establishment of setback zones or design of a bench in the upper slope that would reduce the potential for failures to migrate into graded areas.

Areas of significant rock creep influence might require use of tie-backs and structural sheets to protect against this phenomenon. Figures 13a and 13b depict types of possible slope creep mitigation.

In areas where daylight fill lots lie adjacent to ascending natural slopes, building pad elevations could be raised and toe-of-slope catchment troughs designed as areas into which the failure materials could accumulate with little impact. In areas where a more significant volume of debris is expected, such as an area situated within the path of adjacent natural drainage swale, impact or deflection walls could be installed. Surficially unstable cut or fill slopes can be mitigated through use of design stabilization fills typically the width of standard grading equipment.

Strong Ground Shaking

As the active Whittier fault crosses the southerly portion of the YLE and YT parcels, the property could be subjected to severe degree of ground shaking resulting from a major earthquake along this segment of the fault. Peak ground accelerations could exceed 1.8 g. The level of intensity generated by ground shaking could be as high as "X" (defined as intense) on the Modified Mercalli scale of intensity. A "X" category on this scale indicates that many well-built structures could be destroyed, collapse, or moderately to severely damaged or shifted off their foundations.

The shaking could also cause localized slope deformation and/or trigger slope failures in graded and natural slope areas, potentially leading to structural damage. Uplift of the ground surface and/or the continued propagation of existing folds could occur on a more regional scale which could damage or alter the flow of buried utilities. The integrity of side-hill fills and retaining walls could also be impacted in the event of any related slope deformation.

IMPACT: The potential impact to structures and other improvements due to strong ground shaking generated by a large earthquake along the Whittier fault is considered a significant impact.

MITIGATION: A fault study including excavation and logging of several exploratory trenches, identification of active fault traces, and establishment of an appropriate seismic setback zone should be performed. These tasks were recently completed by AG, and their report was approved by the County of Orange in 2012. The location of the main fault strand was documented using civil survey control and a seismic setback zone established ranging in width between 50 and 120 feet to the north of the most active fault trace. The surveyed location of the main fault trace and setback zone is depicted on conceptual design plans, and habitable lots have been eliminated from within this zone on each plan Option. .

Structural damage to residential and other critical structures and infrastructure caused by strong ground shaking can be minimized through use of structural engineering design appropriate for the level of anticipated shaking. Applicable building codes and standard design practices should be incorporated into construction where appropriate.

Deep Fill Settlement

Fill greater than about 40 feet in thickness can be expected to settle under its own weight. The rate of settlement depends upon fill composition and overall thickness, the ability of the fill to displace pore waters during settlement, and other geotechnical criteria associated with its placement including degree of mechanical compaction. The general types of deep canyon fill settlement and related damage risks are presented in Figure 14a. As a general rule of thumb a sandier fill will settle at a greater rate than a clayey fill. Design fills greater than 40 feet deep are planned for several locations, including Canyon "A" between the N/L and YLE/YT parcels and Canyon "B" across the central YLE/YT parcels where the thicknesses will be approximately 180 and 150 feet, respectively.

IMPACT: Primary (short term) and Secondary (long term) settlement can be expected to affect fill bodies greater than 40 feet thick. The amount of settlement could be up to several inches or even greater than a foot in some cases, and require considerable time to occur. Impacts of this settlement are considered significant not only from the potential damage it can impart to elements of the conceptual design, but also the lengthy overall time required for primary settlement to occur, which may take up to several years depending upon fill composition and methods of emplacement. Not until monitoring data confirms the arrest of primary settlement will restrictions to construction of improvements, including utilities, be lifted. Figure 14b depicts certain potential fill settlement impacts.

MITIGATION: The magnitude of settlement should be investigated and estimates of time required for primary and secondary settlement determined. If many years of settlement time are available then deep fills could be placed using conventional 90 percent relative compaction and above-optimum moisture standards. Common practice is for fills greater than 40 feet thick to be placed at an elevated compaction standard of 95 percent relative compaction. If an even shorter time period is required to achieve settlement then a system of vertical wick-drains could be installed within the fill body to facilitate pore water displacement and accelerate the process. Supplemental grading measures could also be implemented such as placement of surcharge fills.

Steep Cut/Fill Transitions

Where removal contacts between new fill soil and bedrock removals are greater than approximately 1.5:1 the amounts of differential fill settlement which can occur in an area projected upward from the contact can be excessive. Conceptual design elements constructed across such areas could be damaged as a result of settlement. This condition is expected to be emphasized the most where cut/fill boundaries exist between steep natural canyon removals and areas of mass cut. The magnitude of this settlement could be on the order of several inches. The duration of settlement is somewhat different compared to deep vertical fills due to the long term dynamic interaction between fill, bedrock, and groundwater along the contact and component of creep.

IMPACT: The potential damage to conceptual design elements due to anticipated differential settlement in areas above steep daylight fill/cut contacts is considered a significant impact. Generalized cut/fill transition impacts to building lots are depicted on Figure 15.

MITIGATION: A variety of conventional engineering measures can be implemented to mitigate the impacts of excessive differential settlement in cut/fill transition areas. Some of these measures include a flattening of removal profiles to 2:1 or shallower, deepening over-excavation of building pads within zones of expected impacts, use of higher compaction standards, limiting construction of certain improvements within structural setback zones, or construction of stiffened foundation systems including post-tension foundations, caisson walls or mat slabs will reduce the effects of this phenomenon.

Compressible Soils

The impacts of compressible soils herein refer to deposits of recent alluvium within the boundaries of modern stream channels and accumulations of slope wash or colluvium near the base of natural slopes or within side-hill swales. Surficial soils are also categorized within this group but as they are commonly thin on steeper natural slopes and would be removed during conventional grading operations. Hazards associated with compressible soils typically occur as settlement and a loss of support in areas where structural fill has been placed against or above such deposits. The resulting compression tends to destabilize the structural support capability of the fill and promotes damage to structures within the influence of the settlement. Compressible soils will likely pose the most significant impact in development boundary areas, where their removal will be necessary in order to achieve lateral support for proposed fill slopes or daylight cut lots. It is common to establish a prism of structural fill beyond the limits of a fill toe which in many cases is also beyond the limits of grading. Removal distances are dependent on the thickness of the compressible soils in the area and gradient of the natural slope below the fill. Necessary removals typically project beyond the toe of a fill key at ratios of around 1:1. Shallower 1.5:1 or 2:1 projections may be warranted where landslides are present. Removals would extend furthest on the steepest slopes.

The removal of compressible soils to establish structural fill prisms becomes significant where the toe of descending fill slopes is designed mid-height along a natural slope, above sloped areas to otherwise remain natural. One such area where this will occur is along Blue Mud Canyon in association with the proposed main road and retaining walls designed under Option 1. A similar condition occurs along Canyon "A" where the toe of the proposed fill slope occurs in a deposit of thicker alluvium and adjacent active stream channel. Similar concerns of slope stability are associated with natural slopes below daylight cut lots occurring in many locations throughout the property. Where restrictions to offsite grading occur, it is likely that structural support will need to be achieved through other supplemental methods such as pin piles. Use of any such support structures would be an added cost to grading and considered a significant impact.

IMPACT: Compressible soils within the influence of proposed structural fill will impact the stability of design fill slopes and daylight cut lots due to settlement and/or a loss of lateral support and potentially damage improvements. Where removals cannot be extended beyond the limits of grading it may be necessary to employ supplemental engineering methods to achieve stability. The above issues would be a significant impact.

MITIGATION: Removal and re-compaction of compressible native soils could be performed in areas of proposed structural fills to minimize settlement of new fill and/or prevent a loss of lateral support. The areas where impacts are most significant will be along the toe of fill slopes in lower canyon areas or spanning side-slope drainage swales, where adjacent areas are to remain natural. The limits of the removals will need to extend beyond conceptual plan boundaries and possibly beyond the limits of grading and into areas to remain natural. In areas where no removals are permitted beyond the boundaries of the design, possibly in areas where slopes are coincident with property boundaries, it may be necessary to install engineered structures such as pin piles to achieve property slope stability.

Liquefaction

Liquefaction is defined as a failure of structure in loose medium-grained soils in the presence of high groundwater due to an increase in pore pressure and resulting loss of shear strength induced by strong ground motion typically resulting from a large earthquake. The potential for liquefaction is limited to deposits of recent alluvium occurring within modern drainage channels. The most significant areas of liquefaction concern exist within Canyons “A” and “B” where grading of roadway fill is proposed to support the main routes of access for Options 2 and 2A. Another area exists along the alignment for an emergency fire access road where it crosses Blue Mud Canyon south to Via de Agua across the Cielo Vista project on the parcel owned by the Richards Trust.

IMPACT: Seismically induced ground shaking from a large earthquake in southern California could trigger the liquefaction of recent alluvium deposits on the property and result in settlement which could in turn damage proposed infrastructure and improvements. This would be a significant impact.

MITIGATION: Conduct geotechnical investigations of recent alluvium deposits in order to evaluate the potential for liquefaction and incorporate the findings of the studies into the design of structures proposed in these areas. Mitigation measures could include in-situ ground stabilization, use of deep piles for foundation support or dewatering practices.

Corrosive Soils

Corrosive soil types are categorized herein as being corrosive to metal, mainly steel and concrete elements. Where the chemistry of certain soils is corrosive to a degree that concrete and steel are weakened, the strength and integrity of foundations can be jeopardized.

IMPACT: Soils corrosive to metals and concrete would pose a significant impact to proposed improvements.

MITIGATION: Geotechnical studies should be conducted to evaluate the presence/absence and general locations of corrosive soils. Laboratory testing should be conducted to evaluate the chemical character of fill soils and the results used to formulate appropriate foundation design criteria. Mitigation measures available to reduce the adverse effects of corrosive soils could include use of concrete types that are resistant to corrosion (e.g., dense, water-tight concrete), steel that is coated to protect against corrosion or isolating foundation elements from corrosive soils through use of selective grading. In the case of block masonry, dense concrete stem walls can be elevated a few inches above grade to remove the more porous block masonry from contact with mineral laden soil.

Groundwater

Groundwater on the property is currently confined to permeable deposits of alluvium within the lower reaches of drainage canyons. The groundwater tends to perch above bedrock in these areas. For all effective purposes the bedrock underlying the property is considered impermeable. The potentiometric groundwater surface (height of the water table) tends to fluctuate in response to seasonal rainfall amounts. It is anticipated that implementation of the conceptual design will dramatically increase the amount of subsurface groundwater, mostly relating to residential landscape irrigation activities common to such developments. Common methods of subsurface groundwater control include use of subdrain networks in areas along which groundwater is expected to occur (bedrock/fill contacts or within the bottom of canyon cleanouts). The drains typically consist of perforated Schedule 40 PVC pipe surrounded by highly permeable 3/4-inch rock, all encased in a protective geo-filter fabric. Connecting solid pipes are directed to safe discharge locations such as storm drains, drainage ditches on finish slopes or into nearby canyons.

IMPACT: The great volume of water that will be introduced into the subsurface as a result of irrigation will dramatically alter groundwater levels and migration pathways. These conditions will pose a significant impact.

MITIGATION: A variety of mitigation measures commonly implemented as part of conventional earthwork grading can be employed to control groundwater. These include a network of subdrains and back-drains in areas of expected groundwater or active seepage.

Rippability and Over-Size Rock Disposal

A majority of bedrock on the property is expected to be easily rippable using conventional grading equipment such as large dozers with ripper-teeth and scrapers. It is possible that hard sandstone beds and/or concretions up to several feet thick may exist locally within bedrock formations on the property. The Soquel Member of the Puente Formation within the northern portion of the N/L parcel is a more likely deposit where these conditions might be encountered. Although they may require additional effort or equipment to break up or remove, they still fall under the category of rippable and would not require extreme measures such as blasting.

Should large boulders be encountered on the project it is anticipated these can be disposed of on the property within areas of deep fill in accordance with an established geotechnical protocol.

IMPACT: The presence of significant amounts of hard cemented sandstone or concretions would pose an impact to the development from the standpoint of excavation and disposal.

MITIGATION: The excavation and breakdown of localized cemented sandstone bedrock and concretions, if present, is expected to be feasible using conventional grading equipment. Disposal of such material could be accomplished by supervised placement incorporating proper details in deep fill areas during grading.

Expansive Clay Soils and Bedrock Heave

Impacts associated with expansive clay soil and heaving bedrock relate to the adverse effects these materials can have on the structural integrity of foundations and other improvements. In soil form on graded projects, expansive soil materials typicality occur as part of engineered fill mixture derived from areas of bedrock cut. Some impacts of this condition to improvements are depicted in Figure 16. Expansive materials can also exist as relatively thin sedimentary bedding within in-situ bedrock, exposed in areas of cut. When subjected to moisture these materials tend to swell and can transfer significant upward forces into overlying earth materials and/or buildings. These conditions are generally depicted in Figure 16. Owing to the variable distribution of expansive soils within a fill, the distribution of forces and magnitude of swelling is usually uneven, as are damages. Where cut areas expose high-angle bedding structure and an alternating pattern of expansive/non-expansive lithology, expansive clay beds subjected to moisture can heave relative to non-expansive beds. This phenomenon could result in a correlative pattern of heave and damage distribution.

IMPACT: Expansive fill soil mixtures and/or areas underlain by expansive high angle clay beds within bedrock cut, can damage a foundation or other infrastructure upon wetting. The occurrence of this phenomenon would be considered a significant impact.

MITIGATION: Geotechnical studies should be conducted to evaluate the occurrence and character of expansive clay soil on the property, its use as fill, and lithologic distribution within bedrock. Criteria for foundation design can be formulated to mitigate associated hazards. Mitigation measures available to reduce possible adverse effects of expansive soil may include selective grading methods including placement of adverse clay soils in deeper fill areas, or within non-structural fill areas. Post-grading studies and testing should be conducted on finished building pads (at depths consistent with foundation bottoms) to verify the adequacy of foundation design. Deeper overexcavation and recompaction depths can be performed in areas where bedrock heave is expected, further vertically separating threats from areas of proposed foundations and/or improvements. All standard construction and foundation design practices should be employed. Specially designed, stronger and stiffer foundation systems are generally adopted for expansive environments.

Problematic Existing Infrastructure

Problematic infrastructure is described herein as those structures that presently exist within the influence of the conceptual design plans and may be adversely impacted by proposed grading and/or construction activities. Two existing large-diameter natural gas pipelines buried within a Southern California Gas easement are an example of such a structure. These pipelines extend along the western boundary of the Sage parcel. Minor cuts and fills are proposed in order to construct the road to Aspen Way across this easement as a part of the Option 2 plan. Use of special supplemental engineering structures and/or grading methodology may be required in order to establish a stable roadway, and/or maintain/protect the integrity of the pipelines during grading. Although the lines will not be crossed by the access road under Option 2A, it is possible that remedial grading for the road could encroach up to the boundaries of the easement. Excavations may require use of special methods such as slot-cutting or segmental removals in order to maintain the integrity of the lines.

A second problematic infrastructure is the regional Southern California Edison electrical transmission line system crossing the easterly margins of the property. At least two significant cut slopes are proposed within close proximity to the towers. It will be imperative that the integrity of the transmission towers be maintained during rough grading. Special grading techniques or supplemental engineered structures may be warranted to maintain short term and long term stability.

IMPACT: It is possible that the stability of existing natural gas pipelines and electrical transmission towers could be adversely affected as a result of grading activities. The configuration of the conceptual design plans may also adversely impact the stability of this existing infrastructure. In the worst case scenario a failure of temporary backcuts or removals could occur that resulting in the loss of support and possible catastrophic failure or disruption in infrastructure service. This would be a significant impact with disastrous consequences.

MITIGATION: Geotechnical investigations and engineering analyses should be conducted in areas where proposed roadways cross existing natural gas pipelines, and transmission towers exist adjacent to proposed cut slopes. Recommendations should be formulated to protect the integrity of this infrastructure both temporarily during grading and long term following grading.

GEO-ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Oil Wells

A total of three "active" and four "inactive" (or previously abandoned) oil wells are located within the boundaries of the YLE/YT parcels as documented by the State of California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) online database. Individual oil well numbers referred to herein are consistent with those published within the database. A summary of DOGGR findings is presented in the below table.

Well site numbers 1, 5, and 9 are recorded as having active oil pumping activity. It is proposed that some of these wells remain operative following site development but may be relocated pursuant to an agreement between the owners of the Richards Trust and Amos Travis parcels and the proposed Cielo Vista project developers. Oil well sites 13, 14, 15, and 24 are reported as abandoned. Field locations of the abandoned wells are identified by level pads graded into hillsides and the presence of local concrete tie-downs. Historically, non-productive wells were abandoned in accordance with standard practices at the time they were originally drilled and may not comply with current regulatory criteria for safe oil well abandonment. No physical evidence of well casing, piping or concrete pads were observed at abandoned sites. At this time it is uncertain if the well casings remain intact below the ground surface or how the wells were capped.

OIL WELL SUMMARY TABLE

Well Reference Number	Existing Well Condition	DOGGR Database Well Operator Name	Operator Well Number	DOGGR Database Well Lease Name
1	**Active**	Gary A. Darnell, Trust	1	CRA Texas A.U.W.C.
5	**Active**	Santa Ana Canyon Dev. Corp.	2	Reeves
9	**Active**	Santa Ana Canyon Dev. Corp.	3	Reeves
13	**Abandoned**	Petrominerals Corp.	2	Anaheim Union Water Co.
14	**Abandoned**	Terra Resources, Inc.	3	Westpet-Texas A.U.W.C.
15	**Abandoned**	Petrominerals Corp.	3	Anaheim Union Water Co.
24	**Abandoned**	Petrominerals Corp.	1	Anaheim Union Water Co.

Except for minor oil-stained soils and excess oil ponded within containment areas adjacent to well heads, no areas of natural surface oil seepage or oil-bearing bedrock is notable on the property that might pose an impact to grading logistics, schedules or cost.

A total of five above ground storage tanks and associated pipelines are present on the property. These structures and piping represent potential obstructions and sources of accidental or unauthorized releases of oil or hydrocarbon product if disturbed during development of the property.

IMPACT: Design grades will be either raised or lowered in areas of previously abandoned oil wells. Remedial grading activities in areas of proposed fill and removal excavations in areas of design cut would pose a significant impact from a re-abandonment cost standpoint. Significant impacts will also be incurred where it is necessary to avoid and/or protect the integrity of active oil operations and facilities from the effects of remedial mass grading.

Based on the historical and current use of the property as part of an active oil field, the potential exists for the property to be locally impacted by oil spills, leaks, or overflow during the transfer and storage of oil product. It is also possible that hidden pits or accumulations of drilling mud containing elevated levels of hydrocarbons and/or heavy metals may exist within the immediate vicinity of the wells although none have been observed to date. Should any of the above issues exist they would be considered a significant impact depending upon the limits and types of hazardous materials encountered.

MITIGATION: A Phase II Environmental Assessment can be conducted prior to grading which may include performance of a geophysical survey. This survey could specifically identify the location of abandoned wells, and any hidden pits or accumulations of drilling mud in the vicinity of the wells. The assessment could also include review of available well logs and abandonment documentation in order to verify the regulatory compliance of previously abandoned wells. Any pits encountered as a part of this process, or during grading, could be mitigated through environmental sampling, laboratory analyses and disposal at a proper hazardous waste facility. Impacts related to abandoned piping and storage facilities can be mitigated through removal of these elements from the property.

Areas of oil stained soil can be mitigated/cleaned in compliance with current regulatory standards and practices.

Respectfully submitted,

AMERICAN GEOTECHNICAL, INC.

exp 12-31-13

PROFESSIONAL GEOLOGIST
JEFF L. HULL
No. 2056
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Jeff L. Hull, CEG 2056
Chief Engineering Geologist

JLH/DW:re/dl

Distribution: 2 – Addressee (Regular Mail and PDF via Email: dwymore@q.com)

wpdata/oc/33366-03.jlh.dw.re.dl.august.2013.GeotechnicalReviewOfConceptualDesign

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3) Earth Consultants International, 1998, "100-scale Geologic Constraints Map and Estimated Thickness of Alluvium and Landslide Debris, Murdock Company Properties near Yorba Linda, Orange County California", dated February 10, 1998.

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9) United States Geological Survey, 7.5-Minute Topographic Quadrangle, Prado Dam California 1964, photo revised 1981.

10) United States Geological Survey, 7.5-Minute Topographic Quadrangle Yorba Linda California 1964, photo revised 1981.

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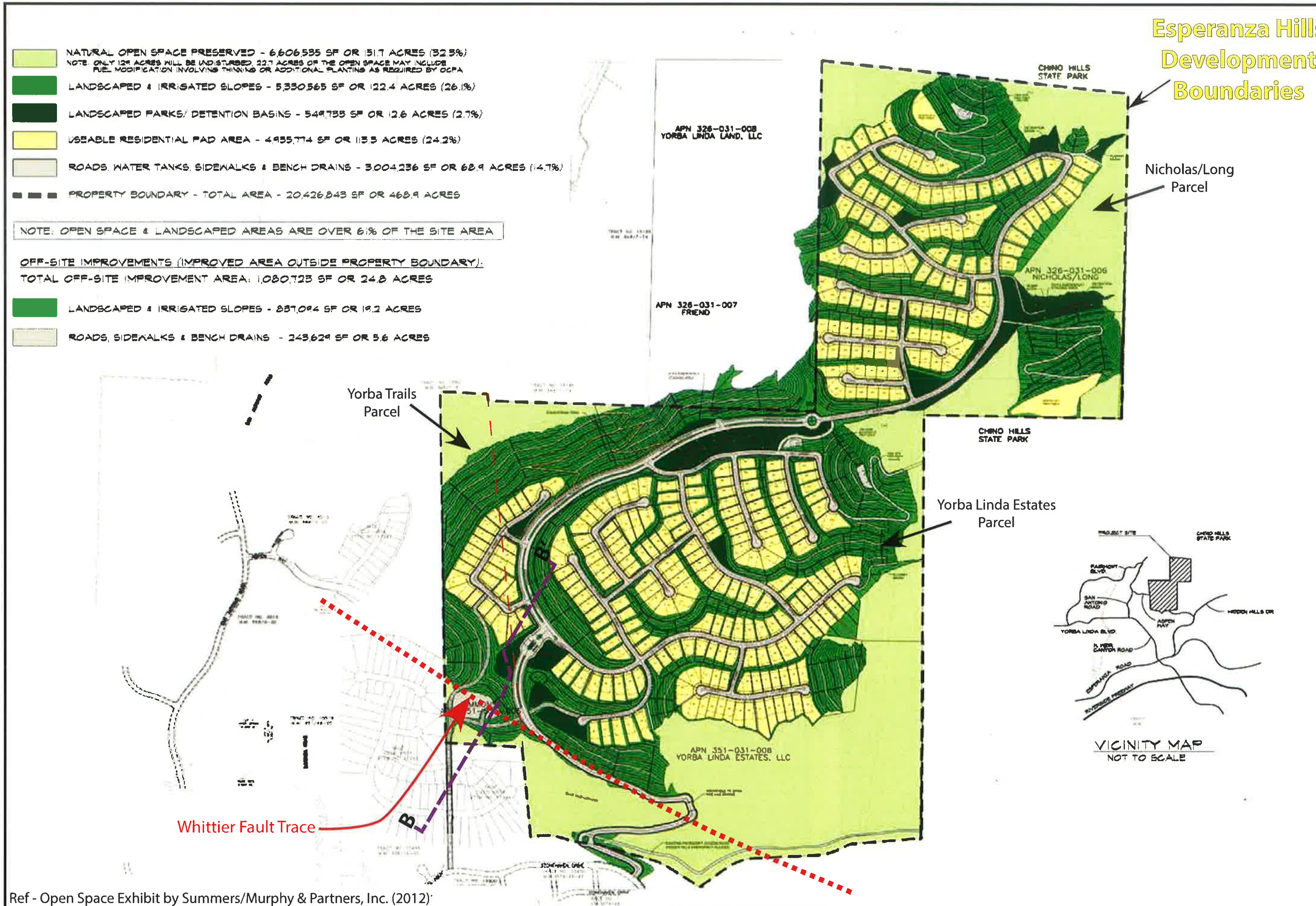


REVISIONS

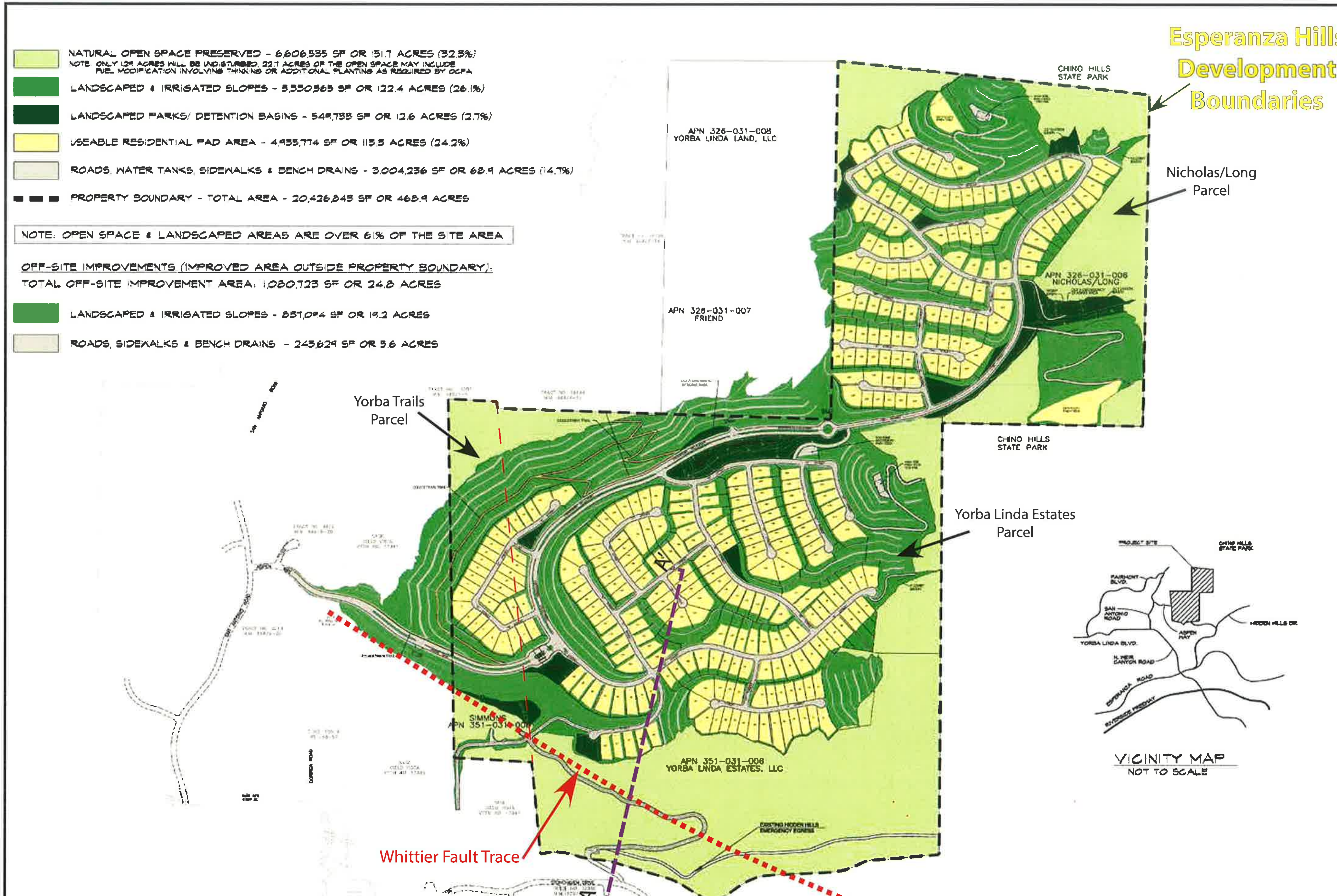
AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Esperanza Hills Conceptual Design Plan
Option 1
Yorba Linda Estates
Yorba Linda, CA

File No. 33366-03

Date : MARCH 2013

Figure 1



Ref - Open Space Exhibit by Summers/Murphy & Partners, Inc. (2012)

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AMERICAN GEOTECHNICAL, INC.

22725 Old Canal Road, Yorba Linda, CA 92887

PHONE: (714) 685-3900, FAX: (714) 685-3909

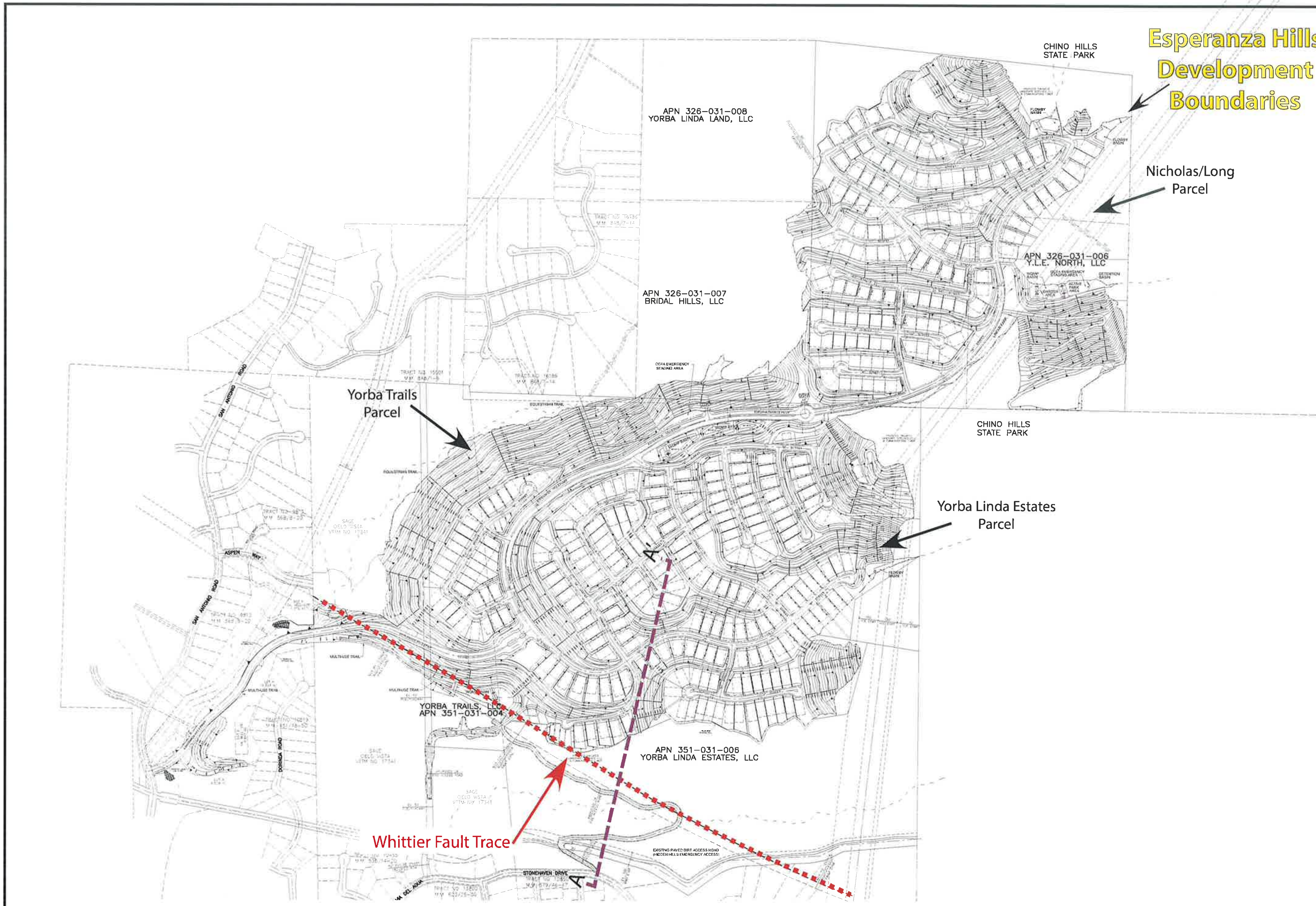
Esperanza Hills Conceptual Design Plan
Option 2

Yorba Linda Estates
Yorba Linda, CA

File No. 33366-03

Date: MARCH 2013

Figure 2



REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

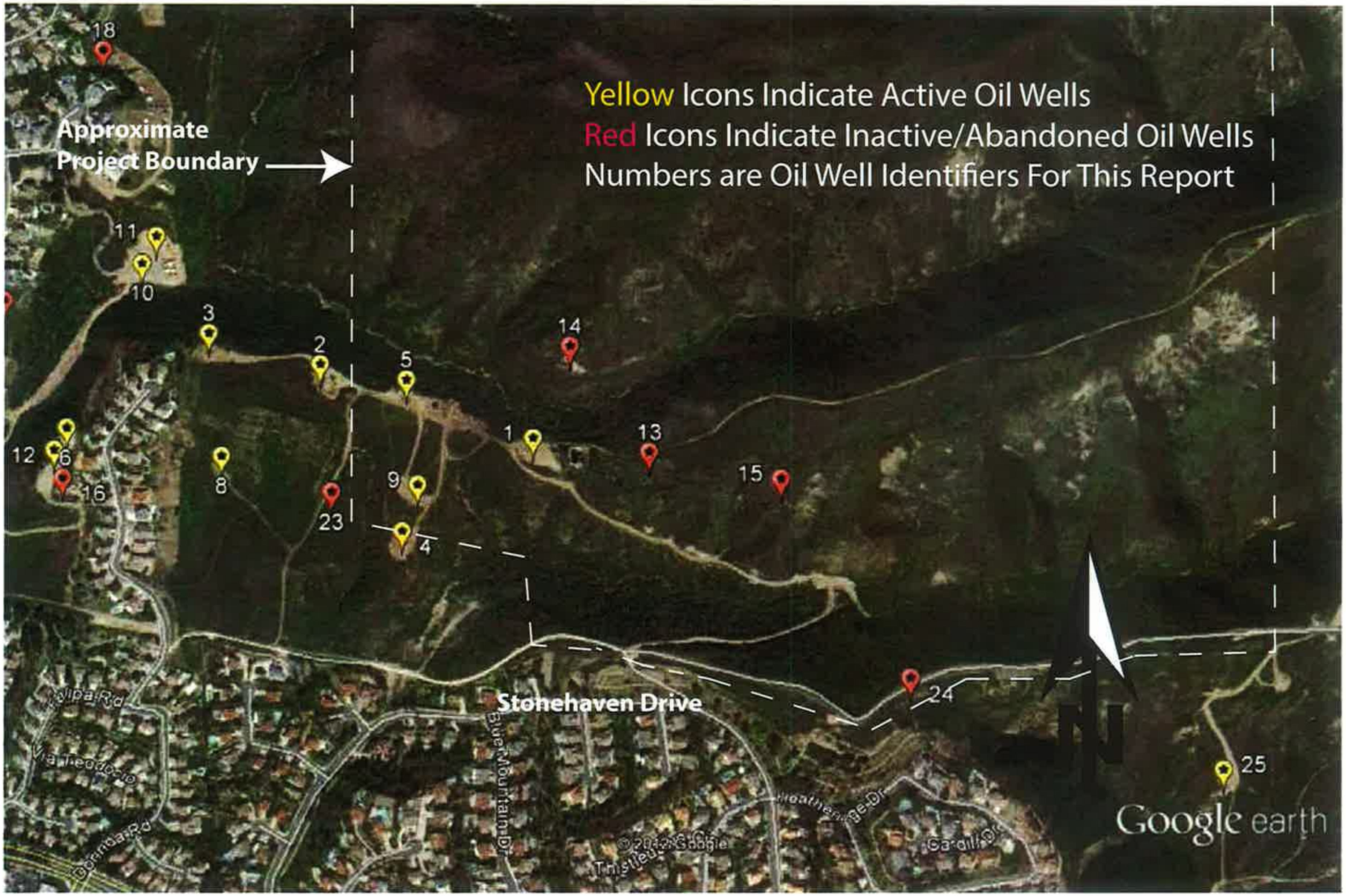
Esperanza Hills Conceptual Design Plan
Option 2A

Yorba Linda Estates
Yorba Linda, CA

File No.
33366-03

Date :
JULY 2013

Figure 2A



American Geotechnical, Inc.
22725 Old Canal Road, Yorba Linda, CA 92887
Phone: (714) 685-3900, Fax: (714) 685-3909

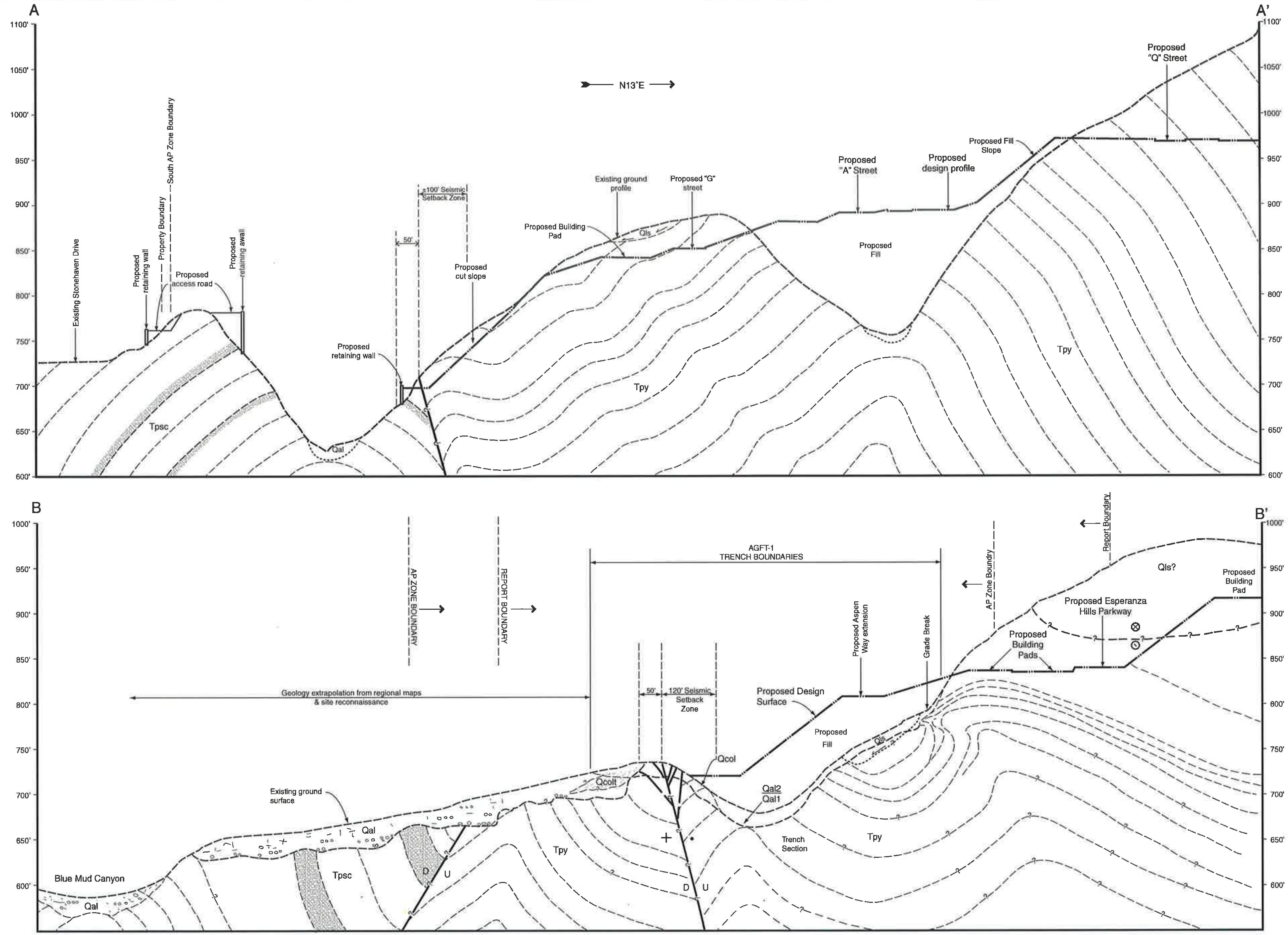
YORBA LINDA ESTATES, LLC.
COUNTY OF ORANGE, CA

ON-SITE OIL WELL LOCATION PLAN

F.N. 33366.03

MARCH 2013

FIGURE 3



NOTE: SETBACK ZONE SOUTHWEST OF PRINCIPAL FAULT TRACE TO BE ESTABLISHED AS PART OF PENDING STUDIES.

Cross Section A-A' & B-B'

Date:	File No.:	Plate No.:	Scale:
MARCH 2013	33366.03	FIGURE 4	HORZ. 1"=100' VERT. 1"=50'

American Geotechnical, Inc.
22725 Old Canal Road, Yorba Linda, California 92887
Tel. (714) 685-3900 Fax. (714) 685-3909
www.amgt.com

Generalized Graded Lot Types

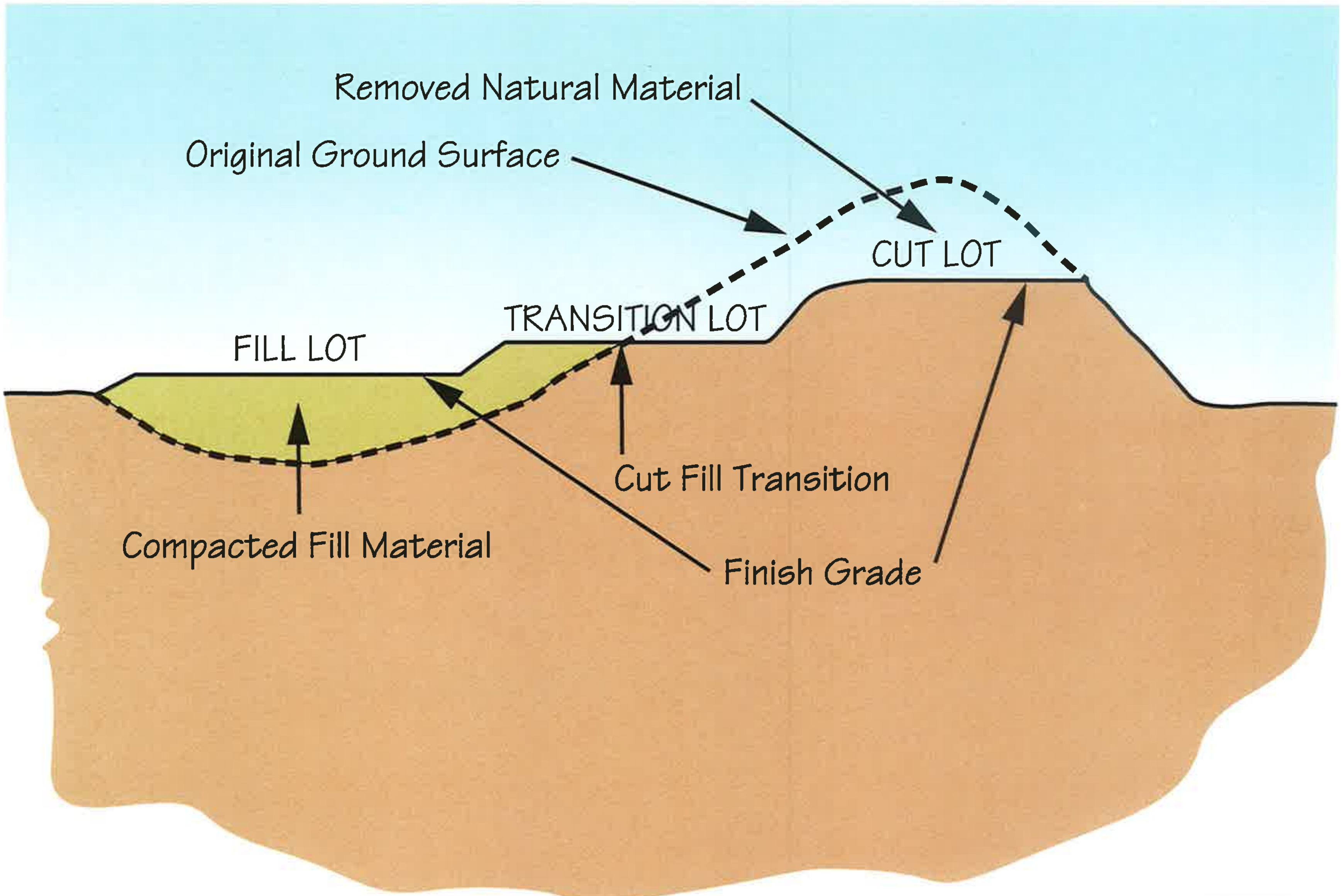


FIGURE 5
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Typical Translational Landslide

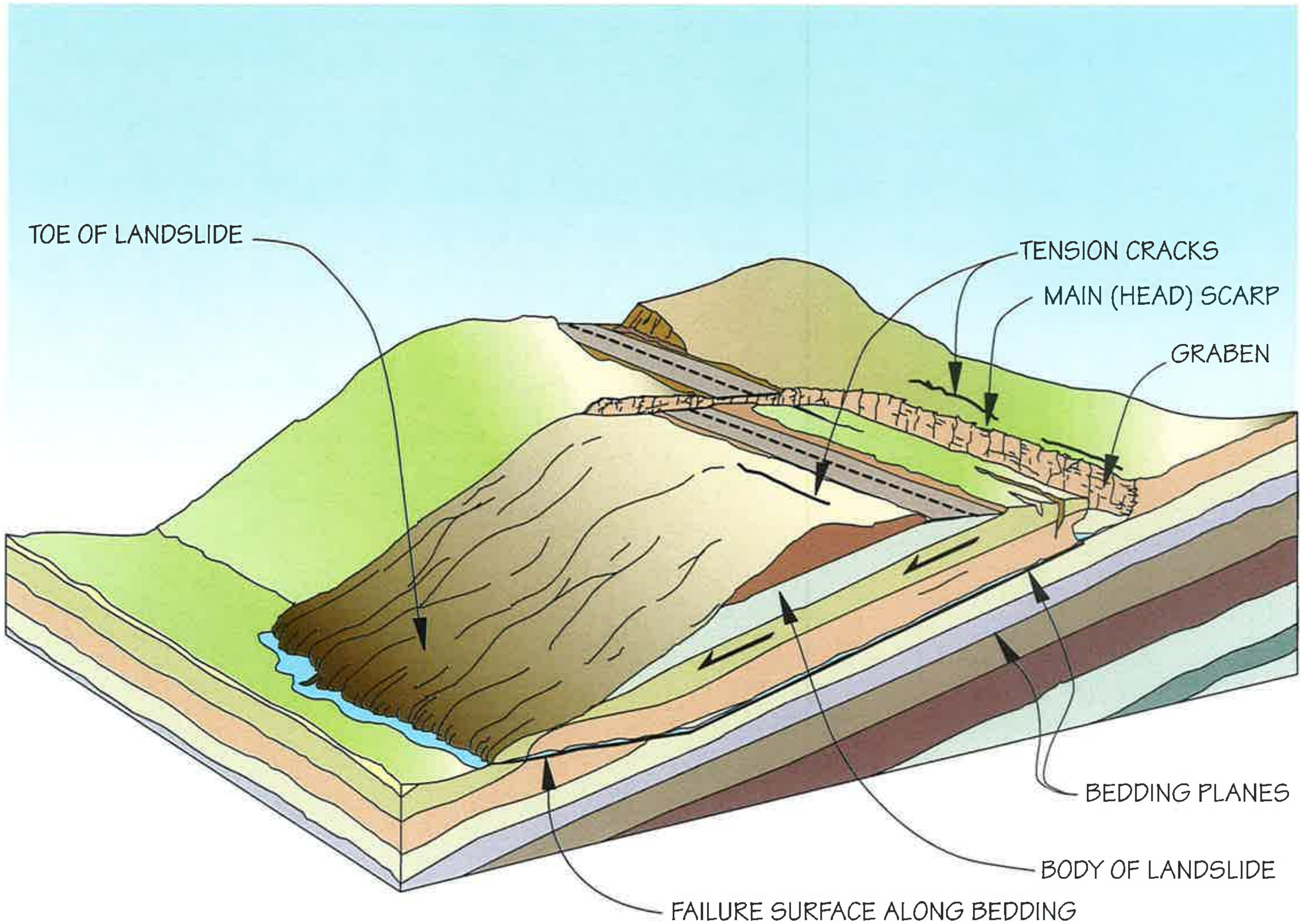


FIGURE 6
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Typical Rotational Landslide

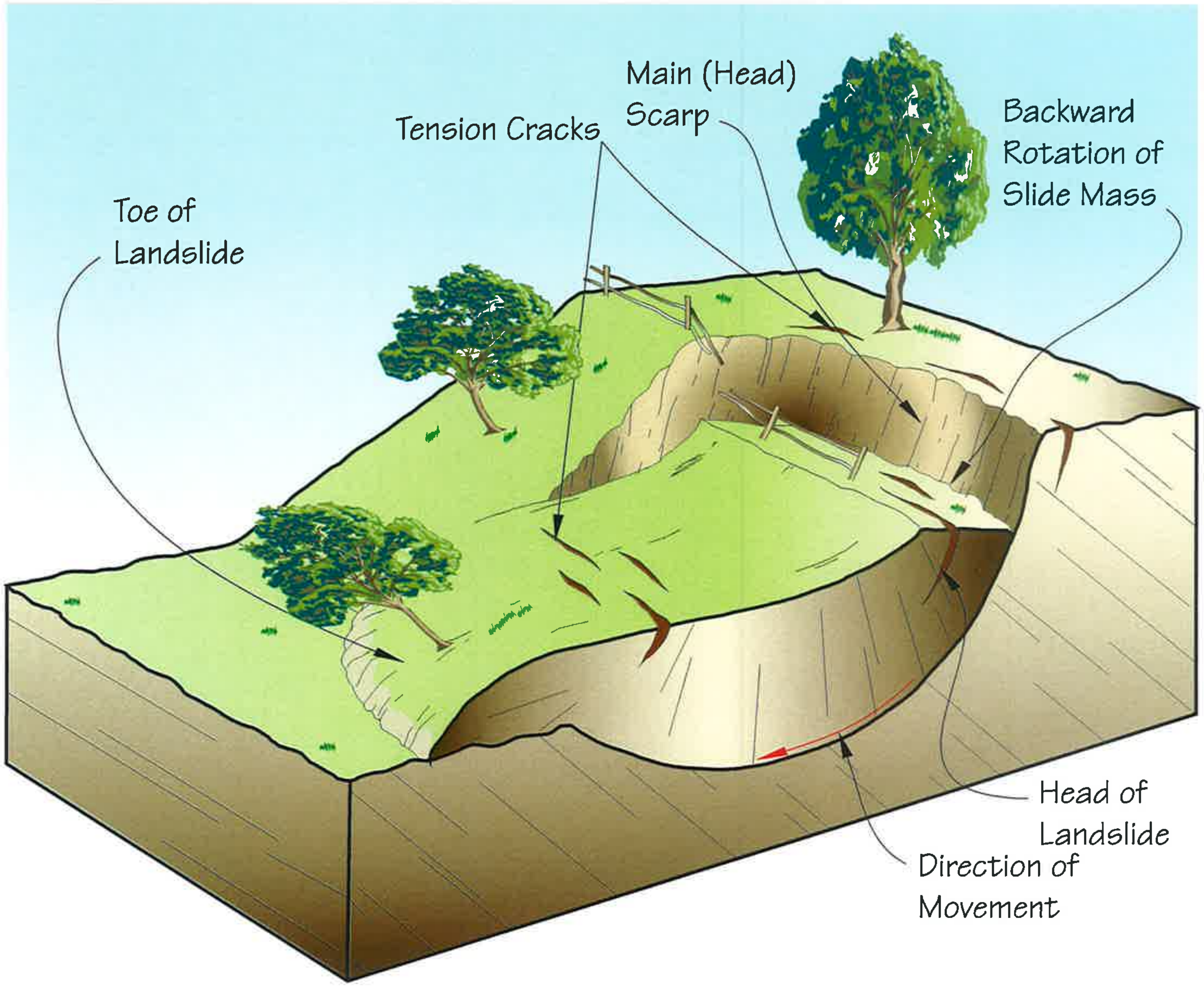


FIGURE 7
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Typical Fill-Over-Cut Slope Mitigation

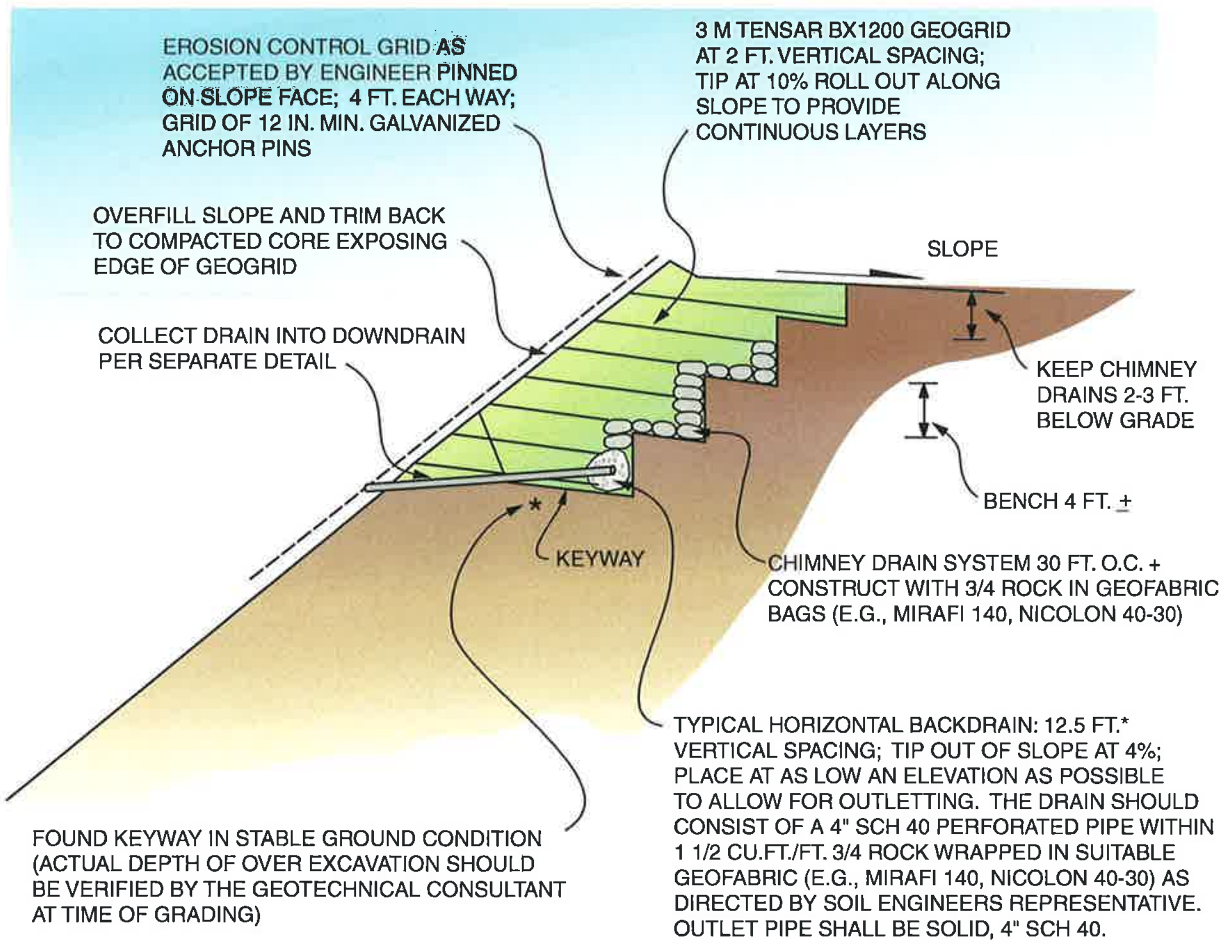


FIGURE 8A

AMERICAN GEOTECHNICAL, INC.

F.N. 33366-03 **MARCH 2013**

Typical Stabilization Fill with Backdrain/Chimney Drain System

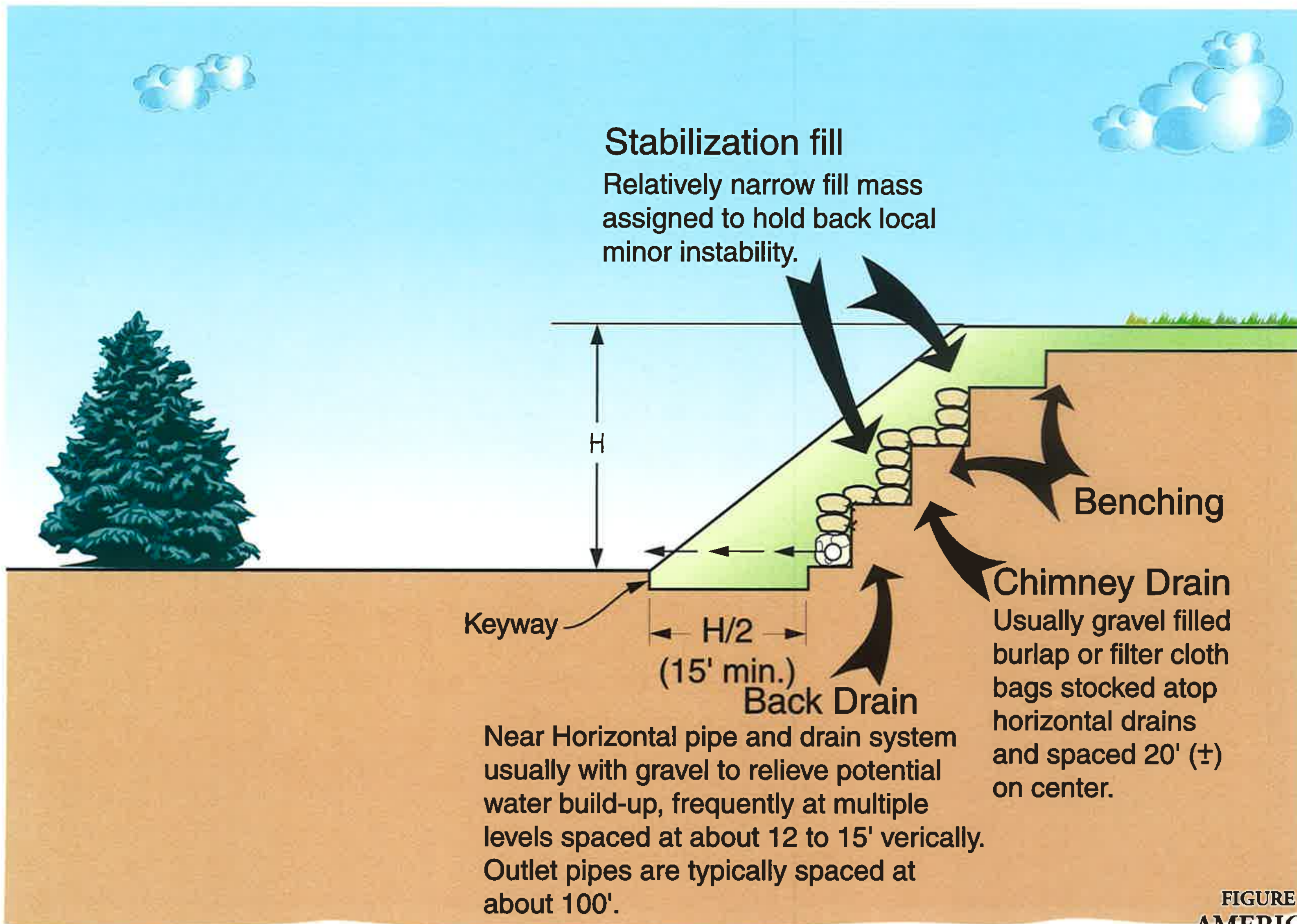
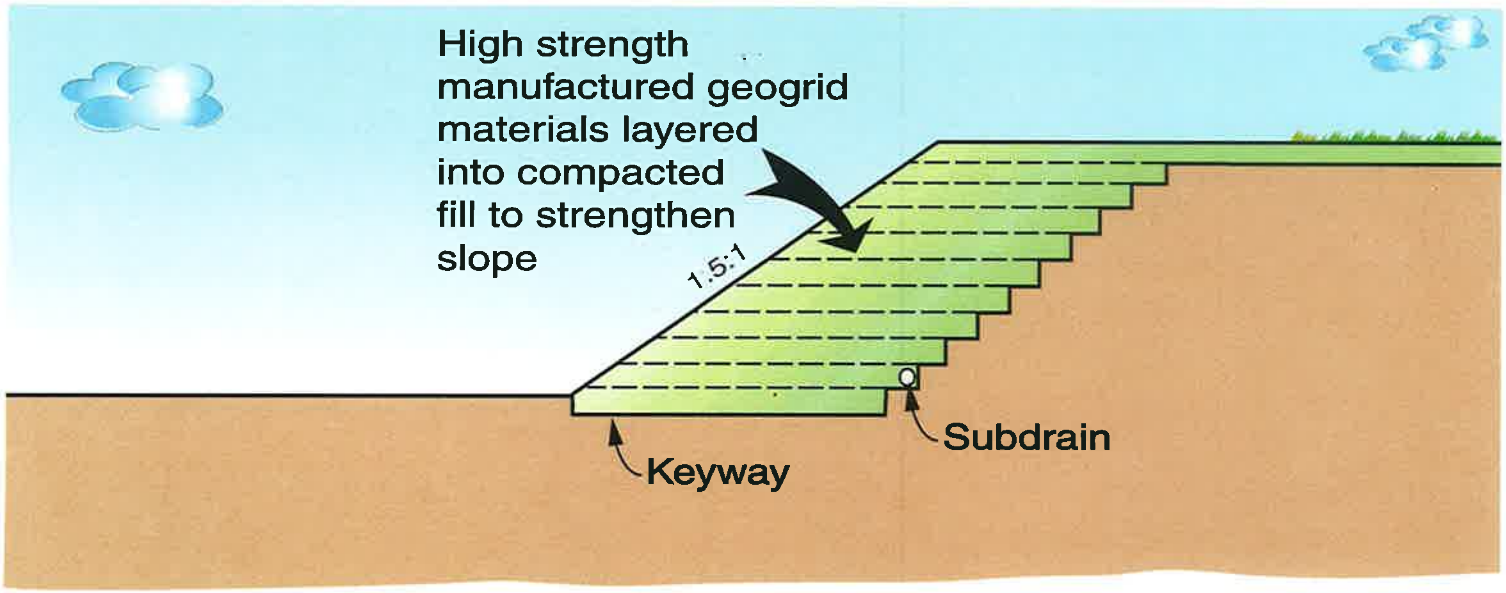


FIGURE 8B
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Typical Slope Reinforcement Measures



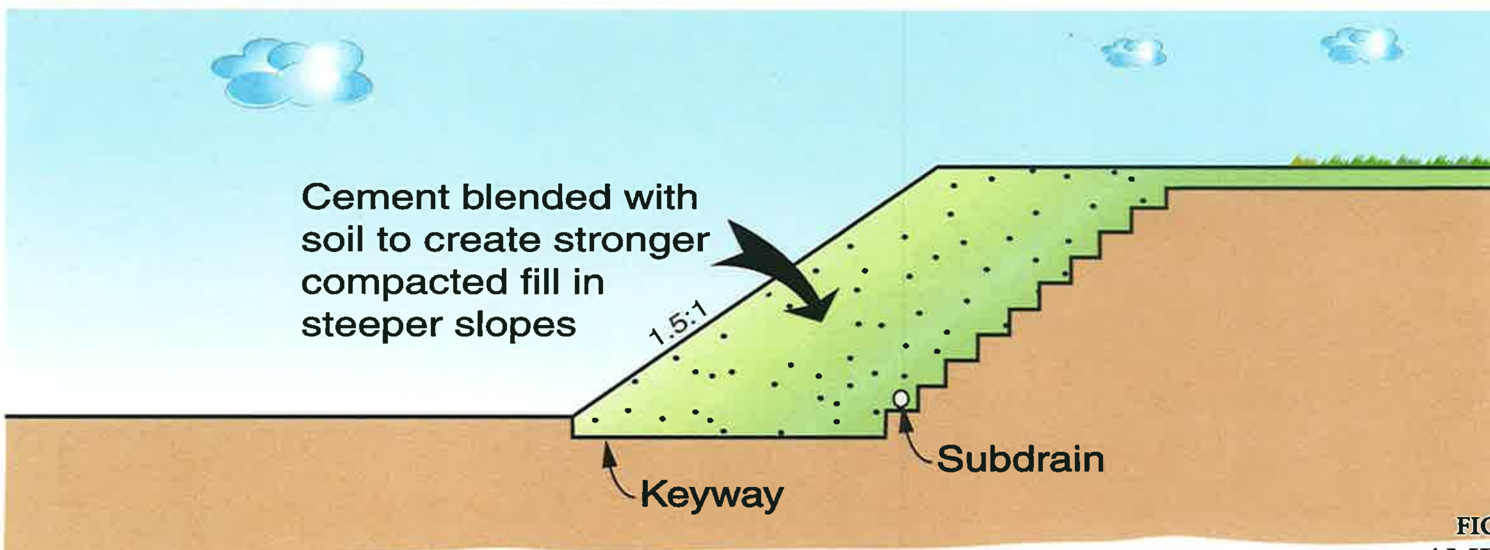


FIGURE 8C

AMERICAN GEOTECHNICAL, INC.

F.N. 33366-03 MARCH 2013

Typical Soldier Pile Retaining Wall

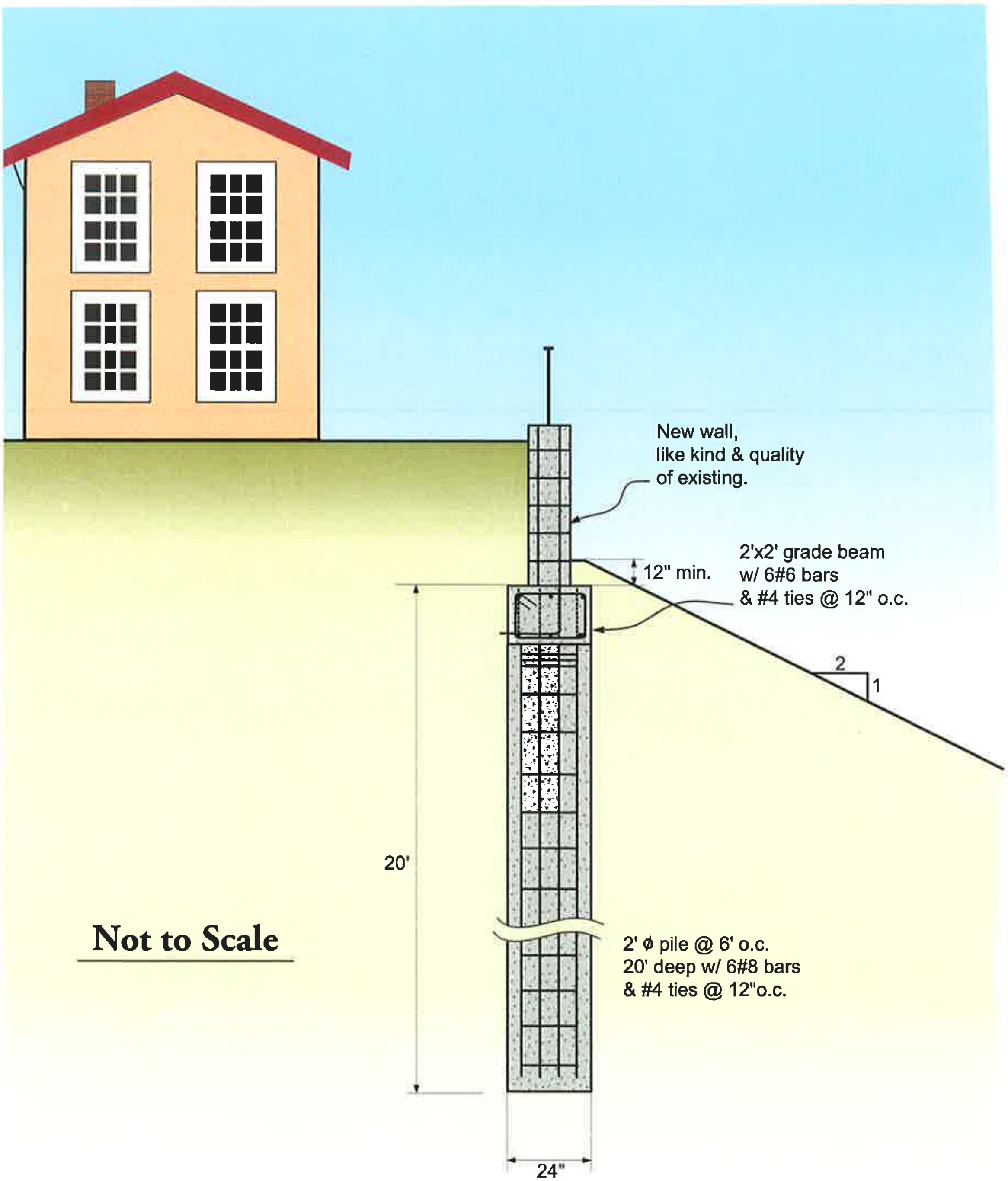
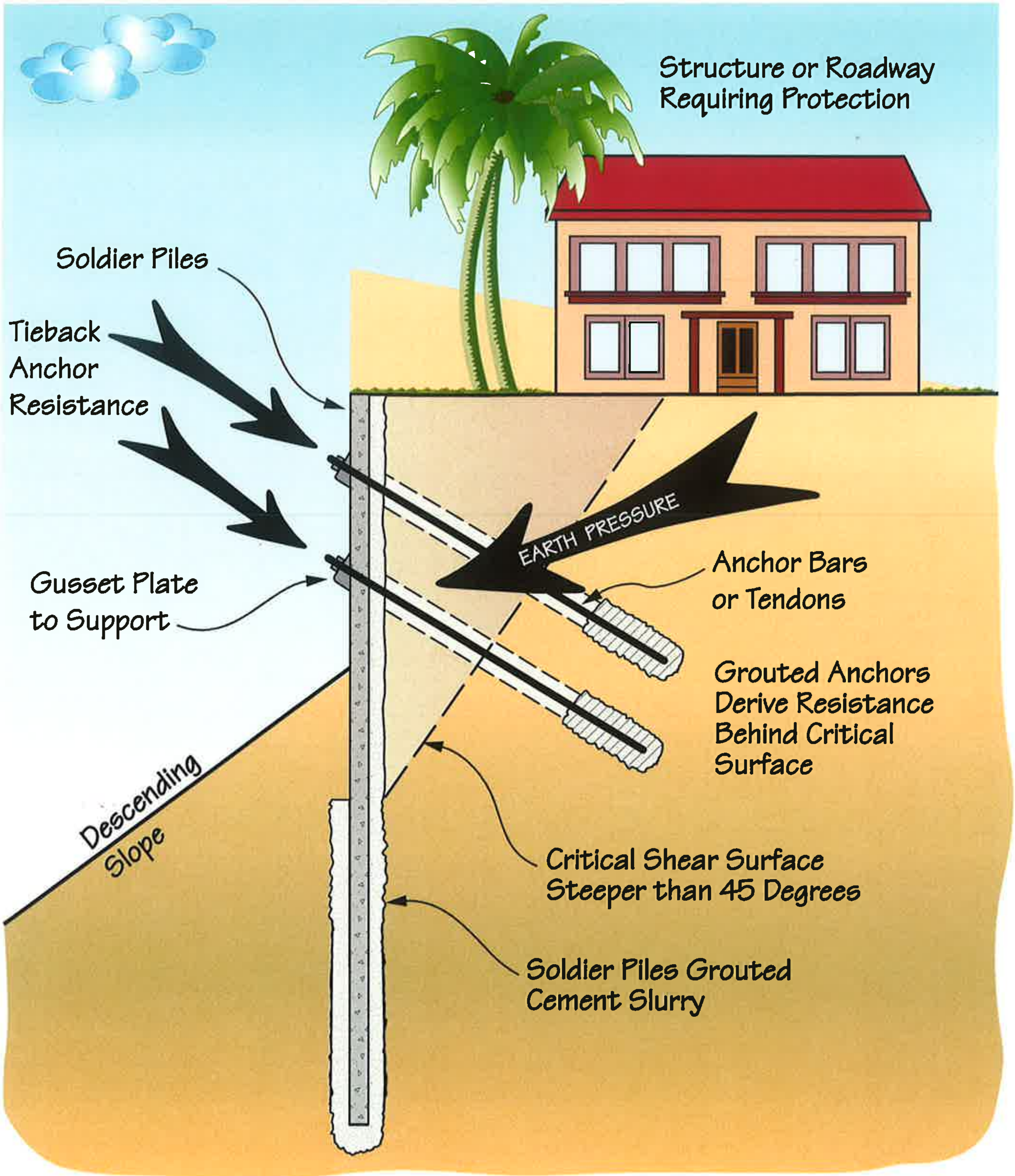


Figure 9A

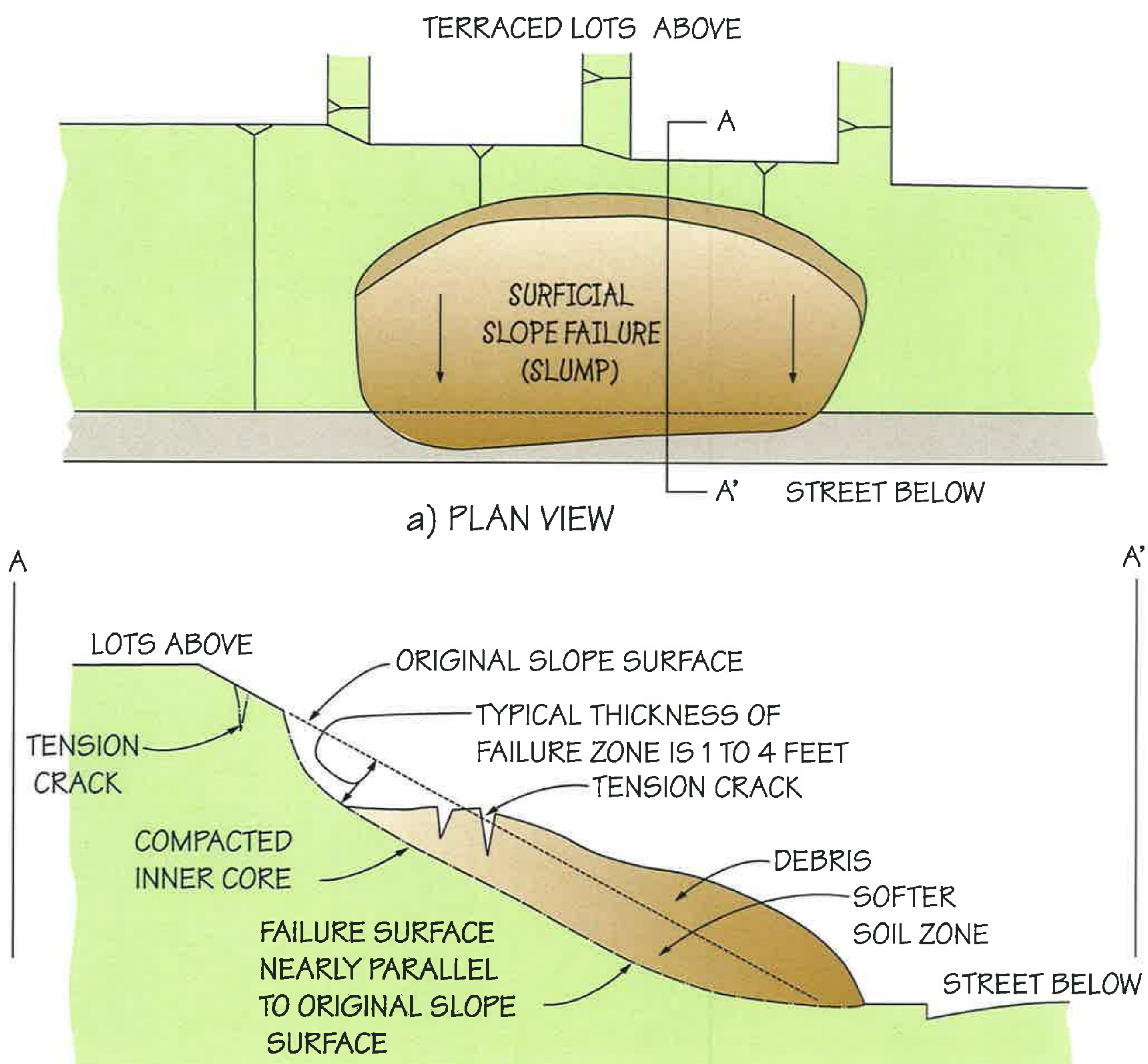
AMERICAN GEOTECHNICAL

F.N. 33366.03 MARCH 2013



Typical Soldier Pile/ Tieback Retaining Wall			Figure 9B
AMERICAN GEOTECHNICAL	FN. 33366.03	MARCH 2013	

Typical Surficial Slump and Repair



b) SECTION VIEW

FIGURE 10
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Typical Mud-Debris Flow

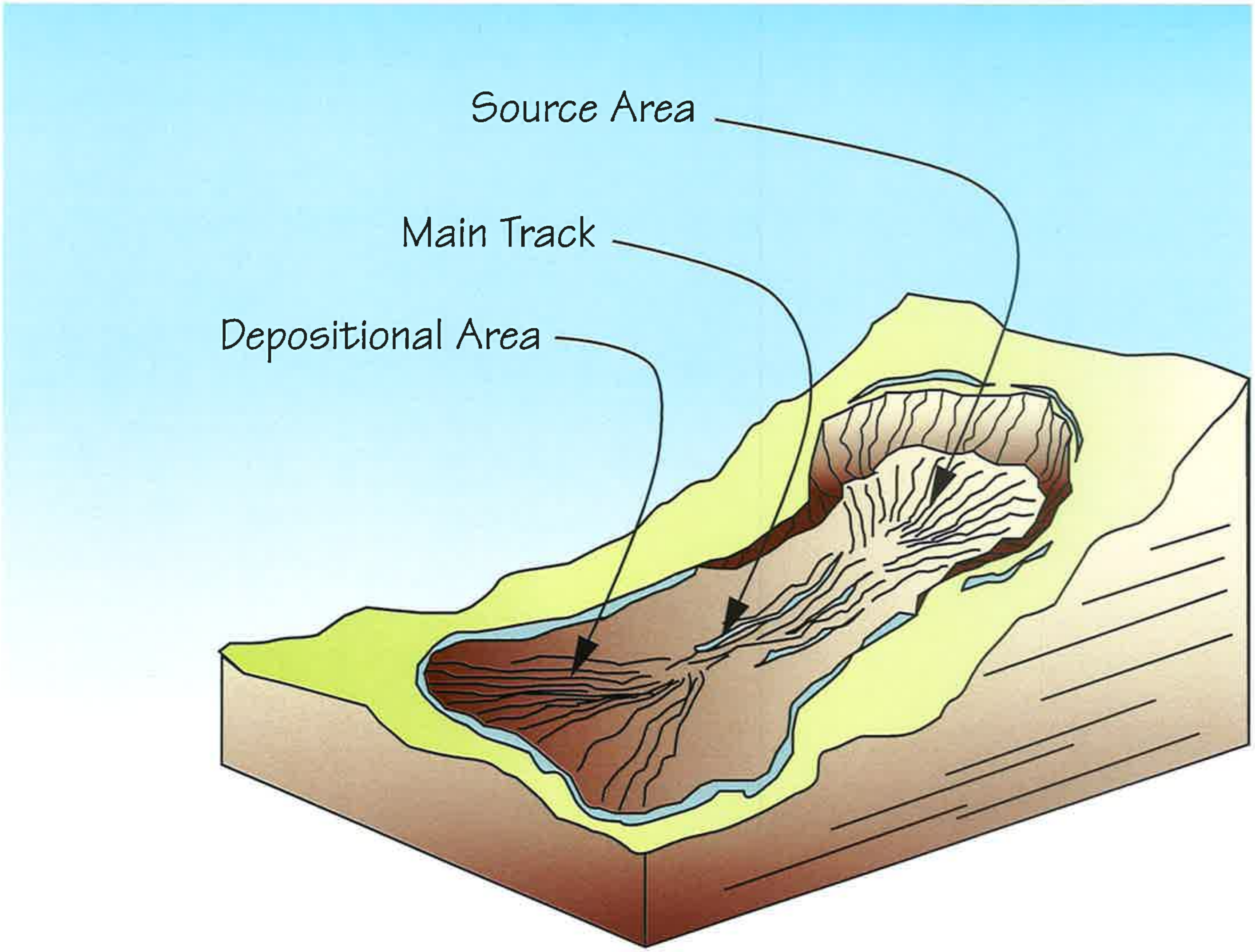
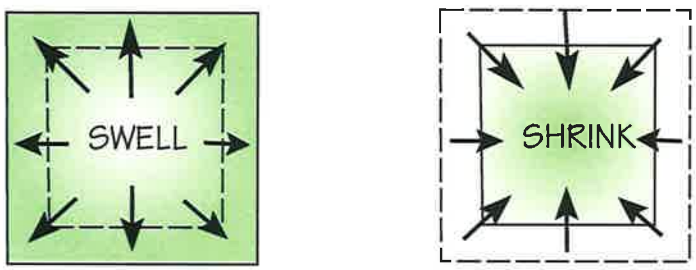


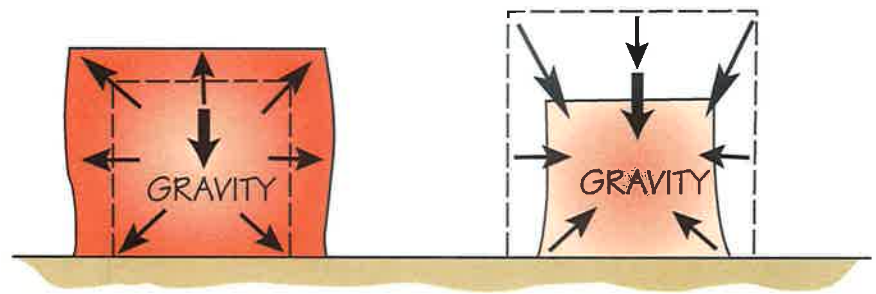
FIGURE 11
AMERICAN
GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Typical Environmental Slope Creep Process (Expansive Soil)

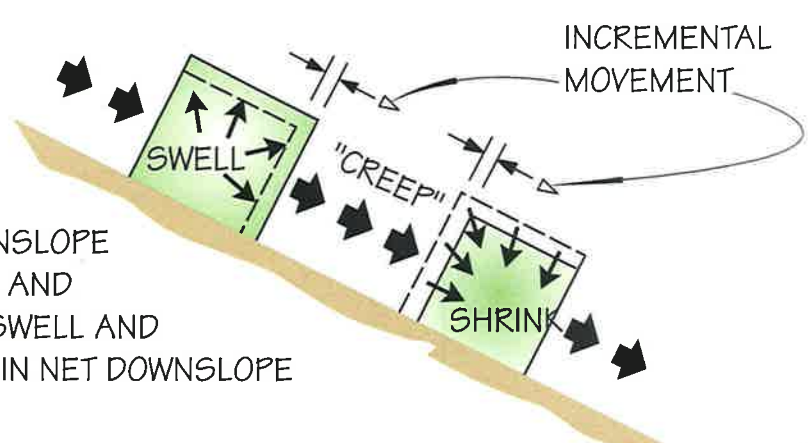
A. NO EXTERNAL FORCES
SYMMETRICAL CHANGE



B. GRAVITY EFFECT
ASYMMETRICAL CHANGE



C. SLOPE INFLUENCE



GRAVITY AIDS DOWNSLOPE SWELL AND SHRINK AND INHIBITS UPSLOPE SWELL AND SHRINK RESULTING IN NET DOWNSLOPE MOVEMENT.

FIGURE 12
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Possible Tieback/ Structural Sheet-Creep Slope Creep Mitigation

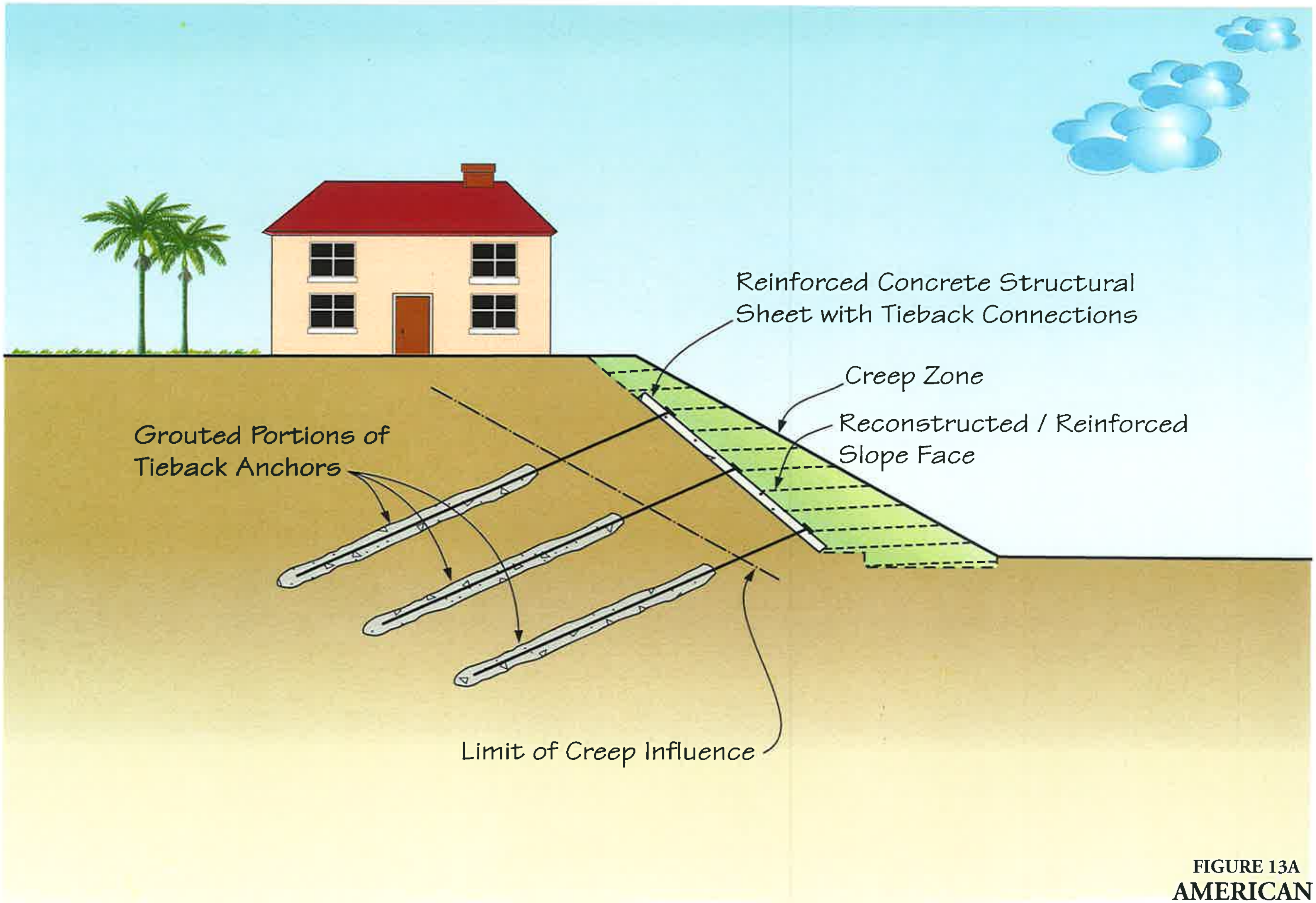
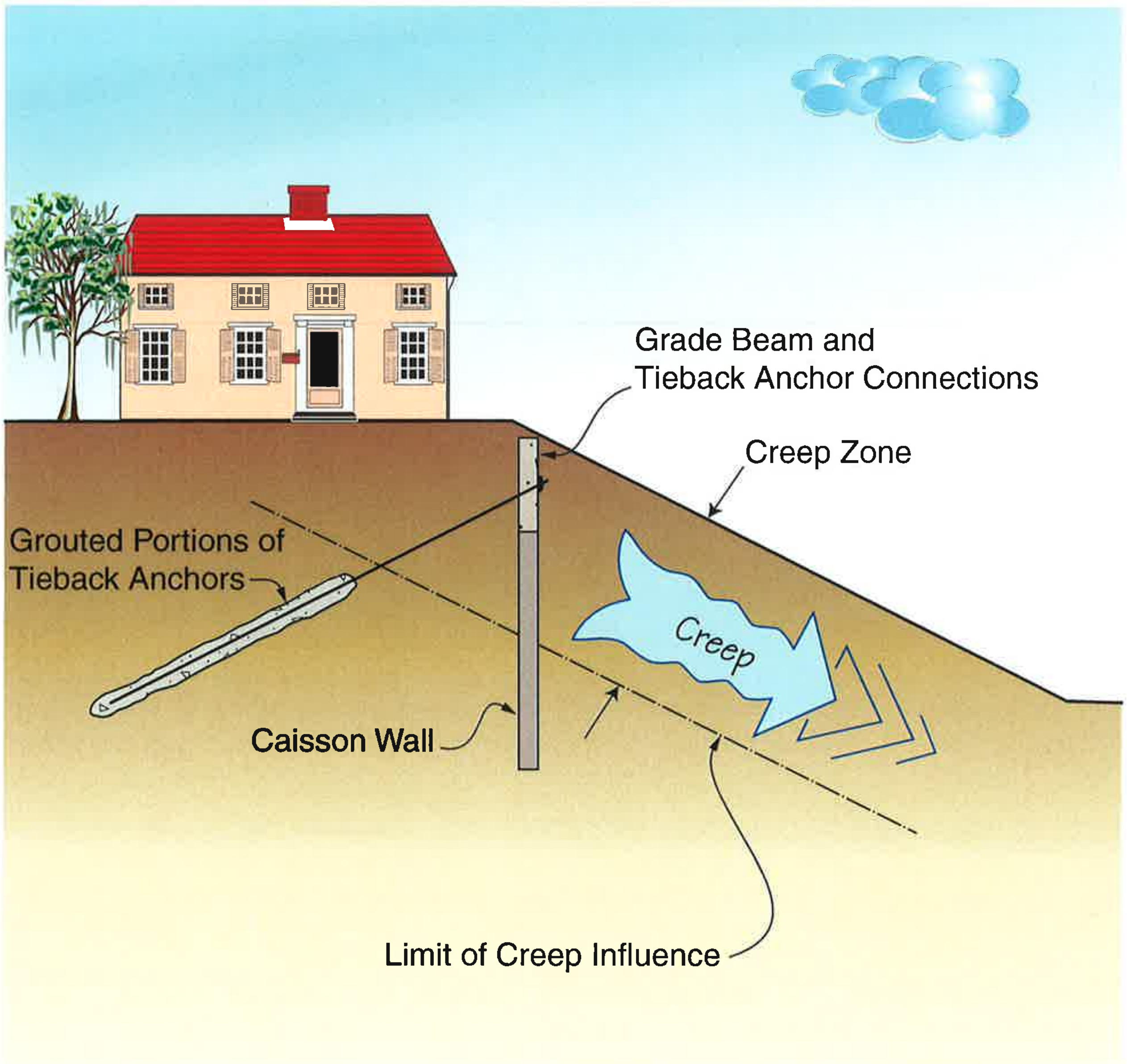


FIGURE 13A
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Possible Caisson/Tieback Slope Stabilization Mitigation



(Illustration Only)

FIGURE 13B
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GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Restraint Systems

Typical Tieback Anchor Detail Installation

Sketch - No Scale

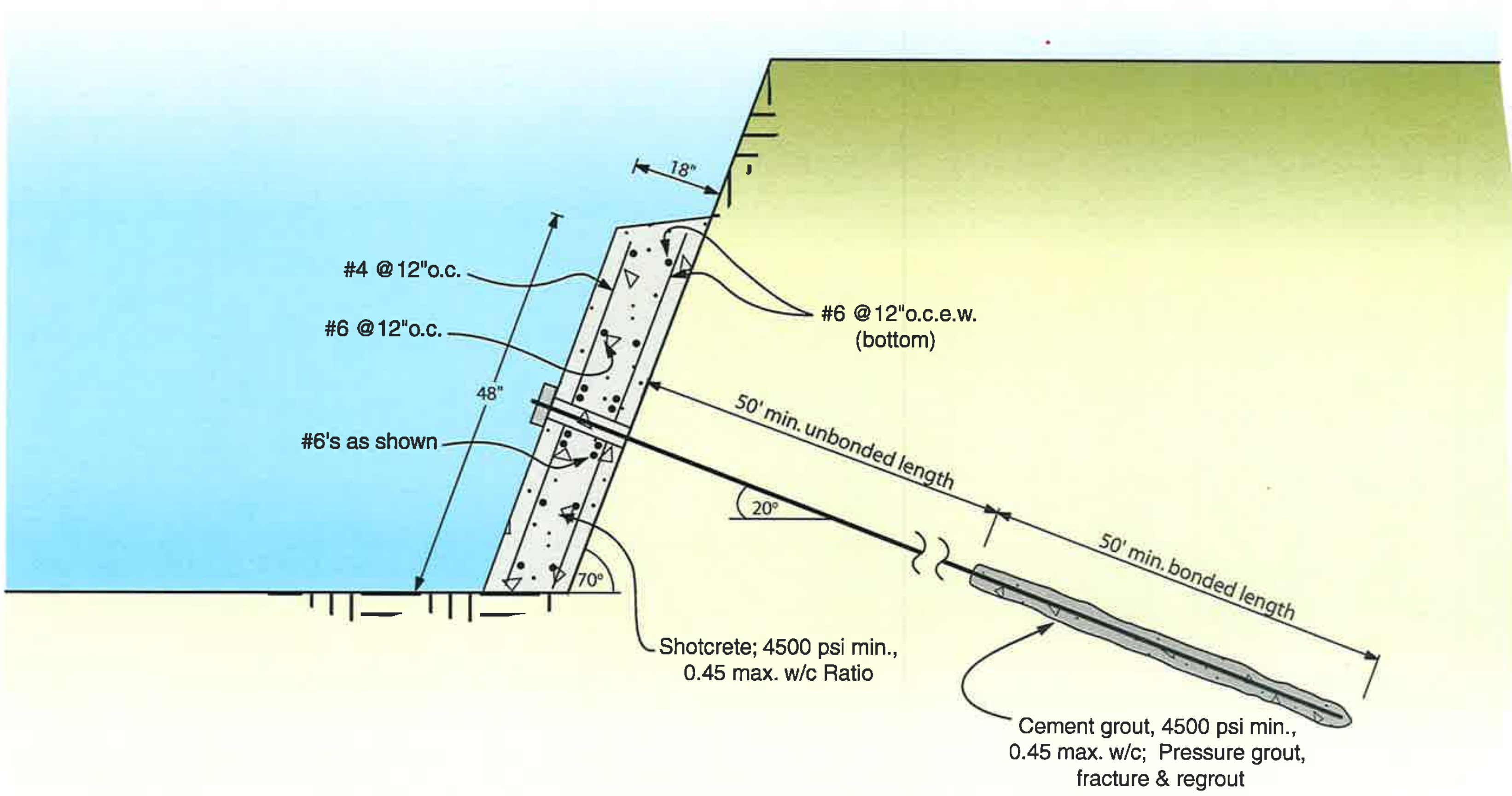
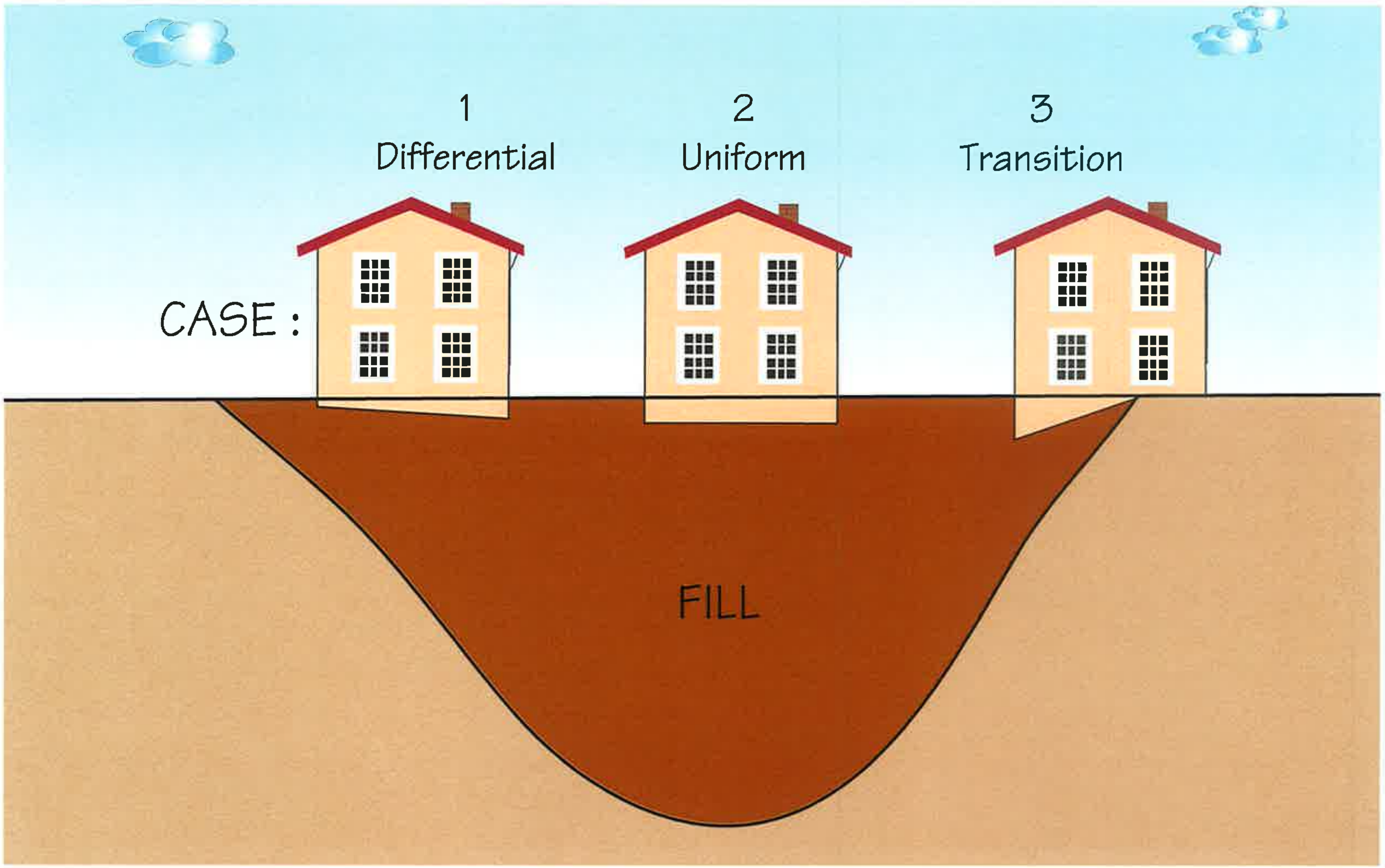


FIGURE 13C
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

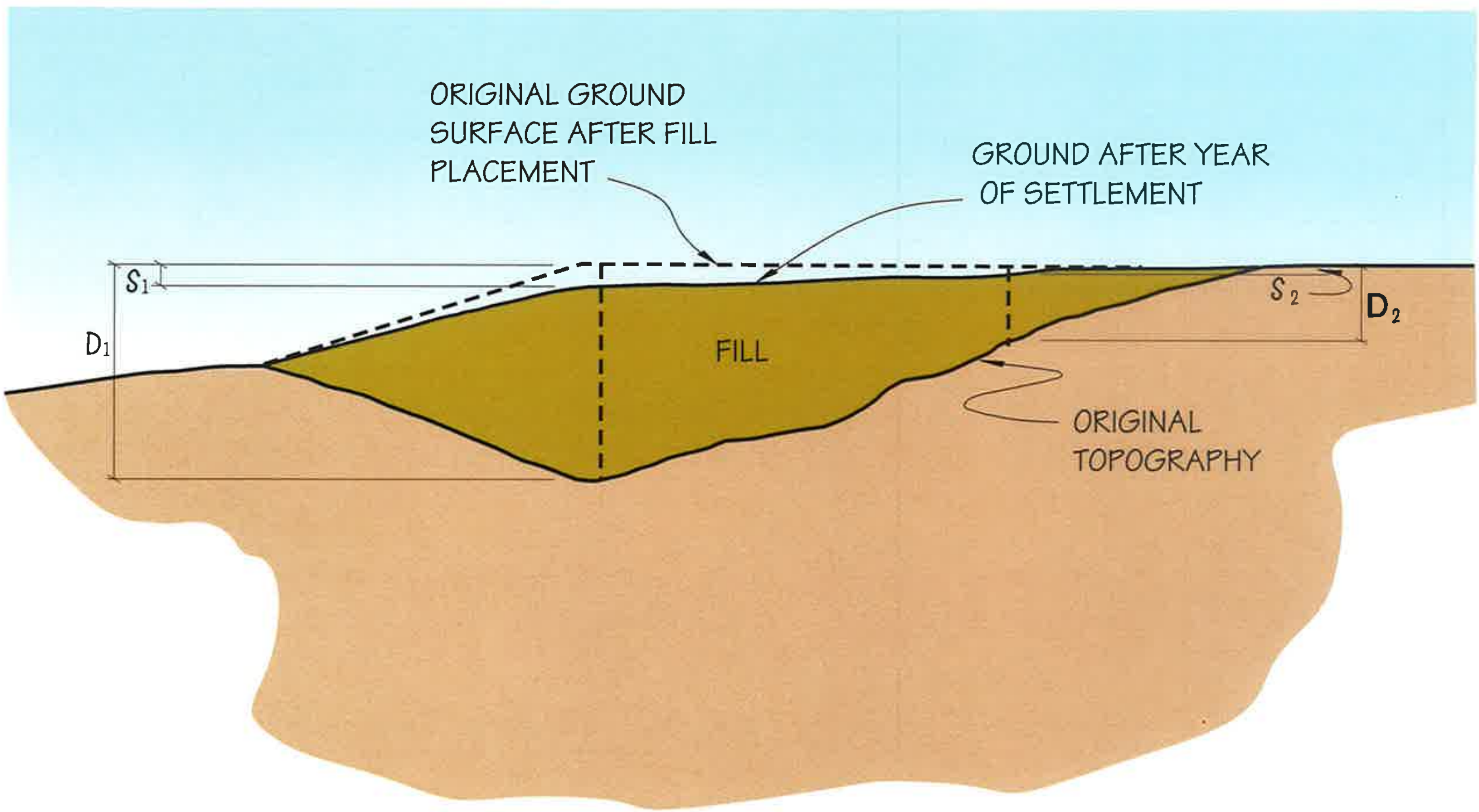
Settlement Types



Category	Comparative Risk of Damage
1	Intermediate
2	Lowest
3	Highest

FIGURE 14A
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Potential Fill Settlement Impacts



D = DEPTH OF FILL

S = AMOUNT OF SETTLEMENT

NOTE: IN POOR QUALITY FILL THE AMOUNT OF SETTLEMENT TENDS TO BE PROPORTIONAL TO THE DEPTH OF FILL .

DAMAGE TO IMPROVEMENTS IS USUALLY MOST SEVERE OVER THE DEEPEST FILL.

FIGURE 14B

AMERICAN GEOTECHNICAL, INC.

F.N. 33366-03 MARCH 2013

Potential Transition Lot Impacts

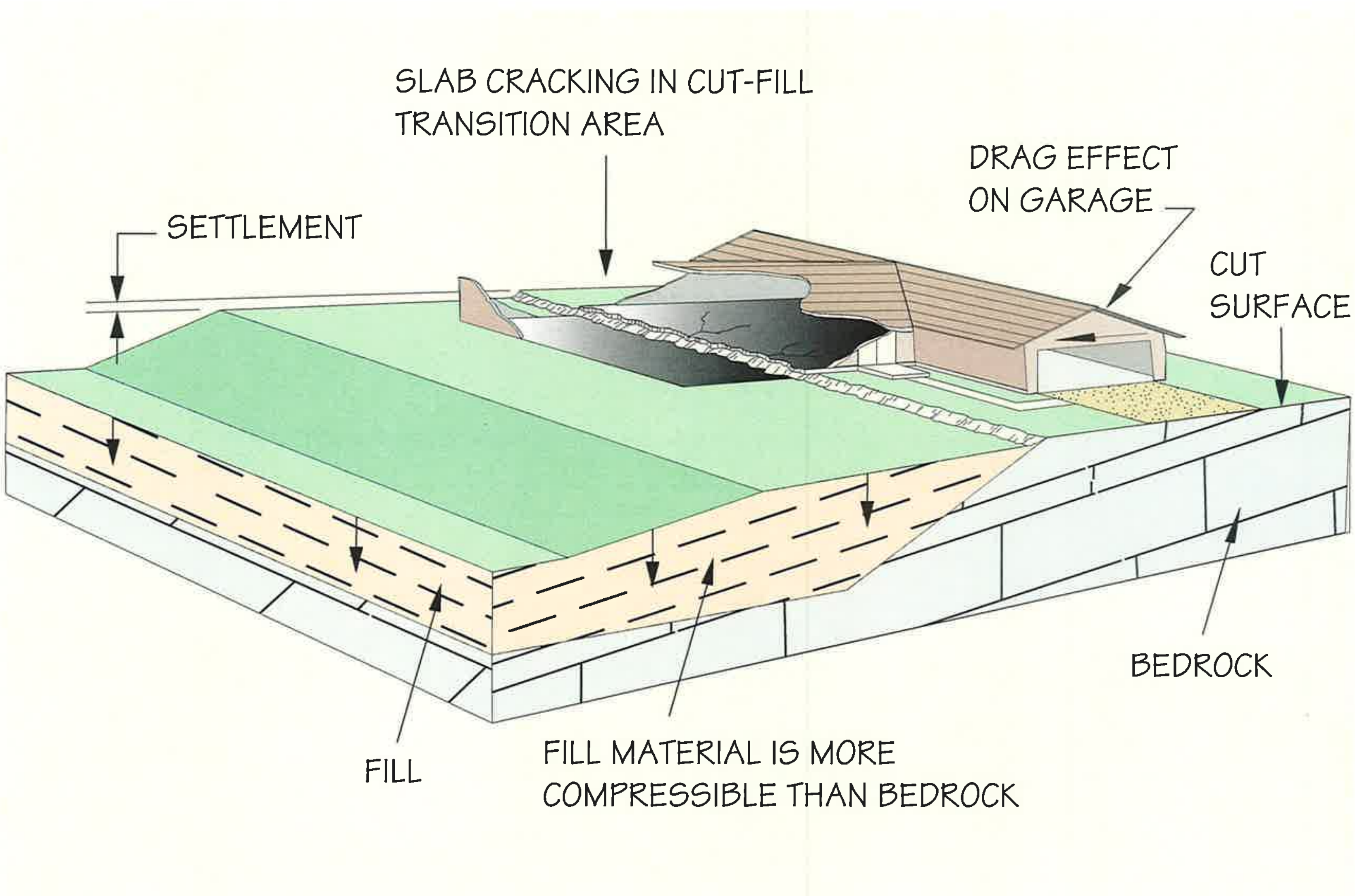


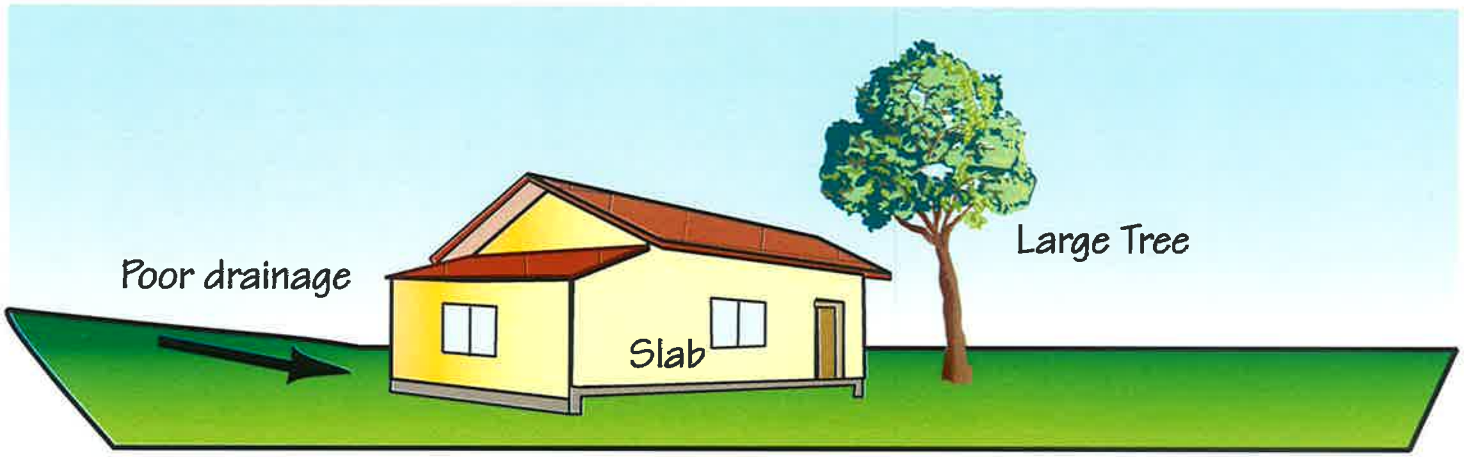
FIGURE 15

AMERICAN GEOTECHNICAL, INC.

F.N. 33366-03 MARCH 2013

Potential Expansive Soil Impacts

a) NEWLY CONSTRUCTED



b) EXPANSIVE SOIL MOVEMENT

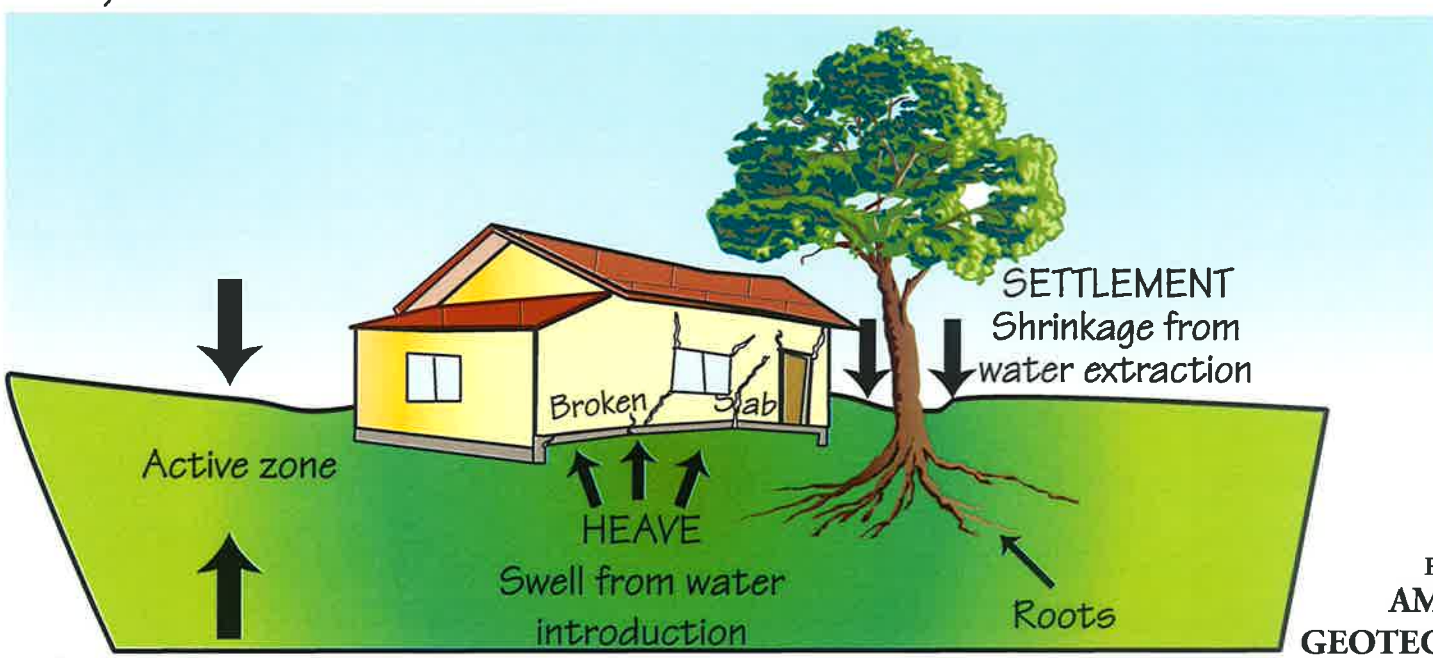


FIGURE 16

AMERICAN GEOTECHNICAL, INC.

F.N. 33366-03 MARCH 2013