YES! YOUNG ENGINEERING SERVICES
GEOTECHNICAL CONSULTANTS e-mail gyoung@sonic.net
132 Boas Drive • Santa Rosa, CA 95409-3611 • (707) 538-7503 • (FAX) 539-6227

JOB COPY

March 26, 2018

Job 12641

Schellinger Brothers
Attn: Frank Schellinger
1270 Airport Boulevard
Santa Rosa CA 95403-1007

Gentlemen and Ladies:

Soil Investigation Update
Royal Glen Subdivision Rebuild
Fountaingrove II-East, Unit 4
GPS: Lat/Long N38.4857, W122.6908
Santa Rosa, CA

This letter presents the consultation that Young Engineering Services (***YES!***) has provided at your request in connection with the referenced property, and is intended to summarize geotechnical design parameters for use at this site.

It is our understanding that our reconnaissance and review are to visually assess any wildfire-related damage from the Northbay Firestorms of October 2017, subsequent to your previous site development and geotechnical study performed for this site by others; review of any existing file data; review of published data relating to geotechnical hazards; and provide geotechnical conclusions and recommendations regarding the suitability of the site for the intended development, and recommendations consistent with current good practice, and recent geotechnical provisions of the California Building Code (CBC), including Chapter 18 and Appendix J.

A representative of this office reviewed the site and vicinity on December 20, 2017, in the presence of Frank Schellinger, and at several times since that date. In addition to our reconnaissance, we reviewed data in our files which included: topography and aerial photography mapping data obtained from the Sonoma County PRMD, GIS site mapping database; Sonoma County Parcel Maps; the California Division of Mines and Geology (CDMG) Special Report 120, entitled Geology for Planning in Sonoma County, dated 1980; the CDMG Regional Geologic Map of Santa Rosa, dated 1982; the CDMG Special Studies Zone (Alquist-Priolo), Santa Rosa quadrangle map, dated July 1, 1983; the CDMG Active Fault Near-Source Zones mapping, dated August 1997 (incorporated under 1997 Uniform Building Code, UBC and 2001

California Building Code, CBC); and the USGS Seismic Design Maps web application updated to ASCE 7-10 with March 2013 errata.

The approximate 14.65 acre Royal Glen Subdivision site is also known as Fountaingrove II East - Unit 4, and is bound by Fountaingrove Parkway on the west and Rincon Ridge Drive on the east, in the Fountaingrove development of Santa Rosa, California. The site was subject to a Geological and Geotechnical Investigation Report - Fountaingrove II East, dated October 19, 1992, prepared by Kleinfelder. On the basis of our site reconnaissance, review of the geotechnical study by others, and our knowledge of soil conditions in the area, it is our opinion that the parcel is stable; the surficial soil cover was identified to have "very low to low expansion potential" (tendency to undergo volume changes with changes in moisture content) per California Building Code (CBC) classification; that overall site drainage gradient within this development trends south, varying from as steep as 19 percent on the lots north of Repton Way, to 8 percent through the middle third of the development, to less than 3 percent south of Yorkton Way; and that is there is relatively limited soil cover overlying weathered bedrock ; the bedrock is consistent with published mapping which indicates the site to be underlain by Pleistocene Age, Sonoma Volcanics. Large boulder "floaters" were originally noted exposed throughout the site slopes, with more typical clay and gravelly silt alluvial soils on the lower third of the site.

The previous development on site was razed due to damages resulting from the October 2017 wildfire, and resulted in surficial disturbance of the near surface soils to depths of at least 12 to 18 inches, and an overall lowering of the site on order of at least 1 foot, more typically 1 to 2 feet, though locally up to about 4 feet due to offhaul of the foundations and near surface soils. The driveways and pool pads have largely been left in place, and are considered a source of fill during reconstruction.

The original site development noted alluvial soils to about 4 feet thick on the lower third of the site, with typically less than 2 feet of residual soil cover on the upper slopes. Previous site grading reprocessed the surficial weaker soils, with excavations on steeper slopes tending to largely remove the surficial soil development by excavating on the upslope/inboard side of the building pads, and generating fill over the weathered bedrock on the lower/outboard sides of these pads. Basement excavation into the underlying weathered bedrock was limited to Lots 3, 4, 5, 8, 9 and 10. We estimate that there is typically less than two feet of residual soil cover overlying weathered bedrock on the upper two thirds of the project, and that the bedrock is consistent with published mapping which indicates the site to be underlain by Pleistocene Age, Sonoma Volcanics. Firm native soils and engineered fill founded on such soils is indicated in place on the lower third of the site. (Residual soil is derived in-place from weathering of bedrock; colluvium is soil transported downslope by gravity and water; alluvium is soil deposited from stream flow.)

Discussion - Conclusions

This development is relatively stable, and the conditions which affect development are common to sites sustaining wildfire-related damage. The main geotechnical considerations pertinent to the reconstruction of this subdivision are the depth of soils disturbance from razing of former site improvements, and potential presence of remnant foundation artifacts associated with the former improvements; steepness of the site slopes; surface and subsurface drainage characteristics; the thickness of surficially weak and compressible soils under structure loads (particularly when saturated). The surface soils across the site are not especially susceptible to downhill creep (tendency for soils to migrate downslope during the seasonal shrink/swell cycles, due to the force of gravity) due to their low expansion potential.

At this time, we understand that due to disparate ownership and changes in individual circumstances of the various lot owners, not all lots will be able to participate in full restoration of the civil improvements at this time. We anticipate that a majority of the lots may be regraded, likely balancing the existing site soils between participating lots, resulting in an overall lowering of such lots from the original finished pad elevation on order of one foot. Control of site drainage will require careful consideration in design so that runoff discharges onto site paving, at the curb, or into a storm drain system to inhibit ponding and the erosion potential of concentrated flow, and equally important that discharge is not redirected onto an adjacent lot that is not being restored at this time. This will be most critical in the lots on the southerly third of the development where the lowering of individual building pads through offhaul of the wildfire-related damage has lowered the pads elevation so that runoff is readily achieved to the street frontage.

There are no known active faults within the immediate site vicinity; the site is not within an Alquist-Priolo Special Studies Zone relating to fault hazard potential. The closest active faults are the Healdsburg-Rodgers Creek Fault, located approximately 1½ miles to the west/southwest, and the San Andreas Fault, located approximately 22 miles to the southwest. The northerly terminus of the potentially active (Quaternary displacement, or movement within the last two million years) West Napa Fault Zone is about 11 miles to the east/northeast.

The site will be subjected to strong ground shaking during future, nearby, large magnitude earthquakes. Generally, structures founded in firm soil and/or bedrock can be expected to be subjected to short period, jarring motions, with little or no ground wave amplification. Wood-framed structures founded in firm soil, and designed in accordance with current earthquake resistant building codes (CBC), are well suited to resist the effects of strong ground shaking. The site soils are not considered susceptible to liquefaction (loss of axial strength), lurching (lateral spreading), or differential settlement (rapid compression) potential under strong shaking. No additional geologic or engineering geologic studies appear warranted.

Recommendations

The following is based on our site reconnaissance, evaluation of the prior geotechnical study developed for use at this site and neighboring vicinity, supplemented with California Building Code (CBC) minimums in design. Our recommendations are contingent upon an opportunity for our review of final grading and building plans (and soil-related specification), and construction period observations. These reviews would allow us to verify conformance of the work to project guidelines, determine that the soil conditions are as anticipated, and to modify our recommendations, if necessary.

In general, this development is stable, and support can be achieved on firm soils which underlie this site and/or engineered fill founded on such soils. The major geotechnical consideration are steepness of the site slopes, site drainage/backdrainage, surficial soils that are weak or disrupted from razing of former site improvements, and special attention in consideration of grading and drainage for lots abutting sites that are not being restored at this time. Soil expansion potential will not require significant consideration. Due to the lack of full participation in regrading of all lots at this time, we have also included options for rebuilding of these individual lots without full reconstruction of the graded pads. These concerns are discussed in more detail as follows.

Site Grading. Full reconstruction of the graded pads is anticipated to balance the soils on participating lots, resulting in a lowering of the finished pad grade on the order of one foot from that previously developed. However, with the exception of preparation for any lower floor slabs, or presence of old tree root basins, there are options to available to mass grading at the site. Depth of soils disturbance from razing of former site improvements can be largely accommodated by the careful consideration of the depth and type of foundations selected for use at this site, and limiting use of slab-on-grade floors.

Site grading should conform to Chapter 18 and Appendix J of the California Building Code (CBC). The site should be cleared of any rubbish, debris, and organic materials. These materials should be removed, and disposed of off the site. Where trees have been removed to make room for planned structures, deeper excavation will be required to remove heavier concentrations of roots. For fill to support structure foundations and/or use of slab-on-grade floors in living areas, the weak or disturbed surficial and/or old fill soils should be removed to full depth and replaced with engineered fill. All fill material should be free of any debris, organic matter, and oversize (four inch or larger dimension) rocks, and should be approved by a representative of ***YES!*** before it is placed. The existing on-site soils in a "cleaned condition" (eg, less any debris or organic matter) are considered satisfactory for reuse as engineered fill. Imported fill should be of relatively low expansion potential (Expansion Index less than about 30). All fill should be placed to at least 90 percent relative compaction per ASTM D1557.

Cut and Fill. In general, cut or fill slopes should be no steeper than two feet horizontal to one foot vertical (2H:1V). Where fill is to be placed on an existing slope steeper than 5H:1V, the fill must be keyed and benched into firm material. The keyway at the base of the fill should consist of a level bench cut into the firm, intact soil (requiring excavation through any uncontrolled fill). Bonding of the fill to the backslope should be accomplished through use of discrete treads and risers placed at approximately two foot vertical intervals. A subdrain will be necessary at the base of any keyway excavations, and on very deep keyways, possibly on a few of the benches above the keyway. Refer to the Keyway Bench Details attached for more information.

The faces of all slopes (cut and fill) should be protected from erosion by providing drainage control measures, such as channels or berms near the crown, to prevent surface water from flowing over the slope. Cut or fill surfaces should be planted with fast growing, erosion resistant vegetation.

Finished Grading. All finished surfaces should be graded to drain away from the building envelopes. Discharge of collected runoff should be onto site paving or common public property such as at the curb or into a storm drain system, with careful attention so that runoff is not redirected onto an adjacent lot that is not being restored at this time. Surface drainage should be consistent with current CBC standards which requires a drainage gradient five percent (or at least two percent on impervious surfaces and/or soils which have high erosion potential), achieved and maintained to at least 10 feet away from structures. Where physical obstructions or lot lines occur within the minimum clearance, drainage diversions (eg, interceptor swales) should have slope a minimum of two percent.

All concentrated flows, such as from roof downspouts or surface water runoff, should be collected in a conduit, berm, or lined channel, and discharge away from the structures so that they will not pond or erode materials contributing to structure support. The water should be disposed of on site paving, at the curb, into a storm drain system, or on-slope through an energy dissipater (eg, a "bubble" box or an apron of Rock Slope

Protection, RSP) to inhibit ponding and the erosion potential of concentrated flow.

Subgrade soils should be finished true to line and grade to present a smooth, firm, unyielding surface, and should be maintained moist and free of shrinkage cracks until covered by permanent construction.

Seismicity. Based on the results of our investigation, which included use of the USGS Seismic Design Maps online mapping tool, in accordance with ASCE 7-10, with March 2013 errata, we recommend that the following seismic design criteria be used in accordance with the provisions of the 2013 California Building Code (CBC):

GPS Site Location, Lat/Long	N38.4857, W122.6908
Seismic Occupancy Category	II
Site Class (Soil)	D
Spectral Response Accelerations, S_s	2.156
Spectral Response Accelerations, S_1	0.889
Maximum Earthquake Accelerations, S_{MS}	2.156
Maximum Earthquake Accelerations, S_{M1}	1.333
Spectral Response Coefficient, S_{DS}	1.437
Spectral Response Coefficient, S_{D1}	0.889
Peak Ground Acceleration, PGA	0.828

Footings. Foundation support for the planned residences can be established on conventional spread footings, providing that such footings penetrate through any remnant weak or disturbed soils (native topsoil, poorly consolidated alluvium, colluvium or residual soil) and bottom with the underlying weathered bedrock and/or engineered fill founded on such soils. The footing elements should penetrate at least 24 inches below the existing ground surface; this depth should be considered a minimum for planning purposes. We recommend that footings be stepped as necessary to achieve at least 12 inches of penetration through any remnant weak or disturbed soils (native topsoil, poorly consolidated alluvium, colluvium or residual soil). Wall and column footings should be no less than 12 and 18 inches wide, respectively, regardless of load; the perimeter wall line footings should be continuous, while the remainder of interior elements may be either isolated or continuous.

If foundation support is achieved entirely in weathered bedrock and/or engineered fill founded on such soils (requires full reprocessing of the weak soils above the weathered bedrock), the minimum footing depth can be decreased to 18 inches below lowest adjacent finished grade, with total load soil pressures increased to 1800 psf. Further, if foundation support is achieved entirely in the weathered bedrock (as identified during construction by a representative of ***YES!***), the allowable total load soil pressure can be increased to 2500 psf.

Footing foundations on slope are to be stepped so that they have a lateral confinement of at least 5 foot from the face of the slope, or a theoretical two foot horizontal to one foot vertical (2H:1V) plane projected up from the toe of the slope, whichever controls. Consistent with typical hillside practice, we recommend that the foundation elements on lots with an overall gradient of ten percent be interconnected with grade beam ties on 20 foot centers traversing up/down slope. Any remnant weak or disturbed soils (native topsoil, poorly consolidated alluvium, colluvium or residual soil) will not be considered as a part of this confinement. Minimum tread length of steps should be 24 inches. Maximum step height should be limited to 18 inches without specific consideration of the project structural engineer.

Penetration to less this minimum may be acceptable where excavations encounter hard boulders/rock or remnant concrete foundation artifacts. Footings at such locations may be dowelled. Dowels should penetrate 12 inches into the rock or concrete. We would expect one dowel per isolated boulder (for long segments, maximum 24 inches on-center). Dowels should be at least equal to a Number 4 rebar, and should be secured using an "epoxy" backfill (Simpson SET-XP, Hilti HIT-RE-500-SD, Powers AC100 Gold, or equal.

Foundation support can be achieved on drilled piers or conventional spread footings, providing that such footings penetrate through the weak and disturbed surficial soil. Estimated soil design criteria are not presented here, due to the potential for encounter of hard rock (boulders and/or remnant foundation artifacts) and substantial variations which occur with subtle changes in soil conditions.

<u>Retaining Walls.</u> Footing support for retaining walls is available as indicated above for typical wall footings. It would be prudent for upslope wall lines to be designed to retain slough to about 2 feet deep. An appropriate Equivalent Fluid Pressure (EFP) for use in design of such walls would be 40 pounds per cubic foot (pcf) with a level backslope; design values would be increased to 60 pcf with superjacent slopes to 2H:1V; design values would be increased to 80 pcf if the walls are not drained, but subject to full hydrostatic head.

As active earth pressure assumes that relative movement will occur between the backfill and the wall, backfill should be finished prior to completion of the framing tie-in. If walls are "fixed", or unable to rotate, they should be designed for a higher at-rest value of 60 pcf EFP. Use of other than select, low expansive soil as backfill would require an increase in these lateral design pressures.

The retaining wall backdrain should be prevented from clogging. This may be most readily accomplished by separating the aggregate backfill from the adjacent soil by incorporation of a geotextile filter fabric (Mirafi 140 or equal). Refer to the Retaining Wall Details attached for more detailed information.

If retaining walls are to be designed to withstand dynamic earthquake (or seismic) loading, a lateral load equal to 18.2 H^2 (or 18.2 times the square of the height of the retained soil) should be applied at two-thirds of the wall height. ($P_E = \frac{1}{2} K_h K_a^{\frac{1}{2}} \gamma H^2$; where P_E is the Pseudostatic horizontal force, K_h is the seismic coefficient (maximum considered ground acceleration) divided by the acceleration of gravity, K_a is the active earth pressure coefficient, γ is the unit weight of soil, and H is the height of the retaining wall.)

Lateral Resistance. Resistance to lateral loads can be obtained using a combination of passive earth pressure against the base of foundations and frictional resistance against the face of footing elements. We estimate an allowable passive earth pressure (for penetration into the weathered bedrock) of 400 pcf (triangular distribution), and frictional resistance of 0.30 times the net vertical dead load (to 650 psf maximum), can be used in design. Passive pressure should be neglected within 12 inches of pad grade, unless the surface is confined by slabs or pavement, and within 7 feet of the face of the exterior slopes. Any remnant weak or disturbed soils (native topsoil, poorly consolidated alluvium, colluvium or residual soil) shall be discounted and not be considered a part of this confinement.

Swimming Pool Support. Pools on lots with an overall gradient of ten percent should be designed to be free-standing, with footings founded directly into the underlying weathered bedrock, as discussed under Retaining Walls above. We recommend that the pool shell be backdrained to minimize hydrostatic pressure. This can be most readily accomplished using a series of vertical strips of composite geosynthetic drainage fabric (Miradrain) 12 to 18 inches wide, spaced 4 feet on-center were placed around the pool perimeter. The toe of the composite strips can drain into a drain rock gallery of crushed ¾ inch drain rock backfill in the pool bottom.

A perforated pipe network within the drain rock gallery can discharge by gravity onto site paving or on slope through onto an energy dissipater, Rock Slope Protection (RSP) apron or RSP lined drainage swale. The RSP apron and RSP lined drainage swales should be underlain by a Stabilization Grade Geotextile (Mirafi 600X or equal). RSP should be roughly consistent with the requirements for Caltrans Backing No. 3 (per Section 72 of Standard Specifications), placed to a minimum thickness of 9 inches, or 1½ times the maximum aggregate dimension. This material is available locally as 6 inch minus.

If gravity outfall of collected seepage is not available, we recommend incorporation of vertical stand pipes to facilitate future maintenance. These stand pipes may be placed around the pool perimeter (at a minimum of two locations), and should be connected to the perforated pipe seepage collector network embedded within the drain rock gallery under the pool. The stand pipes should be sized for both monitoring of free water levels and to allow installation of a submergible pump to facilitate draw down prior to draining of the pool for maintenance.

An acceptable alternate to stand pipes sized to allow insertion of a submergible pump would be a smaller (eg, 1½ to 2 inch) pipe with a threaded connection embedded in the pool patio to allow surface pumps to be connected by pool service contractors.

Alternately, the fill supporting the pool shell will need to conform to site grading for structure support consistent will full reconstruction of the graded pad as discussed herein. This would require removal of all weak and disturbed soils; establishing the bottom of the fill on a firm level bench; reconstruction of the slope by benching of the fill to the backslope using discrete treads and risers placed at approximately two foot vertical intervals; and incorporating a subdrain at the base of the keyway excavation, and possibly on a few of the benches above the keyway.

<u>Site Drainage.</u> Drainage considerations will include control of surface water runoff, and seepage under the structures. A wall backdrain will be required on the upslope side of the residences, and adjacent any slab-on-grade floors. An expedient and economical solution for this drainage envelope would be to use a composite synthetic drainage material (eg, Miradrain or equal), also discussed on the attached Retaining Wall Details. The composite drain system is well suited for footings poured "neat" (without forming, as indicated on the plans), and should be placed along the upslope wall of the footing excavation prior to footing pour. To relieve this drainage envelope, a perforated pipe and typical drainage envelope (drain rock wrapped in geotextile filter fabric, <u>or</u> perforated pipe wrapped in the composite fabric) should be in contact with the ends of the drain for a distance of at least 5 feet. In lieu of this treatment, a typical 4 foot deep underdrain will be necessary upslope. Refer to the Subdrain Details attached for more detailed information.

Weep holes should be placed at six foot spacing through the stem wall of the interior cross slope footings, the lower sides of the slab-on-grade garage floor, and along the lower (perimeter) wall lines of the residence. (A perforated pipe embedded within the slab rock along the exterior perimeter of the garage could be used in lieu of weep holes in this sub-slab area.) Weep holes can consist of 2 inch PVC cut to fit within the foundation stem wall, and on the perimeter, with the ends wrapped in hardware cloth (one-quarter inch sieve openings) to minimize clogging, and prevent access from rodents.

The roof runoff should be collected and transmitted away from the structure in a closed conduit. The water should discharge onto site paving, at the curb, or into a storm drain system, or on slope through an energy dissipater (eg, a "bubble" box) to inhibit ponding and the erosion potential of concentrated flow.

All finished surfaces should be graded to drain away from the building envelopes. A surface drainage gradient consistent with current CBC standards requires a drainage gradient five percent (or at least two percent on impervious surfaces and/or soils which have high erosion potential), achieved and maintained to at least 10 feet away from structures. Where physical obstructions or lot lines occur within the minimum clearance, drainage diversions (eg, interceptor swales) should have longitudinal slope a minimum of two percent.

Where the underfloor subgrade is depressed below the finished exterior grade, the surface drainage gradient is to be increased to about 8.3% or one foot vertical to 12 feet horizontal (1V:12H). Optionally, installation of underfloor "rat-proofing" could be utilized to prevent ponding in the underfloor area and complete the stabilization of the subgrade moisture conditions and minimize the expansion potential of the subgrade soils. This treatment should consist of a 6 mil polyethylene (Visqueen) moisture barrier laid on the ground surface and covered with a protective layer of lean concrete or grout. The seams should overlap 6 inches, and edges of the vapor retarder should extend at least 6 inches up interior posts and stem walls and be sealed or taped.

On slopes with a gradient of 5H:1V or more, provision for seepage relief in trenches is required. Cross-slope trenches will require selective grading to avoid effectively "damming" natural drainage at the soil/rock interface. Such damming could result if only fine-grained soil is compacted for trench backfill. Use of the native soils for backfill above the pipe bedding (which extends to at least one foot over the pipe) is anticipated for utility trench backfill which traverse downslope.

<u>Slabs-on-Grade.</u> Slab-on-grade floors are not recommended without reprocessing for uniformity of support. Due to the poor support characteristics of the weak and disturbed surficial soils, preparation for floor slabs will require recompaction or replacement of any remnant weak or disturbed soils (native topsoil, poorly consolidated alluvium, colluvium or residual soil) within the area of planned slabs.

A minimum 18 inch blanket of low expansive soils is recommended incorporated at slab subgrade in living areas, or at least 12 inches under garage or porches which are not considered especially sensitive to slab cracking. In addition, any fill placed within 24 inches of slab subgrade (includes typical slab rock) should be of similarly low expansive soil. Expansion may be checked at grade during construction, as such low expansive soils are naturally present. The requirements of this fill blanket should be reviewed by ***YES!*** if design considerations relative to structure service, grade changes, or structure type differ from that discussed herein.

These materials should be replaced with low-expansive, engineered fill (compacted to at least 90 percent compaction per ASTM D1557), or be clean, coarse free-draining material (as discussed above). The sub-slab aggregate (slab rock) should be free-draining to provide a capillary break; this granular blanket should be graded in size between ¼ and 1½ inches. It would be preferable for this material to be a crushed product. Use of ¾ inch drain rock would provide an economical source of material to provide these characteristics. If such coarse, granular materials are used, they can be tamped, wheel rolled, or vibrated "tight".

Slabs should be poured structurally separate from foundations (be "floating") and have deep joints or expansion joints at centers of about 12 feet or less. To reduce the potential for slab cracking due to post construction subslab soil volume changes, native site soils within 18 inches of subgrade should be moisture conditioned immediately prior to pour. This may be accomplished through ponding, after slab rock and footing elements are in place. This moisture conditioning should be affirmed by a representative of ***YES!*** prior to pour.

A Vapor Retarder should be used to retard vapor transmission through floor slabs. The vapor retarder membrane should be placed between the base course and the slab. If a polyethylene (eg, Visqueen) or more durable butyl membrane is utilized, it should be covered by a protective 2 inch sand cap. If a Vapor Barrier (eg, Stego Wrap) is desired due to especially sensitive floor coverings, adhesives, coatings or building environments, it should be installed in accordance with the manufacturers recommendations. In either case, buildup of vapor pressure through diffusion will be minimized if the vapor membrane has a lower permeance than the floor covering system. It should be noted that American Concrete Institute (per ACI 302, Guide for Concrete Floor and Slab Construction) recommends that protective membranes be not less than 10 mils thick, or 15 mils when placement equipment drives directly on the membrane. Support for exterior flatwork may be placed directly on the subgrade which has been prepared in accordance with the recommendations contained above.

<u>Asphalt Paved Areas.</u> Where fills are necessary within paved areas, they should conform to the previous fill quality recommendations noted above under Site Grading, and be compacted to at least 90 percent relative compaction, with 95 percent relative compaction achieved at pavement subgrade. Prior to subgrade preparation, utility trench backfills should be placed

and compacted in accordance with the governing specifications. The upper six inches of subgrade soils should then be moisture conditioned to near optimum moisture content, and be compacted to at least 95 percent relative compaction. Finished subgrade surfaces should be maintained moist and free of shrinkage cracks until covered by permanent construction.

Aggregate Base, and Subbase if used, should conform to the requirements of the State of California "Caltrans" Standard Specifications, latest edition. Aggregate base courses should be placed in thin lifts in a manner to prevent segregation, moisture conditioned as necessary, and compacted to at least 95 percent relative compaction to provide a smooth, unyielding surface.

Additional Considerations

Prior to construction, we should review the final grading and building plans (and soil-related specification) for conformance with the intent of our recommendations. Our review of construction excavations is considered an integral part of our review for this residence. Please call when the excavation has been scheduled so that we can coordinate with the contractor to provide the necessary reviews. Our construction period observations would allow us to verify conformance of the work to project guidelines, determine that the soil conditions are as anticipated, and to modify our recommendations, if necessary.

Limitations

This consultation is limited to our site reconnaissance, review of former site studies, published geotechnical literature, and our experience in the vicinity. We cannot predict site conditions that may have been noted during a subsurface exploration performed as a part of a comprehensive soil investigation.

We have enjoyed this opportunity to be of service. Please do not hesitate to call if we can be of further assistance.

Very Truly Yours,

YOUNG ENGINEERING SERVICES

REGISTERED PROFESSIONAL ENGINEER
GEORGE B. YOUNG JR.
#922
GEOTECHNICAL
STATE OF CALIFORNIA

George B. Young, Jr.
Civil Engineer - 27405
Geotechnical Engineer - 922

3 copies submitted
cc: Johnson DeBois & Forrest, Attn: Kelly Johnson
Farrell•Faber & Associates, Attn: Kevin Farrell

Attachments: Plate 1 - Expansive Soil Classification
Plate 2 - Retaining Wall Details
Plate 3 - Subdrain Details
Plate 4 - Keyway Bench Details

YES!

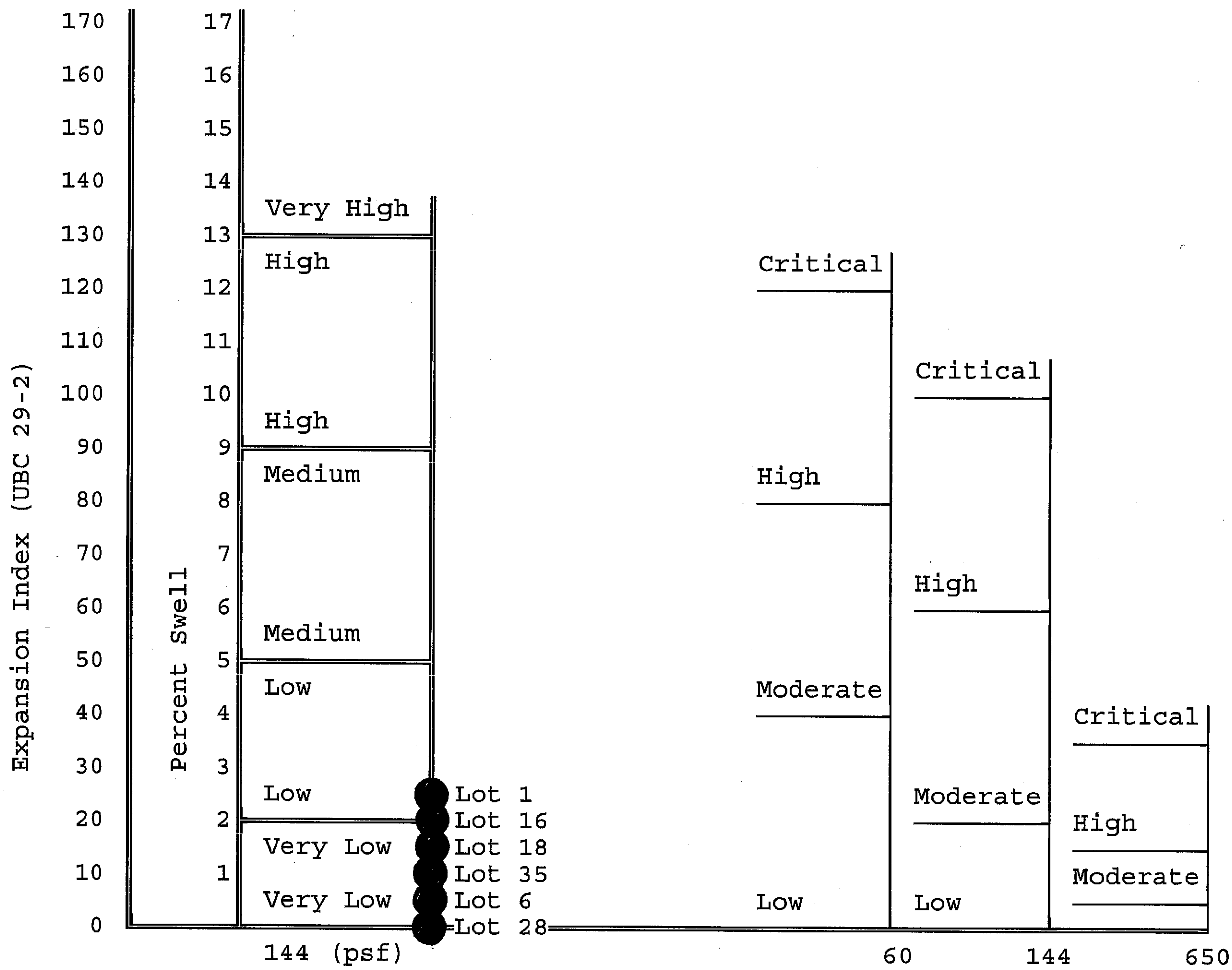
EXPANSIVE SOIL CLASSIFICATION

Royal Glen Subdivision Rebuild
Santa Rosa, California

EXPANSION INDEX TEST (CBC 18-2)

(4" diameter x 1" thick specimen, 144 psf surcharge, 24 hr saturation)
(90 percent relative compaction at optimum moisture per ASTM D1557)

Test Pit/ Depth (ft)	Initial Dry Density (pcf)	Initial Moisture (%)	Final Moisture (%)	Expansion Index
Lot 1	91.5	17.7	32.7	27
Lot 6	81.1	16.4	37.0	5
Lot 16	88.9	16.7	32.9	18
Lot 18	83.4	20.7	37.8	14
Lot 28	83.1	16.5	36.1	1
Lot 35	87.0	15.0	35.6	9



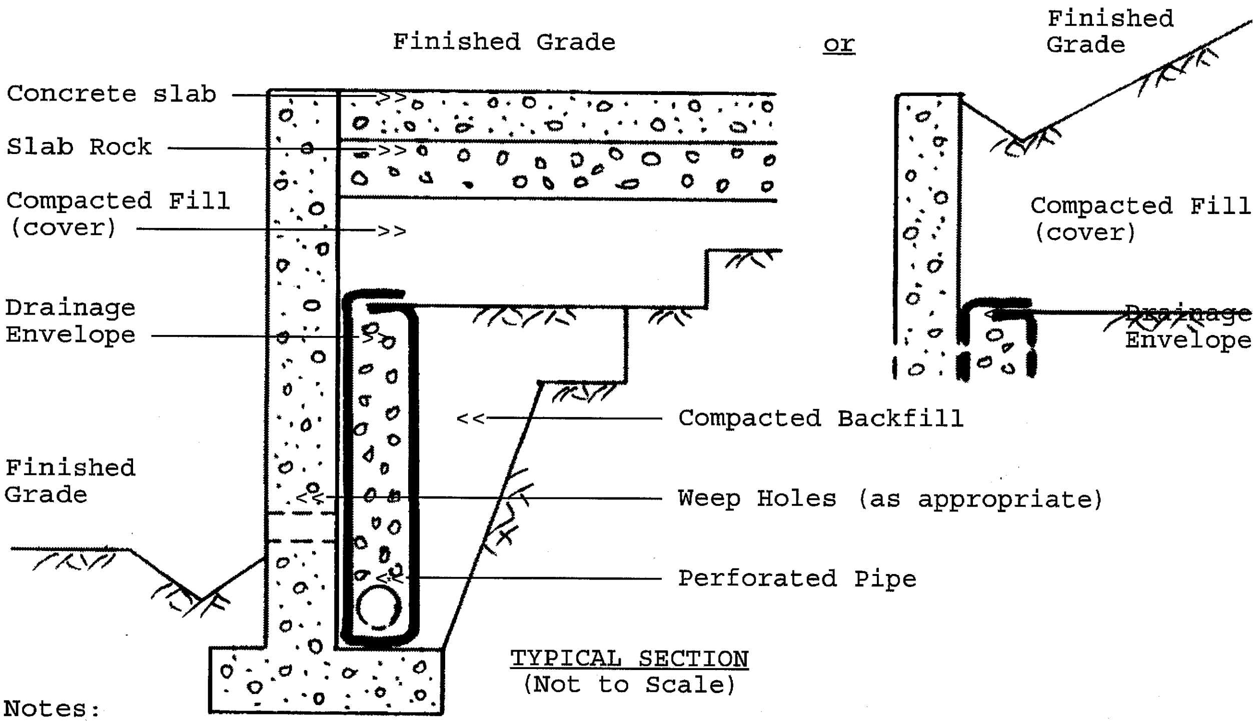
UBC Expansion Index

FHA/HUD Criteria

YES!

RETAINING WALL DETAILS

Royal Glen Subdivision Rebuild
Santa Rosa, California



TYPICAL SECTION
(Not to Scale)

Notes:

1. Compacted Fill (cover). The drainage envelope should be capped by a compacted soil cover a minimum of 12 inches thick. This cover blanket may be omitted where the surface is paved.

2. Drainage Envelope. To minimize potential for clogging of retaining wall drainage, the drainage envelope should also be separated from the soil by use of a Geotextile Filter Fabric (Mirafi 140NP or equal).

   or utilize a select Permeable Material (per Section 68 of Caltrans Standard Specifications) for backfill.

   or utilize a Composite Geosynthetic Drainage System (Miradrain or equal). To relieve this drainage envelope, a perforated pipe and typical drainage envelope (drain rock wrapped in geotextile filter fabric, or perforated pipe wrapped in the composite fabric) should be in contact with the ends of the drain for a distance of at least 5 feet.

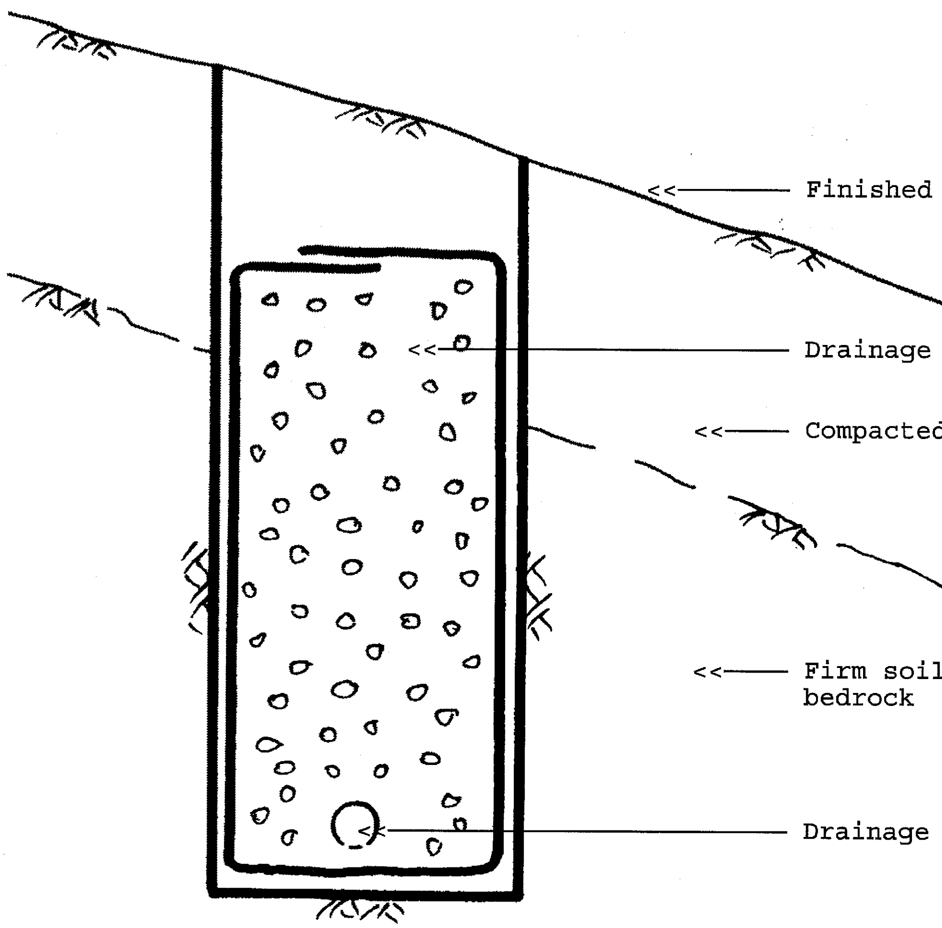
3. Perforated Pipe. The perforated pipe should conform to the requirements of Section 68 of Caltrans Standard Specifications, perforations placed down, sloped at least one percent to drain to a gravity outlet.

   or Weep Holes. Where water draining in front of the wall is acceptable, weep holes should be placed at six foot spacing. Weep holes can consist of 2 inch PVC cut to fit within the foundation stem wall, with the ends wrapped in hardware cloth (one-quarter inch sieve openings) to minimize clogging, and prevent access from rodents.

4. Compacted Backfill. The compacted backfill should be keyed and benched into the backslope. The width and location of benches are approximate, and will be determined in the field by a representative of ***YES!***.

5. Surface drainage is to be provided at the toe of the retaining wall.

YES! SUBDRAIN DETAILS
Royal Glen Subdivision Rebuild
Santa Rosa, California



TYPICAL SECTION
(Not to Scale)

Notes:

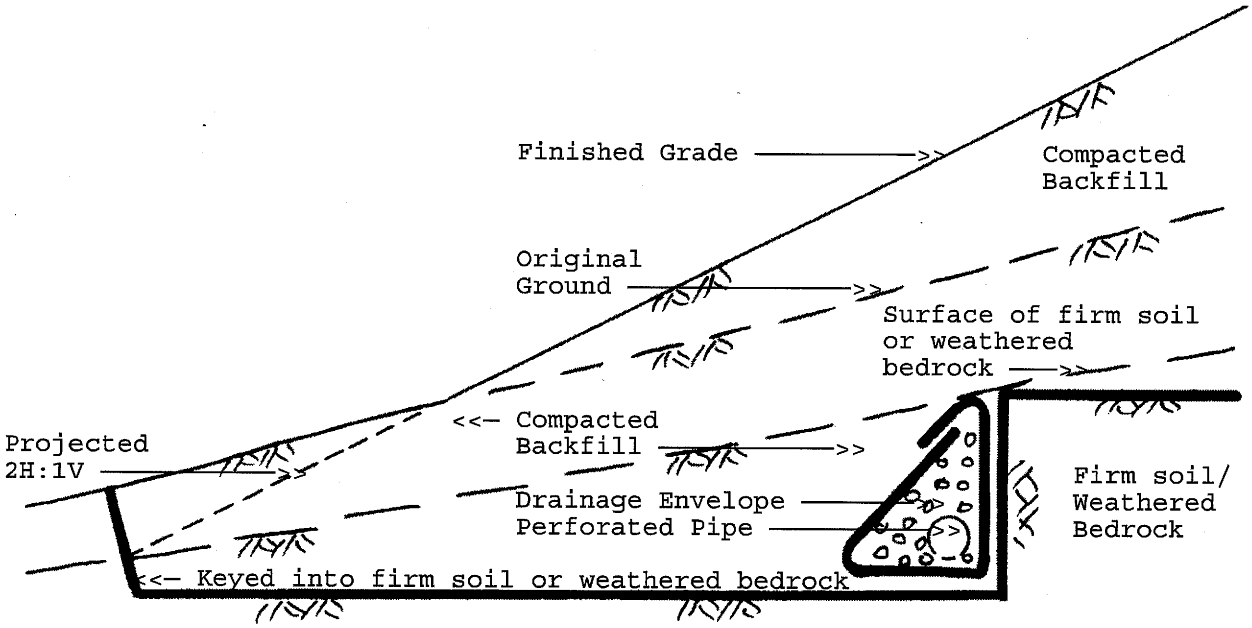
1. Compacted Fill (cover). The drainage envelope should be capped by a compacted soil cover a minimum of 12 inches thick. This cover blanket may be omitted where the surface is paved.

2. Drainage Envelope. Unless otherwise approved by ***YES!***, the subdrain should be at least 4 feet deep and 1 foot into the firm soil or weathered bedrock, and be of minimum width 12 inches. To minimize potential for clogging of the subdrain, the drainage envelope should also be separated from the soil by use of a Geotextile Filter Fabric (Mirafi 140NP or equal).

   or utilize a select Permeable Material (per Section 68 of Caltrans Standard Specifications) for backfill.

3. Perforated Pipe. The perforated pipe should conform to the requirements of Section 68 of Caltrans Standard Specifications, perforations placed down, sloped at least one percent to drain to a gravity outlet.

YES! KEYWAY BENCH DETAILS
Royal Glen Subdivision Rebuild
Santa Rosa, California



TYPICAL SECTION
(Not to Scale)

Notes:

1. Keyed into firm soil. The keyway should be have a minimum embeddment of 1 foot into the firm soil or weathered bedrock, as approved in the field by a representative of ***YES!***.

2. Drainage Envelope. To minimize potential for clogging of the keyway drain, the drainage envelope should also be separated from the soil by use of a Geotextile Filter Fabric (Mirafi 140NP or equal).

   or utilize a select Permeable Material (per Section 68 of Caltrans Standard Specifications) for backfill.

3. Perforated Pipe. The perforated pipe should conform to the requirements of Section 68 of Caltrans Standard Specifications, perforations placed down, sloped at least one percent to drain to a gravity outlet.

4. Compacted Backfill. The compacted backfill should be keyed and benched into the backslope. The width and location of benches are approximate, and will be determined in the field by a representative of ***YES!***.