Jessie Waldman

From: Douglas Herting <dr.dshdc@gmail.com>
Sent: Tuesday, October 17, 2023 9:54 AM
To: Jessie Waldman
Subject: CDP 20220001 Geo technical report
Attachments: 3977.0 S. Hwy 1 (33101) draft gi.pdf

Categories: Resolved

Jessie,
Please see the attached GeoTech report.
Please advise on additional information you need prior to issuance of the CDP.
Thank you
Doug and Jennifer Herting

BAUER
associates, inc.
GEOTECHNICAL CONSULTANTS

April 19, 2022
Job No. 3977.0

Mr. Douglas Herting
3044 Santa Maria Drive
Concord, CA 94518

DRAFT Report
Geotechnical Investigation
Proposed Residence
33101 South Highway One
Gualala, California

This draft report presents the results of our geotechnical investigation for the planned project. The project is shown on Sheet 1, *Topographic Map*, dated July 16, 2021, prepared by APEX Civil Engineering and Land Surveying (APEX). The plan is partially reproduced and shown on Plate 1.

We understand that the residence will be a two-story, wood framed structure with a concrete slab-on-grade floor basement and garage on the lower level. Foundation loads are expected to be typical for the type of construction indicated. We understand that the basement will extend across a cut and fill area. The structure will be excavated into the hillside. We understand the uphill cut will be on the order of 4 to 5 feet high and supported with a retaining wall. The cut materials are to be used as fill on the downhill side of the structure to create a level building area. Unretained fills will be relatively minor and less than about 4 feet high.

The scope of our investigation, as outlined in our agreement dated December 23, 2021, included reviewing selected geotechnical references from our files pertinent to the site, exploring subsurface conditions, and obtaining samples for visual classification and laboratory testing. Based upon our literature review, subsurface exploration, and laboratory testing, we have developed conclusions and recommendations regarding:

1. Proximity of the site to published active faults.

2. Soil/rock and ground water conditions observed.

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3. Site preparation and grading for the residence.

4. Foundation type(s) and design criteria.

5. Retaining walls.

6. Concrete slabs-on-grade.

7. Geotechnical engineering drainage.

8. Supplemental services.

Our scope of work does not include evaluation of any potential hazardous waste contamination or corrosion potential of the soil or groundwater at the site. Further, our scope of services does not include evaluation of areas beyond the planned residence (i.e., driveway, existing improvements, well, leachfield, etc.).

WORK PERFORMED

We reviewed selected geotechnical and geologic literature and data. A listing of the literature and data reviewed is presented in the *List of References* at the end of this report.

On January 20, 2022, our geologist visited the site to: 1) observe the surface conditions; 2) confirm our exploration approach; and 3) mark our exploration locations. On February 4, 2022, our geologist explored the subsurface conditions to the extent of four test pits. The test pits were excavated with a Kubota KX040-4 track-mounted mini excavator equipped with a 24-inch-wide bucket. The completed test pits were excavated to a maximum depth of about 8-1/2 feet (maximum reach of the mini-excavator bucket).

The test pit locations, shown approximately on Plate 1, were located by our geologist by estimating distances from features indicated on the map. The test pit locations should be considered accurate only to the degree implied by the method used. We also prepared a Schematic Cross Section through the site showing the surface profile, selected test pit locations, conditions encountered, and the proposed building site. The Schematic Cross Section is shown on Plate 2.

Our geologist logged the conditions exposed and obtained bulk soil samples at selected intervals for visual identification and laboratory testing. Logs of the test pits showing the materials encountered are presented on Plates 3 and 4. The soils and bedrock are classified in accordance with the Unified Soil Classification System and Rock Classification Criteria, presented on Plates 5 and 6, respectively.

The logs show our interpretation of the subsurface conditions on the date and locations indicated, and it is not warranted that they are representative of the subsurface conditions at other locations and times. Also, the stratification lines on the logs represent the approximate boundaries between material types; the transition may be gradual. The test pits were not backfilled with compacted fill and will settle. Test pits in development areas must be properly filled during construction where not removed by excavating to achieve planned grades.

Representative samples of the soils encountered were laboratory tested to determine their percent passing the No. 200 sieve, and moisture content. The test results are generally presented on the test pit logs in the manner described in the Key to Test Data, Plate 5.

SITE CONDITIONS

The 8-acre, irregularly shaped parcel is located on the east side of South Highway 1 (Google Earth coordinates: 38.8242° N; -123.6052° W), about 2 miles northwest of Anchor Bay. The parcel is classified by the County as Rural Residential. The terrain is characterized by southwesterly trending spur ridges and intervening riparian lined drainages. The vicinity is densely wooded with Bishop pine and Redwood trees and brush. The proposed building area is situated on the central portion of the parcel and is bounded by a high ridge on the northwest and a drainage on the southeast. The coastal bluff is located about 410 feet to the southwest of the proposed building site. The bluff is very steep to near vertical and is about 100 feet high. The proposed building site is located just south and downhill of a mature Redwood tree grove. The elevation of the building area on the map by APEX is between about 167 feet to 176 feet. Slope gradients across the proposed building site are about 6:1 (horizontal to vertical). Site improvements include a shed and leach field on the northern side of the Redwood grove, and septic tanks, a water tank, and a well towards the northwest. A gravel road accesses these improvements from a common driveway on the north side of the parcel.

The geologic map reviewed indicates that the property is underlain by the Paleocene-Eocene age German Rancho formation. The German Rancho formation is reported by Davenport (1984) to consist of "consolidated, moderately hard, coarse-grained sandstone interbedded with minor mudstone and less common conglomerate; overlain in many places by undifferentiated marine terrace sands; highly sheared and colluvial in appearance near the San Andreas fault system."

Our subsurface exploration, summarized on Plates 3 and 4, confirms the site is underlain by sandstone of the German Rancho formation. Sandstone bedrock was encountered in Test Pits 1 and 4 ranging in depth from about 2-1/2 and 4-1/2 feet, and possibly at the bottom of Test Pit 3 at about 8 feet deep. Test Pits 1 and 4 were excavated near the lower flanks of the ridge on the west. Test Pit 3 was excavated further away from the base of the ridge and near the southeast building footprint. The sandstone bedrock is generally moderately indurated, moderately hard, and weak to moderately strong with discontinuous sandy layers that exhibit low hardness and friable strength. The sandstone bedrock is typically moderately weathered. Bedrock was not encountered in Test Pit 2, excavated to a maximum depth of 8 feet near the northeast building footprint. Medium dense and firm clayey sand soils were encountered at about 4 feet below the ground surface in Test Pits 2 and 3. These firm clayey sands extended to the bottom of Test Pit 2. The clayey sand soils are wet, contain localized pockets of roots, and experienced caving test pit sidewalls in the unsupported excavation.

The sandstone bedrock and firm clayey sand soils are covered by about 3 to 4 feet of weak colluvial soils consisting of clayey, silty and clayey silty sands. These weak soils are generally porous and wet. The upper 1 to 1-1/2 feet is root-laden with roots up to about 3 inches in size. Weak and porous soils are prone to differential settlement and are susceptible to collapse when saturated and under load. Further, these colluvial soils are typically prone to downhill creek on terrain sloping steeper than about 10:1 (horizontal to vertical). Creep is the slow, episodic movement of the surface soils downhill by gravity and seasonal moisture changes. The estimated depth of weak soils is indicated on the test pit logs.

Our visual classification indicates the surface soils exhibit generally low to moderate expansion potential. Expansive soils, where encountered, tend to experience volume changes with different moisture content and can potentially heave, and crack lightly loaded, shallow foundations and slabs.

Groundwater seepage was observed in Test Pits 1, 3, and 4 at the time of our exploration. Seepage was relatively heavy within the soils and near the soil-bedrock interface. Wet test pit sidewalls typically are prone to localized caving into the unsupported excavations. Groundwater conditions are expected to vary seasonally and by location. Temporarily perched groundwater can be encountered at the ground surface or relatively shallow depths, particularly during the winter and spring months. Our work did not include evaluation of flooding.

Davenport (1984) reports that the site vicinity exhibits localized areas of "Disrupted Ground: irregular ground surface caused by complex landsliding processes resulting in features that are indistinguishable or too small to delineate individually at the mapped scale; also may include areas affected by downslope creep, expansive soil, and/or gully erosion; boundaries usually are indistinct." Davenport (1984) also shows a very small slide at the nose of the ridge between the parcel boundary and South Highway 1. This mapped slide may coincide with a road cut during construction of the highway. We did not observe evidence of landsliding or disrupted ground at the proposed building site.

Interactive geologic maps of the area by the California Geological Survey (2018 revision) do not show the presence of active faults crossing the site, and the site is not shown to be within Alquist-Priolo Earthquake Fault Zone boundaries. The nearest mapped active fault (experiencing surface rupture within about the last 11,000 years) is the historically active San Andreas fault, located 2-3/4 miles to the northeast. The San Andreas faut last ruptured in 1906. An offshore trace of the San Andreas is located about 1-3/4 miles to the southwest and is indicated by CGS to have ruptured in about the last 15,000 years. Other pre-Quaternary faults (Bortugno, 1982), not currently considered active, are located near the site. These include two northerly-trending normal faults shown on Davenport (1984) and are mapped to be about 250 feet to the east and 350 feet to the west. Our authorized scope of work did not include subsurface investigation to evaluate the presence or active faults crossing the site.

DISCUSSION AND CONCLUSIONS

Based on the results of our investigation, we judge that the planned development is feasible from a geotechnical engineering viewpoint. The primary geotechnical concerns are: 1) the variable depths to bedrock; 2) the presence of 2-1/2 to 4-1/2 feet of weak and porous surficial soils that are prone to downhill creep; and 3) groundwater seepage at shallow depths along with cave-prone sandy soils across the site.

Weak and porous soils of varying depths are subjected to uneven supporting characteristics and differential settlement. Upon saturation, weak surface soils will lose strength and consolidate rapidly under loads of new fills and structural elements. In addition, these weak surface soils are prone to creep downhill on sloping terrain. Therefore, we judge these weak surface soils are not suitable for support of new fills and shallow foundations in their current condition.

The structure must be supported on firm bedrock to mitigate the differential supporting conditions. Satisfactory foundation support may be obtained from drilled, cast-in-place concrete friction piers that extend through the weak surface soils to bear into firm bedrock. Bedrock was encountered in Test Pits 1, 3, and 4 at depths ranging from about 2-1/2 feet to 8 feet. Bedrock was not encountered in Test Pit 2 excavated near the northeast side of the proposed building area. We considered a mat slab foundation however; the differential depths to bedrock may result in uneven settlement of the mat slab and could result in minor distress of structural elements, such as sticky doors and windows, cracks in sheet rock, gaps between the garage door and sab, etc.

Critical (i.e., basement and garage) slab support can be achieved by removing the weak surface soils for their full depth and replacing these with engineered fill. We anticipate the excavate materials will be suitable for re-use as engineered fill. Additional compaction effort (typically 93 percent relative compaction) would be required where critical slabs span over fills of differential thickness. Differential fill thicknesses are considered to be greater than 3 feet. Alternatively, critical slabs may be structurally supported to span between drilled pier foundation elements.

Light use, non-critical slabs such as equipment or utility pads or landscape sidewalks, may be constructed on properly prepared subgrade provided that: 1) some soil-related cracking and movement is considered acceptable; 2) the slabs are separated from foundations; and 3) the slabs are designed by others to minimize cracking (i.e., reinforced and provided with control joints). If better slab performance is desired or required, it will be necessary to overexcavate a portion of the creep-prone materials and replace these as engineered fill. The depth of overexcavation is dependent upon the level of performance desired by the owner.

We did not encounter highly expansive soils during our subsurface exploration. If expansive soils are encountered during construction, we should be contacted to provide supplemental recommendations to mitigate the effects of expansive soils.

Caving test pit sidewalls were observed in localized areas during our subsurface exploration, and groundwater seepage was encountered within three of the four test pits. Groundwater conditions are expected to vary in depth and extent across the site. Perched groundwater conditions will vary seasonally and by location across the site, particularly after periods of prolonged rainfall or during the winter and spring months. Excavations performed in the summer or autumn months will typically result in a lower risk of encountering groundwater.

Creeping soils should be mitigated by their removal in cut areas and excavation and replacement to grade level of building pads, such as for the basement and garage. Where fills are planned on sloping terrain, the creep-prone soils will need to be removed and reconstructed as a buttressed fill (keyed, benched, drained and compacted). Due to groundwater seepage, we recommend that a subdrain should be constructed uphill of the planned improvements. The subdrain is intended to divert subsurface water around the building improvements to: 1) reduce caving potential during pier drilling; and 2) assist in lowering the soils moisture content for grading the basement.

Future slope instability could be induced by several factors such as high groundwater conditions, the effects of indiscriminate grading and drainage, and earthquake shaking. Casting of new fill on the slopes may result in downhill movements under the influence of gravity. Therefore, excavation and foundation spoils should not be cast on the slopes. The excavated materials and foundation spoils should be placed as properly engineered fill or be removed from the site. Areas of slope instability, sloughing, and erosion must be corrected promptly before enlargement can occur.

Control of surface run off will significantly enhance the stability of the site. Generally, the introduction of water into soils can cause soil instability and should be avoided. The site must be graded to provide positive drainage away from the toes of cuts, fills, and foundations. Roofs should be provided with gutters and the downspouts connected to non-perforated pipes discharging onto erosion resistant areas well away from the structures. Piped outlets should be provided at interior slabs. At critical use slab areas (i.e., basement), slab underdrains with outlets should be provided in the slab rock to reduce the risk of water build up in the slab rock. Crawl spaces, if used, should be sloped to drain through foundations to allow controlled drainage through foundations. All collected water must be discharged onto erosion resistant areas, well away from structural elements.

We did not observe landsliding at the proposed building area. However, landsliding is a risk inherent with all hillside development. Landsliding could be induced by several factors such as high groundwater conditions, the impacts of indiscriminate grading and drainage, and earthquake shaking. The recommendations presented in this report have been prepared to mitigate the hazard of shallow landsliding and creeping soils. Excavated materials cast onto slopes will tend to creep downhill under the influence of gravity. Therefore, on-site excavated materials should be placed as properly engineered fill or removed from the site. Landsliding, sloughing, and erosion must be corrected promptly before enlargement can occur.

The results of our literature review did not reveal active faults passing through the site. Since future faulting is generally considered most likely to follow the trace of the most recent fault rupture, we estimate the risk of future surface rupture at the site during earthquakes to be low.

RECOMMENDATIONS

Site Preparation and Grading

The following recommendations are presented for general grading. We must review and approve any grading planned, since site grading may have a negative impact on site stability.

Areas to be graded should be cleared of septic tanks and leachlines, rubble, debris, old fills, vegetation, etc. Material generated by the clearing operations should be removed from the site. Wells, cesspools, and other voids encountered or generated during clearing should be either backfilled with granular material or compacted soil or capped with concrete as determined by us and in accordance with Mendocino County requirements.

Areas to be graded should be stripped of the upper soils containing root growth and organic matter. We anticipate that the required depth of stripping will average about 2 to 4 inches. Deeper stripping will be required to remove localized heavy concentrations of root growth. The strippings should be removed from the site, stockpiled for reuse as topsoil, or mixed with at least two parts soil and used as fill in areas beyond structures and paved areas.

Test pits were backfilled with on-site excavated materials and tamped with the mini-excavator bucket. Where test pit backfills are not removed by the planned grading, backfills in development areas must be properly filled during construction.

For the purpose of definition, "select fill areas" referred to in this report are building, concrete slab, and planned fill areas and the zones extending for a distance of at least 5 feet beyond their outside edges.

Following clearing and stripping, planned excavations should be performed. In select fill areas, weak soils should be excavated for their full depth. Areas to receive fill should be prepared by cutting level keyways and benches extending into firm materials. Subsurface drainage facilities should be installed at the rear of keyways as recommended by us. Keyways and benches should be excavated in areas where the terrain is sloping steeper than about 10:1. The depth of keyways and subdrains should be determined and approved by us in the field during grading. A typical fill and subdrain detail is presented on Plate 7.

If isolated deeper zones of soft, saturated, dry (shrinkage cracks), highly porous or organic soils are encountered during excavation and recompaction, the soils should be removed to expose firm materials. The depth and extent of overexcavation should be approved in the field by us.

Within the stripping, excavation, and keyway areas, the exposed bottoms should be moisture conditioned to about 2 percent above optimum moisture content, scarified and compacted to at least 90 percent relative compaction. Relative compaction refers to the in-place dry density of the soil expressed as a percentage of the maximum dry density of the same soil, as determined by ASTM D 1557-12. Optimum moisture content is the water content (percentage by dry weight) corresponding to the maximum dry density.

Higher groundwater conditions may be encountered if grading is performed during the winter or spring seasons. Severe groundwater conditions may result in the need for dewatering, placement of stabilization fabrics, and/or placement of ballast rock to achieve stable excavation bottoms.

The on-site soils should be suitable for reuse as general fill provided that: 1) all rock sizes greater than 6 inches in largest dimension and perishable materials are removed, and 2) the fill materials are approved by us prior to use. Imported fill should be non-expansive, free of organic matter, and should conform to the following requirements:

Sieve Size	Percent Passing
6-inch	100
4-inch	90-100
No. 200	15-60

Liquid Limit - 40 Maximum
Plasticity Index - 15 Maximum
(ASTM D 4318-10 Wet Test Method)

Fill should be placed in thin lifts (normally 6 to 8 inches depending on compaction equipment), uniformly moisture conditioned to at least 2 percent above optimum moisture content and compacted to at least 90 percent relative compaction. Higher compaction requirements (i.e., 93 percent) will be required at areas of differential fill thickness (greater than about 3 feet) to reduce the potential for differential settlement. It may be necessary to excavate portions of firm soils in order to provide fill areas with a relatively uniform thickness. All surfaces should be finished to present a smooth, unyielding subgrade.

In general, fill and cut slopes should be constructed no steeper than 2:1. Graded slopes should be planted with quick growing, dense vegetation or protected from erosion by other measures upon completion of grading.

At all times, temporary construction excavations should conform to the regulations of the State of California, Department of Industrial Relations, Division of Industrial Safety or other stricter governing regulations. The performance of temporary cut slopes is the responsibility of the contractor/owner. Temporary cut slopes of 1:1 may be used for planning purposes but must be reviewed in the field by us. Depending on the exposed subsurface conditions, presence of groundwater seepage and the time of year when grading is performed, temporary cut slopes may need to be excavated flatter than 1:1. The tops of the cut slopes should be rounded back to 2:1 in weak soil zones.

Drilled Pier Foundations

Pier lengths will vary across the site due to the uneven depths to bedrock. Drilled piers should have a minimum diameter of 16 inches, and extend at least 4 feet into firm bedrock, as determined by us during pier drilling. Piers should have a minimum length of 8 feet below existing or final grade, whichever is lower.

Since the residence will be constructed on a graded pad, we anticipate the planned basement cut will remove the creep prone soils and the fill on the downhill edge will consist of engineered fill re-constructed as a buttress fill. Therefore, drilled pier foundations will not need to be designed to resist creep forces. Piers will be deeper where fill is placed, such as the outer edges of the fill pads. The portion of the pier extending into firm bedrock can impose 750 pounds per square feet (psf) in skin friction. The upper 2 feet of penetration should be neglected in design. Pullout capacity of the piers should be considered as one-half the downward capacity. End bearing should be neglected because of the difficulty of cleaning out the pier holes, and the uncertainty of mobilizing end bearing and skin friction simultaneously. Piers should not be located closer than three pier diameters, center to center.

The portion of the piers extending into firm bedrock may impose a passive pressure of 350 pcf acting on two pier diameters. Passive pressure should be limited to a maximum of 3,000 psf. Passive pressure should be neglected within the upper 1 foot of pad grade unless confined by other construction

All piers should be interconnected with gradebeams, where applicable, designed to support the design structural loads per current code requirements. Piers should be reinforced for their full length with steel reinforcing that extends into the gradebeams, where applicable.

Caving materials are likely to be encountered in excavations. Therefore, the contractor should be prepared for caving conditions and provide materials and equipment to case the holes during drilling. Where groundwater is encountered, it will be necessary to dewater the holes and/or place the concrete by the tremie method.

The drilling subcontractor should review this report and visit the site to draw his own conclusions regarding drilling conditions, suitable drill rigs and the need for casing and dewatering prior to bidding.

The pier holes should contain no more than 3 inches of slough. The remaining slough should be tamped with a heavy timber or similar prior to concrete placement to prevent wet concrete from settling. Concrete should be placed in pier excavations promptly to avoid caving where holes are not cased. Excess concrete must be trimmed to plan dimensions from the bottoms of gradebeams and tops of piers to reduce uplift pressures. Drilling spoils should not be placed on slopes.

We should observe the start of pier drilling operations to note the conditions exposed and provide recommendations to the contractor. We should observe the completed pier excavations prior to the placement of reinforcing steel and concrete.

Seismic Design Criteria

Using Google Earth site latitude and longitude coordinates of 38.8242°N and -123.6052°W, respectively, the following seismic design criteria is based on 2019 CBC guidelines, ASCE 7-16, and the USGS Earthquake Ground Motion Parameters:

Spectral Response Type & Description	Value (g)
S_S (0.2 second period)	1.973
S_1 (1.0 second period)	0.813
S_{MS} (0.2 second period)	2.367
S_{DS} (0.2 second period)	1.578
S_{D1} (1.0 second period)	0.759
Peak Ground Acceleration (PGA)	0.847
Seismic Design Category	E

Title 24, Part 2, Section 1613.2.2, of the 2019 CBC indicates that site categorization for seismic design should be based on the average soil values within the upper 100 feet of the site. Although the scope of our investigation was limited to relatively shallow test holes, we estimate that a Site Classification "C" will be appropriate for design. Upon request, we could perform supplemental calculations or exploration to determine the site-specific subsurface conditions ranging to 100 feet.

Retaining Walls

Foundation support for retaining walls can be obtained from drilled piers designed in accordance with the recommendations presented above.

Retaining walls free to rotate (yield more than 0.1 percent of the wall height at the top of the backfill) and with level backfill should be designed to resist an active lateral earth pressure (triangular distribution) of 40 pounds per cubic foot (pcf). Rigid walls which cannot yield should be designed for an "at-rest" lateral earth pressure of 60 pcf. A minimum factor of safety of 1.5 against overturning and sliding should be used in the design of retaining walls.

Seismic wall stability may be evaluated based on a uniform lateral earth pressure of 13xH psf (where H is the height of the wall in feet). This force should be considered to act at a height of 0.33H on the wall. This pressure is in addition to the active equivalent fluid pressures presented in this report. For restrained walls, seismic pressures may be assumed to act in combination with active rather than at-rest earth pressures. The factor of safety against instability under seismic loading should be at least 1.1.

These pressures do not consider additional loads resulting from adjacent foundations or other downward loads. If additional surcharge loadings are anticipated, we can assist in evaluating their effects. Similarly, if stepped retaining walls are planned, we should be contacted to provide specific lateral surcharge pressures for the lower walls based on the final wall configuration.

Retaining walls should be provided with backdrains to prevent the build-up of hydrostatic pressure. The drains and backfill should be constructed as shown on Plate 8. The top of the perforated drainage pipe should be located at least 8 inches below adjacent interior slabs to reduce the risk of seepage through walls into interior areas.

Where migration of moisture through retaining walls would be detrimental, retaining walls should be waterproofed as specified by the Project Architect or Structural Engineer. Backfill materials should be compacted in a manner to prevent over-stressing the wall. Further, wall bracing should be considered. Retaining walls will yield slightly during backfilling. Therefore, retaining walls should be backfilled prior to building on or adjacent the walls. Expansive soils may not be used as backfill within the zone defined by a 1:1

projection from the top of the footing. The use of imported granular material will generally require less backfilling effort. We should be contacted to observe the backfill of retaining walls.

Concrete Slab-On-Grade

Critical use slabs-on-grade (i.e., basement and garage) subgrades should be prepared in accordance with our previous recommendations. Subgrade should be maintained at a uniform moisture, at least 4 percent above optimum moisture content (2 percent for low expansion materials), until the concrete slabs are placed. During foundation installation and utility trench excavation and backfilling, previously compacted subgrade soils may become disturbed. Where this is the case, these soils should be uniformly moisture conditioned to above optimum moisture content and rerolled to provide a smooth, unyielding surface compacted to at least 90 percent relative compaction.

Light use, non-critical slabs such as equipment or utility pads or landscape sidewalks, may be constructed on properly prepared subgrade provided that: 1) some soil-related cracking and movement is considered acceptable; 2) the slabs are separated from foundations with felt paper, mastic, or other positive and low friction separation; 3) the slabs are designed by others to minimize cracking (i.e., reinforced and provided with control joints). We should be contacted if improved performance of slabs is desired.

Slabs should be underlain with a capillary moisture break and cushion layer consisting of at least 4 inches of clean, free-draining crushed rock. The crushed rock should be at least 1/4-inch, and no larger than 3/4-inch, in size.

Moisture will condense on the underside of slabs. Where moisture migration through slabs is detrimental, waterproofing methods and specifications should be determined by others for incorporation into the project plans. The basement slab should be provided with underdrains as described in the *Geotechnical Engineering Drainage* section of this report to reduce the risk of water build-up in the slab rock. For less critical slabs, outlets should be provided in the slab rock to reduce the risk of water build up in the slab rock.

Slab thickness should be recommended by the structural engineer to support the anticipated loads and to reduce cracking. Some cracking of slabs must be anticipated considering concrete shrinkage. Reinforcing must be carefully installed in accordance with the structural engineer's recommendations to minimize the potential of cracking. We typically recommend the use of rebar reinforcement, placed on blocks as directed by the structural engineer. We have commonly observed that welded wire mesh is not properly located in the slabs. Control and expansion joints should be provided, as appropriate, to mitigate the effects of differential settlement.

Geotechnical Engineering Drainage

Ponding water will be detrimental to building foundations and structural elements. The site should be graded to provide positive drainage away from the building pads and foundations. Roofs should be provided with gutters, and the downspouts connected to non-perforated pipes discharging into the storm drainage system or erosion resistant areas well away from the structures. Roof downspouts and surface drains must be maintained entirely separate from subsurface drainage. Collected water must be discharged into non-perforated pipes and discharged into the site storm drainage, or erosion resistant areas away from the foundations.

Retaining wall backdrains should be constructed to reduce hydrostatic pressures against retaining walls. The backdrains should be at least 12 inches wide and extend up to the height of the drained portion of the walls. Plate 8 presents criteria for retaining wall backdrains. Subdrains should consist of 4-inch diameter, perforated pipe, installed perforations down, placed at the bottom of the drain and sloped to drain to outlets by gravity. The subdrain pipe should consist of PVC Schedule 40 or ABS with a SDR of 35 or better. The trench should be backfilled with clean, free-draining, ¾ or 1-1/2-inch crushed drain rock separated from adjacent soil/rock by a non-woven filter fabric. As alternatives to standard drain rock and fabric, Class II permeable material complying with Section 68, "Caltrans" may be used without fabric or a prefabricated synthetic drainage structure such as Miradrain 6000 (or equivalent) may be used. The upper 12 inches of the drain should be backfilled with compacted, non-expansive clayey soil to exclude surface water. If groundwater seepage is encountered during grading, additional subdrains should be installed as recommended by us.

Due to groundwater seepage, we recommend that a subdrain should be constructed uphill of the planned improvements to divert subsurface water around the building improvements. The subdrainage materials (i.e., pipe, drain rock, clay cap) used should conform to those shown on Plate 8. The subdrain should extend at least one foot into bedrock and slope at a minimum gradient of 2 percent to its outfall.

Outlets should be provided in the slab rock at slabs-on-grade to reduce the risk of water build up in the slab rock. In the basement area, underslab drains should be provided beneath the slab rock to reduce the risk of water build-up in the slab rock and to increase mitigation of moisture migration through slabs. The subdrain trenches should be 12 inches wide, 12 inches deep and cross the slab area, as directed by us. The slab rock should be connected to the subdrain rock. The materials (i.e., pipe, rock and fabric) should conform to those shown graphically on Plate 9. Crawl space areas beneath structures, where constructed, should be graded to drain and be provided with a means to outlet any water that may accumulate.

Supplemental Services

We should be contacted during design to discuss our recommendations and the design approach. We should review the final plans for conformance with the intent of our recommendations.

During grading and foundation construction, we should provide intermittent geotechnical engineering observations, along with necessary field and laboratory testing, during: 1) removal of weak soils and old fills, where encountered; 2) fill placement and compaction; 3) preparation and compaction of subgrade; 4) installation of subdrainage; and 5) excavation of foundations. These observations and tests would allow us to check that the contractor's work conforms with the intent of our recommendations and the project plans and specifications. These observations also permit us to check that conditions encountered are as anticipated, and to modify our recommendations, as necessary. Upon completion of the project, we should perform a final observation prior to occupancy. We should summarize the results of this work in a final report.

These supplemental services are performed on an as-requested basis, and we can accept absolutely no responsibility for items that we are not notified to observe. These supplemental services are in addition to this investigation and are charged for on an hourly basis in accordance with our Schedule of Charges. We must be provided with at least 48 hours notice for scheduling our initial site visit, and 24 hours thereafter.

MAINTENANCE

Periodic land maintenance will be required. Surface and subsurface drains should be checked frequently and cleaned and maintained as necessary. Sloughing or erosion that occurs should be repaired before it can enlarge. A dense growth of deep-rooted ground cover should be maintained on all exposed slopes.

LIMITATIONS

We judge that construction in accordance with these recommendations will be generally stable, and that the risk of future instability is within the range generally associated with construction in the local area. Subsurface conditions are complex and may differ from those indicated by surface features and those encountered at the test hole locations. Additional exploration could reveal conditions not evident at this time. Therefore, we are unable to guarantee the stability of any hillside construction.

We performed the investigation and prepared this report in accordance with generally accepted standards of the geotechnical engineering profession. No other warranty, either express or implied, is given.

If the project is revised, or if conditions different from those described in this report are encountered during construction, we should be notified immediately so that we can take timely action to modify our recommendations, if warranted. Site conditions and standards of practice change. Therefore, we should be notified to update this report if construction is not performed within 18 months of the submittal date.

We trust this provides the information you require at this time. If you have questions or wish to discuss this further, please call.

Very truly yours,

BAUER ASSOCIATES, INC.

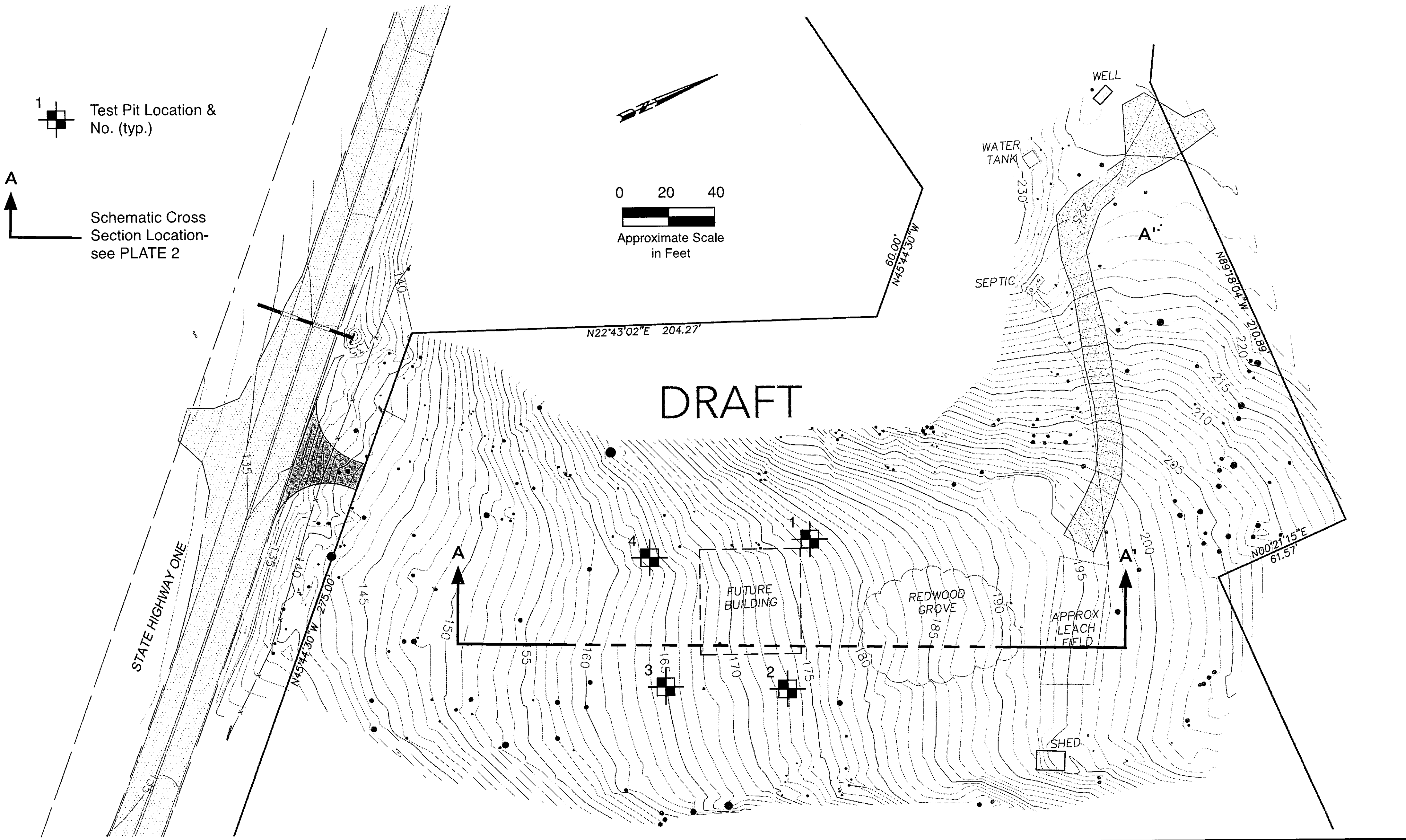
DRAFT

Gregory D. Sarganis
Professional Geologist

DRAFT

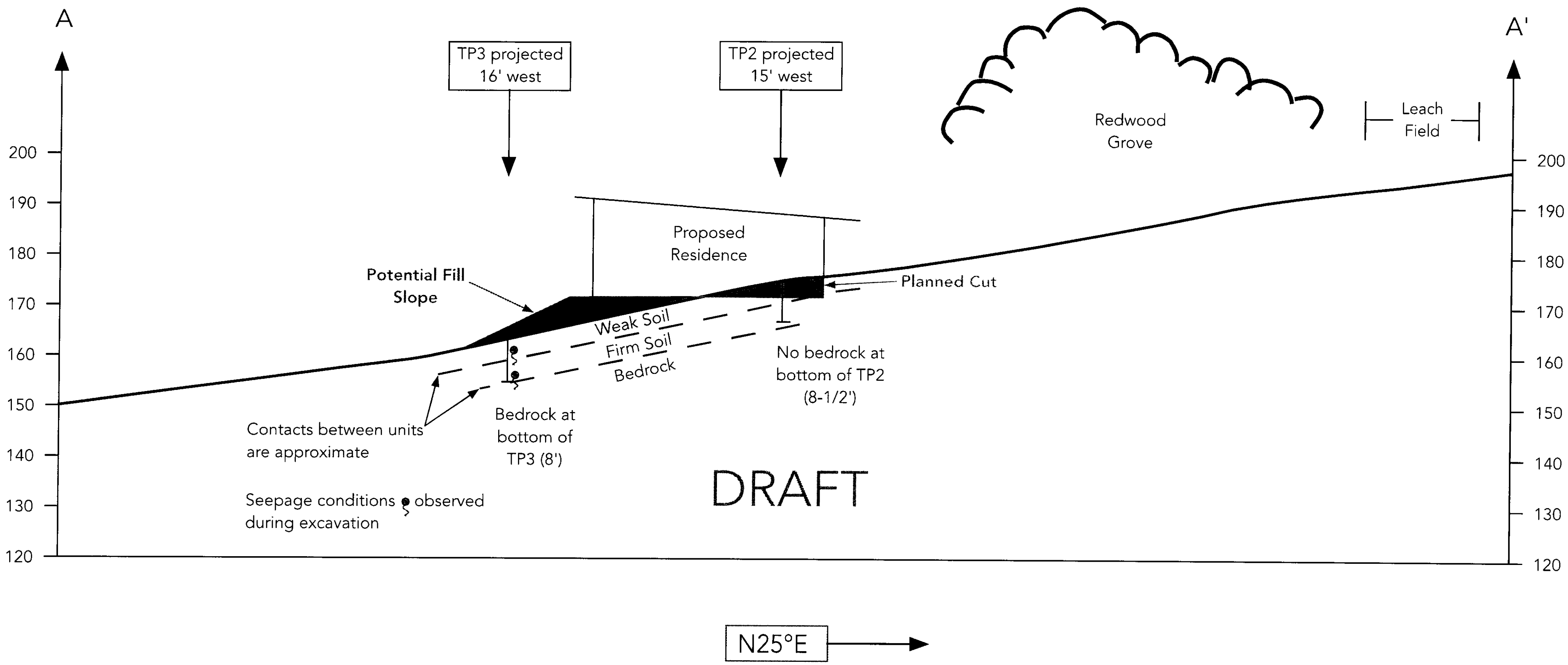
Arthur H. Graff
Geotechnical Engineer

GDS/AHG (gi/south hwy 1)
Attachments: Plates 1 through 9
Email only



Reference: Adapted from Sheet 1, *Topographic Survey,* dated July 16, 2021, prepared by Apex Civil Engineering and Land Surveying.
Note: The locations of all features are approximate and may vary.

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: LT	**TEST HOLE LOCATION PLAN** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **1**



Reference: Cross section drawn from Sheet 1, *Topographic Survey,* dated July 16, 2021, prepared by Apex Civil Engineering and Land Surveying. Horizontal and Vertical Scale: 1" = 20'
Note: The locations of all features are approximate and may vary.

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: LT	**SCHEMATIC CROSS SECTION A-A'** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **2**

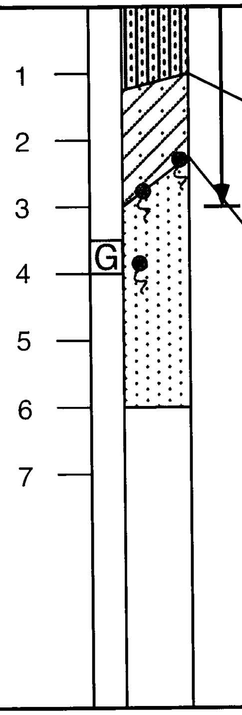
LOG OF TEST PIT 1

Test Pit Orientation: N41°W
Logged northeast pit wall

Laboratory Tests | Depth | Sample | Symbol | Weak Soils

Equipment: Kubota KX040-4 w/ 24" bucket
Date: February 4, 2022
Elevation: 178 feet*

DRAFT



GRAY BROWN CLAYEY SILTY SAND (SM)
loose, wet, porous, abundant roots up to 3 inches (Colluvium)

YELLOW BROWN CLAYEY SAND (SC)
medium dense, wet, porous, with sandstone fragments wedged apart by roots, seepage at base of unit

ORANGE BROWN SANDSTONE
moderately consolidated, moderately hard, weak to moderately strong, moderately weathered, with discontinuous layers of silty sand that exhibit low hardness and friable strength, slight seepage at about 4 feet

Bottom of test pit at 6 feet
Groundwater seepage observed at locations indicated

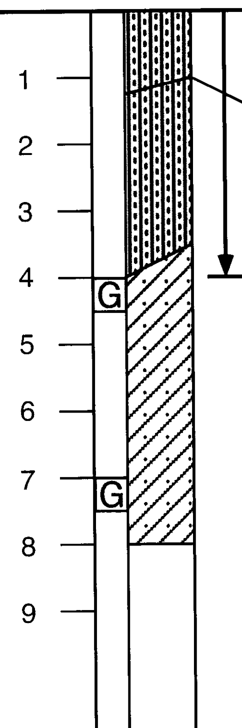
* - Elevation interpolated from Sheet 1, *Topographic Survey*, dated July 16, 2021, prepared by APEX.

LOG OF TEST PIT 2

Test Pit Orientation: N05°W
Logged east pit wall

Laboratory Tests | Depth | Sample | Symbol | Weak Soils

Equipment: Kubota KX040-4 w/ 24" bucket
Date: February 4, 2022
Elevation: 173 feet*



GRAY BROWN CLAYEY SILTY SAND (SM)
loose, wet, porous, abundant roots up to 3 inches (Colluvium)

YELLOW BROWN SILTY SAND (SM)
medium dense, wet, porous, with root zones

-200 = 42%
moisture content = 26.9%

YELLOW BROWN & LIGHT BROWN CLAYEY SAND (SC)
medium dense, wet, with localized pockets of roots

moisture content = 16.3%

Bottom of test pit at 8 feet, maximum reach of mini excavator
Groundwater seepage did not develop during excavation

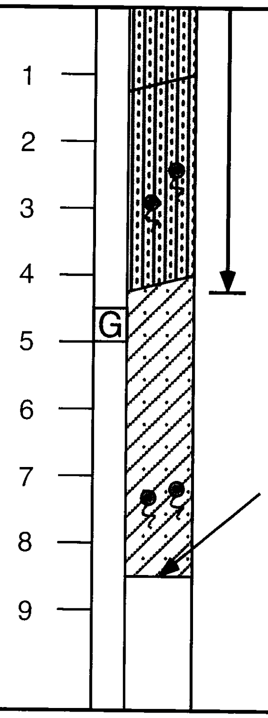
BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**LOGS OF TEST PITS 1 & 2** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **3**

Test Pit Orientation: N45°W
Logged southwest pit wall

Laboratory Tests | Depth | Sample | Symbol | Weak Soils

LOG OF TEST PIT 3

Equipment: Kubota KX040-4 w/ 24" bucket
Date: February 4, 2022
Elevation: 165 feet*



-200 = 35%
moisture content = 24.5%

DRAFT

GRAY BROWN CLAYEY SILTY SAND (SM)
loose, wet, porous, abundant roots (Colluvium)

LIGHT BROWN AND YELLOW BROWN CLAYEY SILTY SAND (SM)
medium dense, wet, porous, roots, localized caving from about 2 to 4 feet

MOTTLED ORANGE & YELLOW BROWN & LIGHT GRAY CLAYEY SAND (SC)
medium dense, wet, localized caving from about 5 to 7-1/2 feet

ORANGE BROWN SANDSTONE
low hardness, friable to weak, moderately weathered

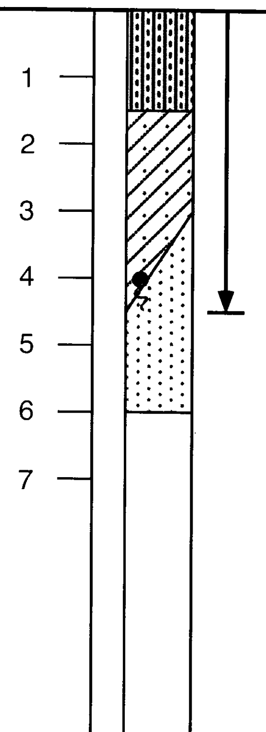
Bottom of test pit at 8-1/2 feet, maximum reach of mini excavator
Groundwater seepage observed at locations indicated

Test Pit Orientation: N23°W
Logged northeast pit wall

Laboratory Tests | Depth | Sample | Symbol | Weak Soils

LOG OF TEST PIT 4

Equipment: Kubota KX040-4 w/ 24" bucket
Date: February 4, 2022
Elevation: 164 feet*



GRAY BROWN CLAYEY SILTY SAND (SM)
loose, wet, porous, root laden (3") (colluvium)

YELLOW BROWN CLAYEY SAND (SC)
medium dense, wet, porous, with sandstone fragments, localized caving from about 1-1/2 to 4 feet, seepage at base of unit

ORANGE BROWN SANDSTONE
moderately consolidated, moderately hard, weak, moderately weathered, with discontinuous layers of silty sand that exhibit low hardness and friable strength

Bottom of test pit at 6 feet
Groundwater seepage observed at locations indicated

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**LOGS OF TEST PITS 3 & 4** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **4**

MAJOR DIVISIONS				TYPICAL NAMES
COURSE GRAINED SOILS	**GRAVELS** more than half coarse fraction is larger than no. 4 sieve size	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
	SANDS more than half coarse fraction is smaller than no. 4 sieve size	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVEL-SAND MIXTURES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, VERY FINE SANDS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC SCLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS OR LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

KEY TO TEST DATA

LL = Liquid Limit (in %)
PL = Plastic Limit (in %)
PI = Plasticity Index (in %)
-200 = % Passing
-No. 4 = % Passing

	Shear Strength, psf	Confining Pressure, psf	
Tx	320	(2600)	Unconsolidated Undrained Triaxial
Tx CU	320	(2600)	Consolidated Undrained Triaxial
DS	2750	(2600)	Consolidated Drained Direct Shear
UC	2000		Unconfined Compression

Note: All strength tests on 2.4 in. inside diameter sample unless otherwise indicated

SAMPLER GRAPHIC SYMBOLS

- Standard California Sampler (2.4 in. ID)
- Standard Penetration Test (SPT) (1.4 in. ID)
- No Sample Recovery
- G Grab Sample

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**SOIL CLASSIFICATION CHART & KEY TO TEST DATA** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **5**

I. INDURATION OF SEDIMENTARY ROCKS; usually determined from unweathered samples. Largely dependent on cementation and compression.

N = Non-indurated – has not undergone any cementation
P = Poorly indurated – break apart easily by hand
M = Moderately indurated – easily broken with a hammer
W = Well indurated – difficult to break with a hammer

II. BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness in Feet	in Inches	Stratification
Massive	greater than 4.0	> 48	very thick bedded
Blocky	2.0 to 4.0	24 to 48	thick bedded
Slabby	0.2 to 2.0	3/16 to 24	thin bedded
Flaggy	0.05 to 0.2	1/16 to 3/16	very thin bedded
Shaly or Platy	0.01 to 0.05	1/64 to 3/16	laminated
Papery	less than 0.01	< 1/64	thinly laminated

III. FRACTURING

Intensity	Size of Pieces (ft)	(in)
Crushed	less than 0.05	< 1/16
Intensely Fractured	0.05 to 0.1	1/16 to 1/8
Closely Fractured	0.1 to 0.5	1/8 to 6
Moderately Fractured	0.5 to 1.0	6 to 12
Occasionally Fractured	1.0 to 4.0	12 to 48
Very Little Fractured	greater than 4.0	> 48

IV. HARDNESS

Soft – Reserved for plastic material alone.
Low Hardness – Can be gouged deeply or carved easily with a knife blade.
Moderately Hard – Can be readily scratched with a knife blade; scratch leaves a heavy trace of dust And is readily visible after the powder has been blown away.
Hard – Can be scratched with difficulty; scratch produces little powder and is often faintly visible.
Very Hard – Cannot be scratched with a knife blade; knife leaves a metallic streak.

V. STRENGTH OF UNFRACTURED SPECIMEN

Plastic – Capable of being molded by hand.
Friable – Crumbles by rubbing specimen with fingers.
Weak – Crumbles under light hammer blows.
Moderately Strong – Withstands a few heavy hammer blows before fracturing.
Strong – Withstands a few heavy ringing hammer blows and usually yields large fragments.
Very Strong – Resists heavy ringing hammer blows and yields with difficulty only dust and small flying fragments.

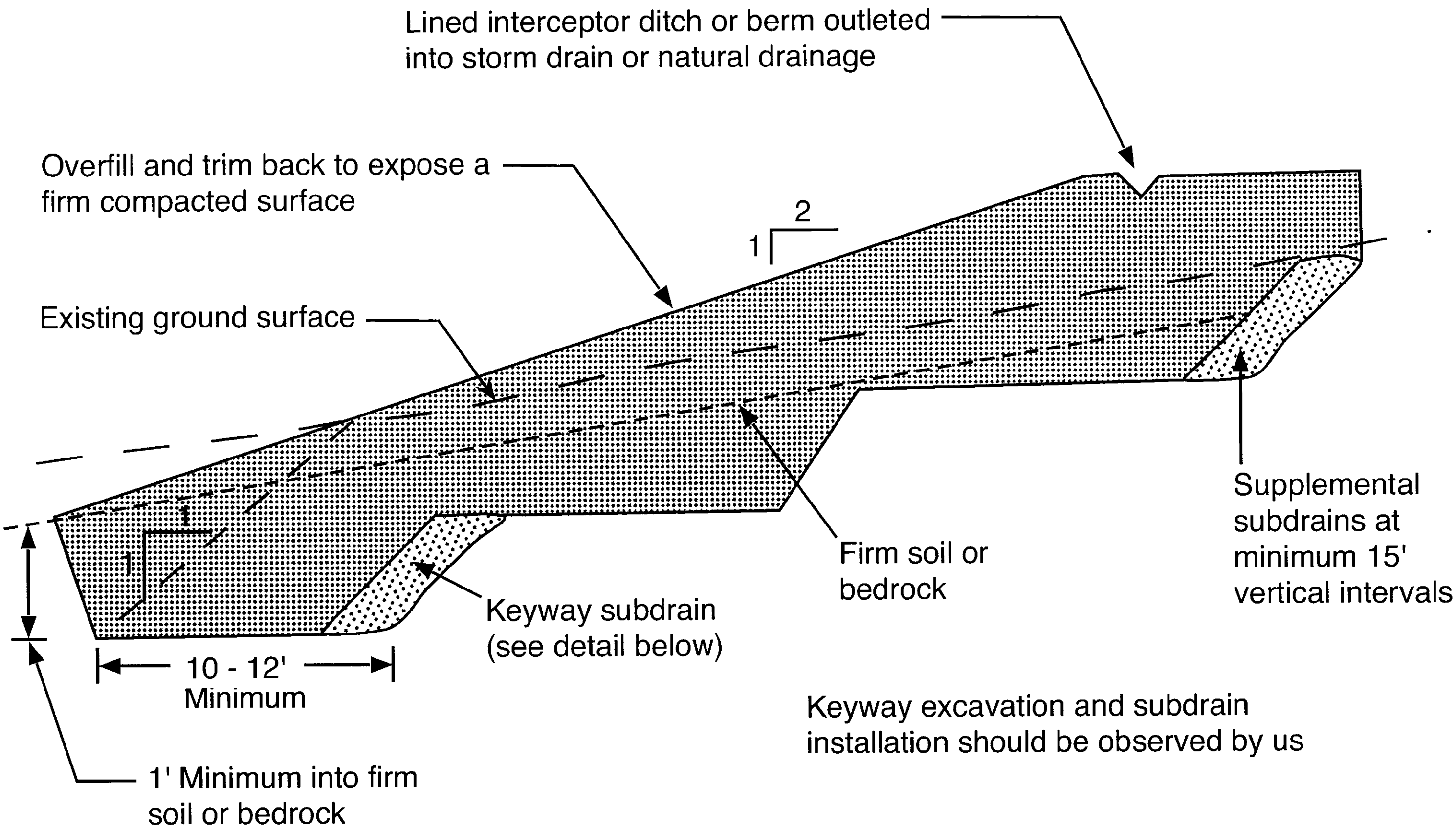
VI. WEATHERING; The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing-thawing.

Deep – Moderate to complete decomposition of minerals, extensive disintegration, deep and thorough discoloration, fractures all extensively coated with oxides, carbonates and/or silt and clay.
Moderate – Slight change or partial decomposition of minerals, little disintegration, little to no effect on cementation, moderate to occasionally intense discoloration, fractures moderately coated with oxides, carbonates and/or silt and clay.
Little – No megascopic decomposition of minerals, little to no effect on cementation, slight and intermittent or localized discoloration, fractures coated with few oxides
Fresh – Unaffected by weathering agents, no disintegration or discoloration.

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**ROCK CLASSIFICATION CRITERIA** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **6**

TYPICAL FILL SECTION - KEYWAY CONSTRUCTION

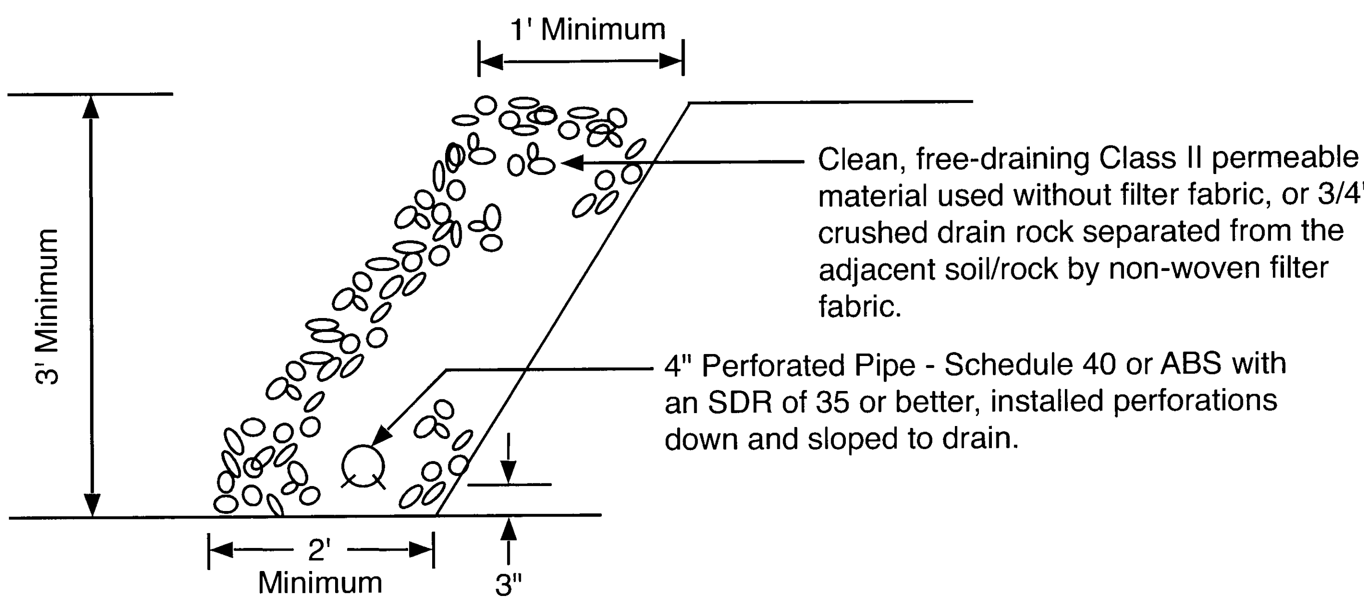
(Not to Scale)



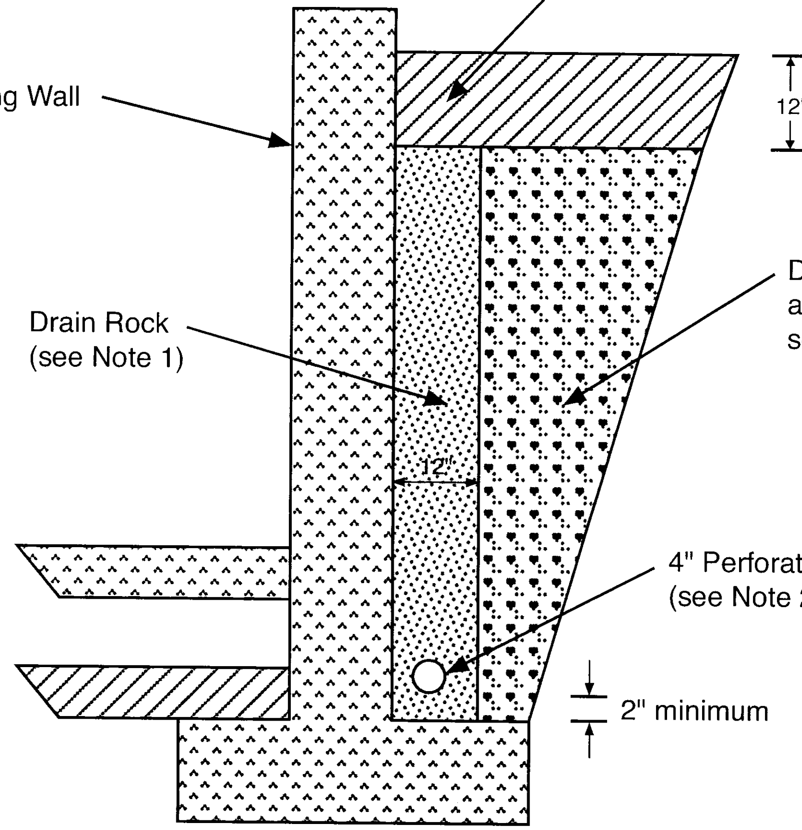
Keyway excavation and subdrain installation should be observed by us

SUBDRAIN DETAIL

(Not to Scale)



BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**TYPICAL FILL SECTION AND SUBDRAIN DETAIL** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **7**



WALL DRAINAGE DETAIL
(Not to scale)

NOTES:

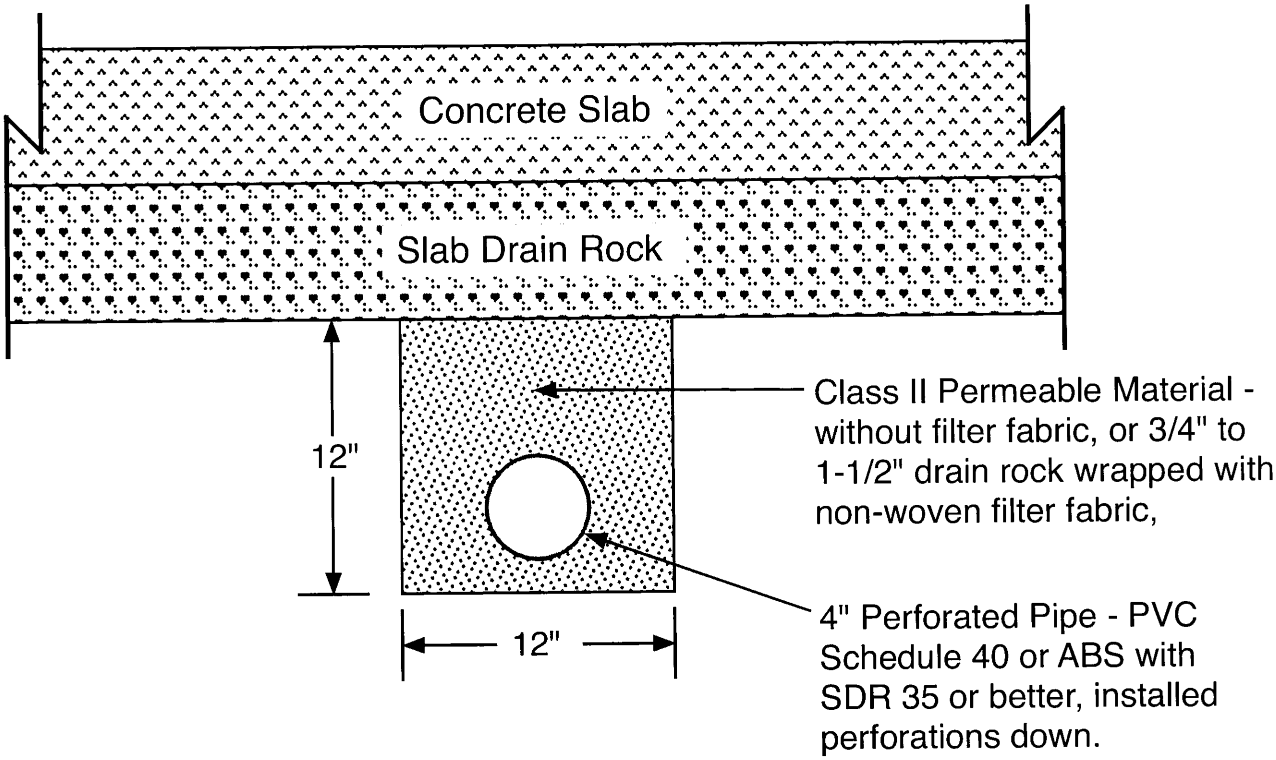
(1) Drain rock should be either: 1) clean, free-draining, and meet the requirements for Class II Permeable material, Section 68, State of California "Caltrans" Standard Specifications, latest edition; or 2) 3/4 or 1-1/2 inch crushed drain rock separated from the adjacent soil/rock by non-woven filter fabric.

Prefabricated synthetic drainage structure, such as Miradrain 6000 or equivalent, may be used in lieu of drainrock along the back of the retaining wall.

(2) Pipe should consist of PVC Schedule 40 or ABS with an SDR of 35 or better, installed perforations down. Pipes for subsurface walls should be sloped at a minimum gradient of 1% to drain to outlets by gravity or sump with automatic pump. The pipe invert should be a minimum of 8 inches below adjacent interior slabs-on-grade. Surface drainage should not be connected to subsurface drain pipes.

(3) The upper 12 inches of the drain should be backfilled with compacted clayey soils to exclude surface water. Retaining walls should be backfilled with materials approved by us and per the recommendations in the report. Backfilling methods should be appropriate to avoid over-stressing the wall structures. Wall bracing should be considered prior to backfilling.

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**WALL DRAINAGE DETAIL** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **8**



TYPICAL SLAB UNDERDRAIN DETAIL

(Not to scale)

NOTES:

1) Drain pipe, drain rock, and filter fabric materials should conform to those specified in the geotechnical investigation report.

2) Pipes should be placed at approximately 15 to 20 feet on center, and within isolated areas.

3) Outlets should be provided through foundations and sloped to drain at a minimum gradient of 1% to outfalls.

BAUER ASSOCIATES, INC. GEOTECHNICAL CONSULTANTS	Job No: 3977.0 Date: 2/2022 By: GDS	**TYPICAL UNDERSLAB DRAIN** 33101 SOUTH HIGHWAY ONE Gualala, California	PLATE **9**

LIST OF REFERENCES

California Building Standards Commission, 2019, California Building Standards Code, California Code of Regulations, Title 24.

California's Office of Statewide Health Planning and Development (OSHPD), Seismic Design Maps Web Application, 2019, https://seismicmaps.org

California Geological Survey, 2018 revision, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: Special Publication 42, https://maps.conservation.ca.gov/cgs/EQZApp/app/

Davenport, C. W., 1984, Geology and Geomorphic Features Related to Landsliding, Gualala 7.5' Quadrangle, Mendocino County, California Department of Conservation, Division of Mines and Geology, Open File Report 84-48 SF, Scale 1:24,000.

Wagner, D.L., and Bortugno, E.J., 1982, Geologic Map of the Santa Rosa Quadrangle: California Division of Mines and Geology, Scale 1:250,000.