LINDBERG GEOLOGIC CONSULTING
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ENGINEERING-GEOLOGIC R-2 SOILS EXPLORATION REPORT

Existing Grading and Cut Fill Construction
422 Wood Ranch Road
Redway, California

Assessor's Parcel Number: APN: 214-231-011

Prepared for:
Mr. Jade Hass

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CERTIFIED
STATE OF CALIFORNIA

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LGC Project No. 0301.00

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Redway, Humboldt County, California

1.0 INTRODUCTION
1.1 Site and Project Description
This report presents the results of the site-specific, engineering-geologic soils exploration conducted by Lindberg Geologic Consulting (LGC) at a property located in a rural area in southern Humboldt County, northwest of Dean Creek (Figure 1), on Assessor's Parcel Number 214-231-011 (Figure 2). Project site location information is listed in Table 1 below.

Table 1 – Project Location Information	
Assessor's Parcel: 214-231-011	
Latitude and Longitude*	40.1603° N and 123.8199° W
Legal Description	Section 35, T3S, R3E; HB&M
Parcel Size	159.55 (GIS) Acres

*Centroid of parcel per Humboldt County Web GIS

Lindberg Geologic Consulting (LGC) was retained to conduct a soils investigation and prepare a soils report to meet the requirements of the County of Humboldt for retroactively permitting grading of two cut and fill pads, and appurtenant structures (e.g. hoop greenhouses) for cannabis cultivation,. This grading created two flat cut fill pads supporting the hoop greenhouses shown in Figure 3. Of concern is the fact that the Humboldt County WebGIS shows historic landsliding occurred on this parcel in the area where the grading occurred. The Owner retained LGC to assess the potential instability of the site and prepare this R-2 soils report. Other concerns beyond stability may include over-steepened cut slopes, and erosion of the graded cut fill pads by concentrated flows of stormwater runoff.

Based on available Humboldt County Web GIS satellite imagery, initial grading occurred after 2016; greenhouses are observable in the May, 2018, satellite imagery (Figure 3). Prior to grading, these areas of the parcel appear to have been small prairies bordered by undeveloped forest lands. Historically, the property was logged for timber and grazed with cattle.

Included in our report are brief assessments of the potential geologic hazards associated with the site grading, and recommendations to help mitigate any potential negative effects of those geologic hazards on the subject site developments (two graded areas). Also provided in this report are recommendations for design professionals (e.g. civil engineers), to utilize for planning and for design of future remedial site grading, if necessary or as appropriate.

This cannabis cultivation site is located on a parcel approximately 1.6 miles northwest of Dean Creek and 3 miles north of Redway. The graded areas are reached via Wood Ranch Road. This property is in an area of previously-harvested forest and former ranch lands that were subdivided and developed with residential developments then mixed with commercial cannabis cultivation operations. The property is bordered on all sides by more or less similarly-developed parcels.

At the location of the existing grading on the property, ground slopes appear to have originally been less than 15 percent, adjacent to 30 percent slopes with a west-southwesterly aspect, based on information from the United States Geologic Survey (USGS) and the Humboldt County Web GIS. Slopes and aspects in the undisturbed areas surrounding the grading appear to be original. No building foundations were within the graded areas and none are addressed in the scope of this soils exploration and report.

1.2 Scope of Work

The Scope of Services for this investigation included identifying potential geologic and soils hazards that could affect the existing graded flat and cultivation areas in the central part of APN 214-231-011, field-characterization of the subgrade soils, development of conclusions and recommendations, and preparation of this Report. The information, recommendations, and design criteria presented in this report are listed below:

- Description of site terrain and local geology.
- Interpretation of subsurface soil and groundwater conditions based on our observations.
- Discussion of the soil profile characteristics as observed in on-site cut faces.
- Assessment of potential earthquake-related geologic and geotechnical hazards including surface fault rupture, liquefaction, differential settlement, and site slope instability.
- Discussion of potential geologic hazard mitigation measures, where appropriate.
- Seismic design parameters per 2016 California Building Code (CBC), including Seismic Design Category, Site Class, and Spectral Response Accelerations.
- Recommendations for earthwork; fill placement and compaction requirements
- Criteria for temporary excavations, if any.
- Recommendations for construction materials testing and inspection, as appropriate.

An environmental site assessment for the presence or absence of any hazardous materials was specifically excluded from our scope of work. Although we have explored subsurface conditions, we have not conducted any analytical laboratory testing for the presence of hazardous material of samples obtained. Roads issues (if any) are being addressed by the Owner's engineer, or others.

1.3 Limitations

This report has been prepared for the exclusive use of Mr. Jade Hass, and his engineers and contractors, and appropriate public authorities, for specific application to the existing grading which occurred at two locations for this parcel (Figure 3). LGC strives to comply with the engineering-geologic standard of care common to this area at the time our work was performed. LGC makes no other warranty, express, or implied.

The analyses and recommendations included in this report are based on data obtained from existing maps and reports, field observations and limited subsurface exploration. Methods used indicate subsurface conditions only at specific locations where we could observe cut faces and fill slopes, only at the time of our observations, and only to the depths exposed. Samples, exposures, and field observations may not always be relied on to accurately reflect stratigraphic or lithologic variations that commonly exist between sampling locations, nor do they necessarily represent conditions at any other time.

The recommendations included in this report are based, in part, on assumptions about subsurface conditions which may only be verified during earthwork. Accordingly, the validity of our recommendations is contingent upon LGC being retained to provide a complete professional service. LGC cannot assume responsibility or liability for the adequacy of our recommendations when they are applied in the field unless we are retained to review the grading or foundation plans, and observe construction. We are available to discuss a schedule of such observations required to provide assurance of the validity of our recommendations, as necessary.

Do not apply any of this report's conclusions or recommendations if the nature, design, use, or location of the earthwork is changed in any way. Should changes be contemplated, it is important that LGC be consulted to review the impact of the changes on the applicability of the recommendations in this report. This report should be reviewed, and our recommendations confirmed in writing, if this project is not begun within one year from the date of this report. LGC is not responsible for any claims, damages, or liability associated with any other party's interpretation of the subsurface data or reuse of this report for other projects or at other locations without our express written authorization.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration Program

A Certified Engineering Geologist from our office visited the graded sites on the subject property on March 6, 2019, when a field exploration was performed. Existing cut slopes were utilized to assess the in-situ soil and groundwater conditions. The cut slope faces allowed us to estimate the engineering characteristics of the subsurface materials at the two grading sites, and determine the potential presence or absence of shallow groundwater when groundwater was at or near the seasonal high. Observation of the fill slopes provided insight into subsurface materials in general, and the stability and suitability of the placement and compaction of the on-site fill prisms. Soils observed were classified in general accordance with ASTM D-2488 visual manual procedures.

2.2 Laboratory Testing

No laboratory analyses were performed for this project due to the apparently-uniform nature of the stratigraphy of the subsurface soils; fractured chert and fine to medium grained sandstone, with a matrix of fine sand and silt. Groundwater was not encountered. Site soils appeared unlikely to be perennially moist below three feet of depth. The uppermost elevation of the unconfined groundwater aquifer was not observed.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Topography and Site Conditions

The subject parcel is approximately 160 (GIS) acres in area and is in a rural, residential and woodland prairie area. Maximum site elevation is approximately 1,300 feet above mean sea level, as interpolated from the USGS "Miranda, Calif.", topographic quadrangle map (1970). At the north and south graded locations on the parcel, the general slope of the ground surface is west-northwesterly, with slopes less than 15 percent prior to grading, and adjacent to slopes of 30 percent and greater. Slopes are now flatter than 15 percent with cuts steeper than 50 percent.

3.2 Geologic Setting

This parcel is located within California's northern Coast Ranges Geomorphic Province, a seismically active region in which large earthquakes are expected to occur during the economic life span (50 years) of any developments on the subject property. Mapping by McLaughlin *et al.*, (2000), shows that the site is underlain by sedimentary rocks of the Del Puerto Terrane.

Del Puerto Terrane has an estimated age range of Middle to Late Jurassic and is described in McLaughlin and others (2000) as "Rocks of the Del Puerto(?) terrane-exposed locally along western margin of Central belt of Franciscan Complex east of Benbow and at Bear Buttes northwest of Garberville. Rocks of this terrane are correlated with a more extensive ophiolite complex and overlying sedimentary rocks with island arc affinities 300 km to southeast, in the Del Puerto canyon area, northeast of San Jose, California.

Includes: Mudstone (Late Jurassic)-Dark green to black, tuffaceous scaly mudstone, highly sheared locally, containing carbonate concretions and nodules with radiolarian faunas of Late Jurassic (late Tithonian) age (dpms). Present only locally above ophiolite east of Benbow.

Coast Range ophiolite (Middle and Late Jurassic)-Dismembered ophiolite, consisting of:

Tuffaceous chert (Late Jurassic)-Dark-green to brownish-red, tuffaceous radiolarian chert present locally east of Benbow, below mudstone and above mafic extrusive and intrusive rocks. Contains radiolarian assemblage of Late Jurassic age.

Basaltic flows and keratophyric tuff (Jurassic?)-Uralitic and intruded locally by mylonitic quartz keratophyre dike rocks, present locally along west boundary of Central belt of Franciscan Complex near Benbow (dpb).

Diabase (Jurassic?)-Dikes and sills, fine to coarse grained, with ophitic texture, present below basalt flows near Benbow and forms Bear Buttes north of Garberville. Lower part of diabase unit of Bear Buttes locally includes minor cumulate gabbro. Lower diabase contact considered to be an attenuation fault (dpd)". Underlying the north and south grading areas on the subject property are the dpd and dpb subunits of the Del Puerto.

Earth materials encountered in the on-site cut bank exposures, consisted of a profile of dark brown to strong brown, stiff sandy clay with angular gravel. Gravel, consisting of angular fine chert and sandstone fragments appeared to increase in abundance with depth. Gravel soils are more than approximately five feet thick and are interpreted to grade to more-dense fractured bedrock at depth. Free water was not observed at shallow depths on March 6, 2019.

Underlying the Del Puerto Terrane rocks on this parcel in fault contact are Pliocene to Late Cretaceous rocks; primarily mélange and sandstone, of the Central Belt Franciscan Complex. These Franciscan Complex rocks are interpreted to be present at the surface at the graded area locations.

The near-surface soils are composed predominantly of clay with silty fine sand and gravel the native prairie sod. Soils, based on our observations, are sandy and rocky, and generally uniform beneath the grading areas. In the areas observed, the soil profile consists of gravel with silty fine sand and clay. Soils we observed were medium dense from approximately six to twelve inches depth, below which soils graded to more dense soils, then, presumably, to weathered and fractured rock. Free groundwater was not observable at the time of our site visit; recent rains had left standing water at the ground surface, but no seepage was observable from the cut slopes.

3.3 Seismicity

This project site is located within a seismically active region in which large earthquakes from a variety of sources have the potential to occur during the economic life span (50-years) of these developments. South of Cape Mendocino and the Mendocino triple junction, the regional tectonic framework is controlled by the Northern San Andreas fault, wherein the Pacific oceanic plate is sliding northwest along the edge of the North American continental plate.

The surface trace of the San Andreas fault is located more than 15 miles southwest of the subject parcel, and is the nearest recognized active fault (CDMG, 2000) to the site. The San Andreas fault is mapped as a northwest-striking, near-vertical, right lateral strike slip fault. The upper-bound earthquake considered likely to occur on the Northern San Andreas fault has an estimated maximum moment magnitude (M_w) of 7.6 (CDMG, 1996). An earthquake on the Northern San Andreas fault is expected to generate strong ground shaking that would affect the subject parcel.

Regionally, the Cascadia subduction zone (CSZ) marks the boundary between the North American plate and the subducting Gorda and Juan De Fuca plates. Recent and ongoing research into the seismicity of the Pacific Northwest has shown that the subduction zone is also capable of generating great earthquakes which could affect this parcel. The CSZ extends from offshore of Cape Mendocino in Humboldt County, California, to Vancouver Island in British Columbia, and is considered capable of generating an upper-bound earthquake with a moment magnitude (M_w) of 8.3 on its southern, Gorda segment, and (M_w) 9.0 on the rupture of its entire length. Based on Japanese tsunami records and geophysical modelling, the CSZ has been interpreted to rupture over its entire length in the year 1700 A.D. in a (Mw) 9.0 earthquake event (Satake, et al, 2003).

Based on the approximately 150 years record of historical earthquakes, faults within the plate boundary zone and internally-deforming Gorda plate have produced numbers of small-magnitude, and several moderate- to large- (i.e. $M>6$) magnitude earthquakes affecting the project area. Several active regional seismic sources in addition to the San Andreas fault and the CSZ are proximal to the project site and have the potential to produce strong ground motions. These seismic sources include the following:

- The Mad River fault zone; similar low-angle reverse or thrust faults (Mad River fault, McKinleyville fault and others) associated with the subduction of the oceanic plates and the accretion of marine sediments onto the leading edge of the North American plate.
- Mendocino fault offshore: a high-angle, east-west trending, right-lateral strike-slip fault between the Gorda plate and Pacific plate more than 40 miles to the southwest.
- Faults within the internally-deforming Gorda and Juan de Fuca plates consisting of high-angle, northeast-trending, left-lateral, strike-slip faults.

3.4 Subsurface Conditions and Description of the Site Soils

To characterize soil and groundwater conditions at this location the soil profile was observed in the cut faces around this cut fill pad (Figure 3). In the field, the soil profile was described in general accordance with ASTM D 2488 standards, and as discussed previously, the soil profile consists of thin topsoil and sod over silt with fine sand and clay, with gravel, grading to bedrock composed of fractured silty fine sandstone.

3.5 Groundwater Conditions

No groundwater was encountered at this project location. Our explorations were performed during the height of the winter wet season, so surface runoff from precipitation may have obscured emergent groundwater flow on these graded areas. There are several springs mapped nearby, but none are at these two graded sites. For the most part, soils encountered on-site generally appeared moderately to poorly drained through intergranular, and fracture porosity. Soil mottling, suggesting transient high groundwater conditions, was not observed.

Groundwater levels are likely to fluctuate with seasonal and long-term climatic variations and changes in land use. Despite this subject parcel being underlain by soil and rock materials, with apparently moderate to poor drainage rates, groundwater is not expected to be encountered during the dry-season (May through September) earthwork, or to depths up to five feet bgs. Earthworks during the wet season (October through April) have the potential to be adversely affected by saturated clayey soil conditions at shallow depths. Groundwater conditions are not anticipated to negatively affect long-term performance of the existing grading areas, assuming the engineers grading plan is adhered to.

4.0 GEOLOGIC AND SOIL HAZARDS

The focus of our geologic hazard assessment for this project site primarily included slope stability and strong seismic ground shaking, due to slopes and proximity to seismic sources. This section will also assess the potential for liquefaction of shallow saturated soils, tsunami, and differential settlement due to undocumented fill soils. Our assessment of these and other common potential geologic hazards is presented below.

4.1 Seismic Ground Shaking

As noted in Section 3.3, the project site is situated within a seismically active area proximal to multiple seismic sources capable of generating moderate to strong ground motions. Given the proximity of significant active faults such as the Northern San Andreas fault, and the Cascadia subduction zone offshore to the northwest, as well as other active faults within and offshore of northern California, the project site will experience strong ground shaking during the economic life span (50 years) of the proposed development.

Site-specific seismic Spectral Response Accelerations, obtained from the SEA (Structural Engineers Society of California) and OSHPD (2018) are presented here in Table 2. The on-line SEA ground motion parameter calculator provides spectral acceleration values (S_s and S_1) based on the site specific geographic coordinates, the latest available seismic database maintained by the USGS, the site classification, site coefficients, and adjusted maximum considered earthquake values (F_a, F_v, SM_s and SM_1).

Based on the site conditions, and an assumption of the soils within 100 feet of the ground surface, we conservatively classify the site as Site Class D consisting of a "Stiff soil" profile (Section 1613.3.2, 2016 CBC). The parameters in Table 2 are based on this classification and were determined using the 2010 ASCE Standard 7 (w/March 2013 errata), minimum design loads for buildings and other structures.

Table 2. Spectral Response Accelerations, APN 214-231-011

Site Information	Latitude / Longitude*	40.1603° / -123.8199°
	Occupancy Risk Category (2016 CBC, Sect. 1604.5)	II
	Seismic Design Category (2016 CBC, Sect. 1613.3.5)	E
	Site Class (2016 CBC, Sect. 1613.3.2)	D
Spectral Acceleration	S_s	1.767
	S_1	0.705
Site Coefficients	F_a / F_v	1.0 / 1.5
Response Accelerations	S_{MS}	1.767
	S_{M1}	1.057
	S_{DS}	1.178
	S_{D1}	0.705

*Centroid of parcel per Humboldt County Web GIS

4.2 Surface Fault Rupture

As discussed, the nearest recognized zoned-active fault to the project is the San Andreas fault, located more than 15 miles southwest of the project location. The subject parcel is not located within an Alquist-Priolo earthquake fault zone in which the State requires special studies to be conducted for construction of structures for human occupancy. Due to the distance from the project site to the surface trace of the nearest recognized active fault, the potential for ground surface fault rupture within the existing graded area is estimated to be low.

4.3 Liquefaction

Liquefaction is a phenomenon involving loss of soil strength that results in fluid mobility through the soil. Liquefaction typically occurs when uniformly-sized, loose, saturated sands or silts that are subjected to repeated shaking in areas where the groundwater is less than 50 feet below ground surface. In addition to the necessary soil and groundwater conditions, the ground acceleration must be high enough, and the duration of the shaking must be sufficient, for liquefaction to occur. These conditions do not appear to have been met at this site. Due to the fact the soils at depth are dense and well-indurated they are not likely to liquefy.

According to Special Publication 115, Map S-1 (CDMG, 1995), the project site is not located within an area of recognized liquefaction potential. Beneath the surface, our explorations revealed dense materials at two to three feet below the ground surface. Groundwater was not encountered on-site. Earthquake-related liquefaction and lateral spreading resulting from liquefaction are not anticipated to affect this site, given that there were no liquefiable materials (loose saturated silts or sands) observed in the shallow subsurface at this site.

4.4 Settlement

Due to the potential to result in excessive total and differential settlement, existing undocumented fill soils are non-engineered fills and unsuitable as foundation load bearing materials for any loads greater than that of a typical hoop greenhouse. No new structures are proposed; if any fills are ever anticipated to support structures for human occupancy, those fills should be excavated and replaced with engineered, compacted fill as described later in this report. Reinforced concrete foundations designed per the current building code may be expected to be sufficient to resist differential settlement on undisturbed native soils, or suitably-compacted fill soils. The potential for settlement appears to be low, provided current building codes, and our recommendations, are adhered to.

Foundation systems in undisturbed native soil, designed in accordance with the building code, our recommendations, and the standard of care for civil engineering, should experience minimal total and differential settlement. Settlement can be reasonably limited through prudent design and construction, including embedding foundations into undisturbed native soil.

4.5 Landsliding

The project site on the subject property is located on a sloping surface at an elevation of approximately 1,300 feet above level. There are steep cut slopes and angle-of-repose fill slopes on this site; these appeared generally stable in their present configuration, as did the native slopes, at the time of our field explorations. Fill slopes on the northwest side of the north grading area appeared to be stable, and have begun to revegetate with grasses; they showed little erosion since their construction.

Some minor erosion and some raveling of cut slopes was observed. Humboldt County Planning's Web GIS database rates the relative stability of this parcel as "Moderate Instability" due to the steepness, and the fact that there has been historic landsliding mapped on parcel 214-231-011 on the Humboldt County WebGIS site. A large landslide is shown east of the property on the county website and on the geologic map (McLaughlin *et al.*, 2000). A small historic landslide is shown on the county website overlapping the northwest corner of the north graded area. Based on our on-site observations, review of published geologic maps, it is our opinion that the Humboldt County WebGIS historic landslide mapping is less than accurate. In our opinion, based on our field review, that the mapped historic landslide is actually located to the north of the two graded sites and that the grading occurred outside of the extents of the historic landslide. Provided our recommendations are adhered to, slope instability or landsliding are not anticipated to negatively impact these two grading sites.

4.6 Flooding and Groundwater

4.6.1 Flooding

According to the county Web GIS database, these parcels are located outside of any 100-year flood zones. Potential for flooding to affect the existing and proposed developments appears low.

4.6.2 High Groundwater

In our opinion, based on our field exploration and professional experience, seasonally high groundwater conditions have a low potential to occur at this site. During our field investigation, we observed moist soils in the graded area due to seasonal precipitation and runoff; nothing suggesting free groundwater is likely to rise to the ground surface for significant periods during the winter wet season was observable. Shallow groundwater conditions are not expected to have an adverse effect on grading sites, provided earth work occurs during the dry season, and all runoff is drained to prevent erosion, sedimentation, or discharge of turbid runoff from this part of the property.

4.7 Tsunami

As mapped by the State of California, this site is far from any Tsunami Hazard zone.

4.8 Soil Swelling or Shrinkage Potential

Subsurface soils at foundation load bearing depths consist of silty fine sand with clay and hard fractured bedrock beneath. Soils were moist to the ground surface in early March. Subgrade materials appeared moderately to well-drained; shallow soils with more clay will be less well-drained. Based on our observations and experience, it is our opinion that existing surface soils at these grading sites with the topsoil removed are not expected to be subject to detrimental shrink and swell effects associated with cyclic seasonal wetting and desiccation. The hazard associated with potential shrink-swell of the soils involved in the grading areas appears low, except where grading spoils are placed in steep loose fills.

5.0 CONCLUSIONS AND DISCUSSION

Based on the results of our explorations, and from an engineering-geologic perspective, it is our opinion that grading at these sites has been performed without being subject to, or negatively-affecting any geologic hazards associated with the property and vicinity.

Cut slopes, while steeper than we would recommend, appeared stable in their current configuration; no evidence of significant erosion was observable in the cut or fill slopes of these grading sites. We observed nothing suggesting settlement of the outboard edges of the fills. Cuts and fills appeared generally to drain runoff without significant erosion.

6.0 RECOMMENDATIONS

6.1 Slope Setback Considerations

From an engineering geologic perspective, we observed no potential geologic hazards from which the grading should be set back. Any settlement cracks that may appear should be scarified and compacted, and regraded to drain by sheet flow. The un-named creek to the southwest is likely a Class II stream with a streamside management setback of 50 feet. No earthwork is anticipated in any streamside management areas. The South Fork Eel River is many hundreds of feet down slope, and west of the graded areas, and there is no earthwork proposed in proximity to the river's streamside management setback area.

Similar cannabis-farming developments are located on parcels near the subject property. In general, much of the subject property, and the surrounding parcels, appear undeveloped, as of the most-recent available Google Earth imagery (2014). Any future cut pads on the property (for whatever purpose), should leave sufficient space (8-feet minimum)around the perimeter of the pads for access by a small "bobcat" or a mini-excavator to navigate so that repairs to cut or fill slopes may be expedited, when necessary.

6.2 Site Preparation

No new earthwork is proposed. Future earthwork (if any), including, but not limited to, site clearing, grubbing, and stripping, grading or excavation should be conducted during dry weather conditions. Sod and topsoil should be segregated and stockpiled on-site for later use as landscaping material to spread on the finished ground surface. Approved erosion and sediment controls should be emplaced prior to the start of the work. An extra level of care may be required to prevent rutting, erosion, or mixing of soils in any areas that may be slow to dry after the wet season. Roadways to these graded sites should be surfaced with six-inches on compacted gravel or crushed rock, so that they can be used during wet weather without rutting, and minimal generation of turbid runoff.

Except in the case of an emergency, no grading or excavation work should be undertaken during the rainy season (October through April). All earthworks and road grading should be conducted only during dry weather conditions; generally, May through September. Failure to comply with this recommendation could result in detrimental erosion or sedimentation, and discharge of suspended sediment into anadromous-fish bearing streams. Recommendations for erosion and sediment control should be provided by the project engineer in their grading plan. We recommend that erosion controls be placed concurrently with, and that they keep pace with, all ground-disturbing earthwork activities regardless of the season, because significant rainfall and subsequent erosion may occur at any time, during any season in the region.

6.3 Subgrade Preparation

For any future grading work, remove the uppermost foot of loose and soft topsoils to expose firm native soil. Segregate and stockpile the excavated loose and soft soils with any excavated topsoil and sod for later use as final landscaping cover fill. If exposed soils at the one-half foot depth are soft, they should be wheel-, or track-packed until firm.

6.4 Temporary Excavations

Significant temporary construction slopes are not anticipated for this project. However, if any temporary construction slopes taller than four feet are proposed, they should be designed and excavated in strict compliance with current applicable safety regulations including the OSHA Excavation and Trench Safety Standards.

All construction equipment, building materials, excavated soil, vehicular traffic, and other similar loads should not be allowed within six feet from the top of any unshored or unbraced excavations. Where the stability of adjoining buildings, walls, pavements, or any other similar improvements may be endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be necessary to provide structural stability and to protect any personnel working in the excavation.

Since excavation operations are dependent on construction methods and scheduling, the owner and contractor shall be solely responsible for the design, installation, maintenance, and performance of all shoring, bracing, underpinning, and other similar systems. Under no circumstances should any comments provided herein be inferred to mean that LGC can assume any responsibility for temporary excavations or the safety thereof. LGC does not assume any responsibility for the design, installation, maintenance, and performance of any shoring, bracing, underpinning, or other similar systems unless they are designed specifically for the work at this site by an experienced licensed professional engineer.

6.5 Cut and Fill Slopes

Limit any future cut and fill slopes to two to one (2:1, horizontal to vertical). Short cut slopes up to five feet in height may be one to one (1:1). At the discretion of the project engineer, temporary excavations for drains or foundation stem walls up to four feet deep may be steeper.

In general, structural fill on sloping ground (if any) should be placed on a suitably-prepared (i.e., stripped of vegetation, topsoil and soft clayey surficial soils), "benched" subgrade surface with a slope of no greater than 5 percent. Fills are to be compacted in accordance with our recommendations to reduce the potential for excessive settlement.

6.6 Fill Materials

- Fill material may be native soil if conditioned to the optimum moisture content.
- Segregate topsoil and sod, and stockpile as described above.
- Remove debris such as trees and limbs from soils, and stockpile separately.

6.7 Compaction Standard

Fill not beneath structures for human occupancy may be compacted by track-, or wheel rolling to a firm and unyielding surface. Fill soil material should be placed in horizontal lifts that do not exceed 8-inches in uncompacted (loose) thickness, then compacted mechanically. A qualified field technician should observe fill placement and verify that fills were compacted as specified.

6.8 Allowable Soil Bearing Pressures

Per Section 1806.2 of the 2016 CBC, for undisturbed native subsoils beneath the topsoil, or a documented engineered fill resting on such material, the following may be used for design: an allowable soil bearing value of 1,500 psf; a lateral bearing pressure of 100 psf per foot below natural grade; and a lateral sliding resistance cohesion of 130 psf. An increase of one-third is permitted where used with the alternate basic load combinations in CBC Section 1605.3.2 which includes wind or earthquake loads.

7.0 FOUNDATION DESIGN

Foundation design recommendations are not relevant to the grading work already performed on this parcel, so none are presented here. Future foundations should be designed according to the current building code (at that time), and embedded at least 12-inches into firm, undisturbed native mineral soils, exclusive of any topsoil or fill.

7.1 Grading and Drainage

Finished grading should be designed and constructed with a gradient sufficient to provide for positive drainage by sheet flow. Finished ground surfaces at this location should be graded to drain by sheet flow to suitable outlet points in such a way that no erosion will occur.

Per CBC 1804.3, slope ground (soil) surfaces around buildings at five percent (minimum) for at least 10 feet from the foundations, where possible. Minimum slope for impervious (i.e., paved) surfaces should be two percent for at least 10 feet from the perimeter of structure foundations.

Landscaping design, grading and construction should be such that no water is ever allowed to pond anywhere onsite. Runoff from these graded sites should be controlled and discharged in such a way that no erosion, sedimentation or discharge of turbid water from the property will occur. Roadway and driveway storm water runoff should be likewise be controlled and discharged at suitable outlet points on the property where no erosion, sedimentation, or ponding will occur.

7.2 Erosion, Sediment Control Recommendations

Adhere to the recommendations of the Grading, Drainage and Erosion Control Plan by the project engineer. Ensure that these areas are graded to drain by sheet flow and do not concentrate runoff flows. Except in an emergency, avoid wet-season travel, earthwork and grading on the site. Wet weather conditions can occur any time but may be expected predominantly from October through April. Storm water erosion and pollution prevention measures should be taken immediately or as soon as possible prior to the onset of the winter rains. To the extent feasible for this project, all current Humboldt County Erosion Control Standards should be incorporated into the project design, and strictly adhered to during construction. We specifically recommend the following erosion and sedimentation control measures:

- Replace topsoil and revegetate disturbed areas as soon as possible following earthwork.
- Mulch exposed flat and gently-sloping (<15%) bare soil with straw.
- Seed with a native grass mix.

- Cover soil stockpiles with 6 mil plastic sheeting, anchored against wind disturbance.
- Drive no vehicles on the graded areas when soils are wet.
- Use four inches of compacted crushed rock or gravel for driveways, parking spaces, and other areas accessed by vehicles during construction and thereafter.
- Verify functioning of erosion protection measures regularly during the wet season.
- Confirm functioning of erosion-control measures prior to runoff-generating storms.
- Confirm site conditions after runoff-generating storms and repair as needed.
- Promptly repair erosion control measures when necessary.
- Protect graded slopes steeper than 15 percent with erosion control mats, staked to the soil.
- Finished cut and fill slopes should have silt fence installed along their bases
- Install straw wattles contour-parallel at the top and middle of cut and fill slopes.
- Line drain ditches with rock, and use lager rock where runoff flows over fill slopes.

7.3 Pavement Design Recommendations

This proposed project includes no new roadways, driveways, or parking areas making pavement design irrelevant to this report. We recommend a minimum of six inches of compacted road base, or crushed rock, and engineered drainage design for all-weather driving surfaces. We can provide pavement designs should it prove desirable or necessary in the future.

8.0 ADDITIONAL SERVICES

8.1 Review of Grading and Drainage Plans

The conclusions and recommendations provided in this report are based on the assumption that soil conditions encountered during grading will be essentially as exposed during our explorations, and that the general nature of the grading and use of the property will be as described above. LGC should be retained to review any grading design plans to assure compliance with our recommendations.

8.2 Observation and Testing

To assure conformance with the specific recommendations contained within this report, and to assure that the assumptions made in the preparation of this report are valid, LGC should be retained to review grading design plans and to observe site grading. We should also review of exposed subgrades prior to placement of fill.

9.0 REFERENCES

CBC [California Building Code], 2016, California Code of Regulations, Title 24, Part 2, Volume 2. California Building Standards Commission.

CDMG, 1995, Planning Scenario in Humboldt and Del Norte Counties, California, for a Great Earthquake on the Cascadia Subduction Zone, Special Publication 115.

CDMG, 2000, Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Northern and Eastern Region.

CGS [California Geological Survey], 2002, Note 36; California Geomorphic Provinces.

Heaton, T. H. and Kanamori, H., 1984, Seismic potential associated with subduction in the northwestern United States, Bulletin of the Seismological Society of America; June 1984; v. 74; no. 3; p. 933-941.

McLaughlin, R. J., S. D. Ellen, M. C. Blake Jr., A. S. Jayko, W. P. Irwin, K. R. Aalto, G. A. Carver, and S. H. Clarke, Jr., 2000, Geology of the Cape Mendocino, Eureka, Garberville, and Southwestern Part of the Hayfork 30 x 60 Minute Quadrangles and Adjacent Offshore Area, Northern California.

Petersen, M. D. et al., 1996, Probabilistic seismic hazard assessment for the state of California. DMG, Sacramento. OFR 96-08 (USGS OFR 96-706), 33 pp. + two appends.

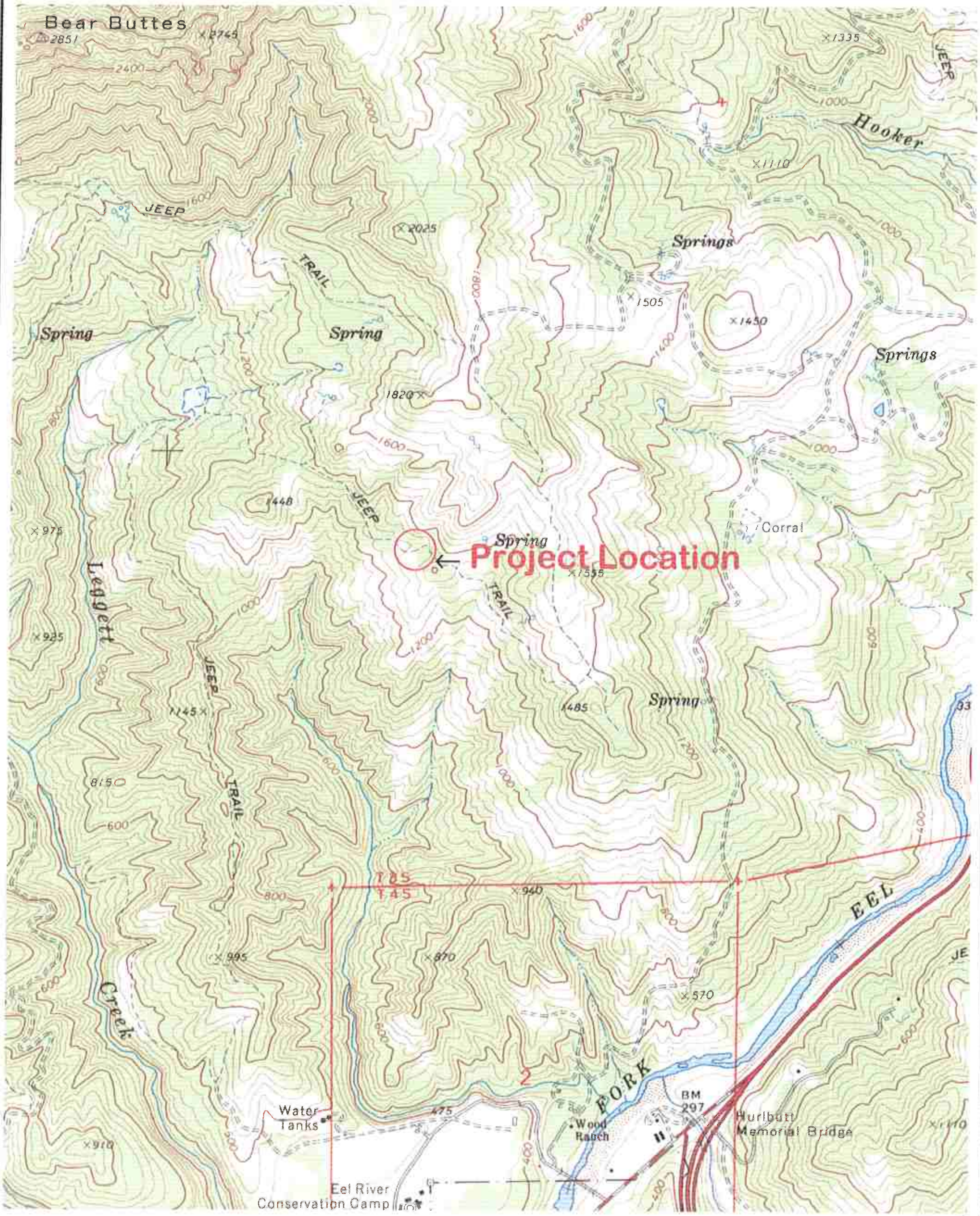
Satake, K., Wang, K., Atwater, B., 2003, Fault slip and seismic moment of the 1700 Cascadia earthquake inferred from Japanese tsunami descriptions. Journal of Geophysical Research, Vol. 108, No. B11, 2535.

USGS, 1970, Miranda, Calif. 7.5' Quadrangle Map, Humboldt County, California.

SEA (Structural Engineers Society of California) and OSHPD (Office of Statewide Health Planning and Development), 2018, Seismic Design Maps. https://seismicmaps.org/

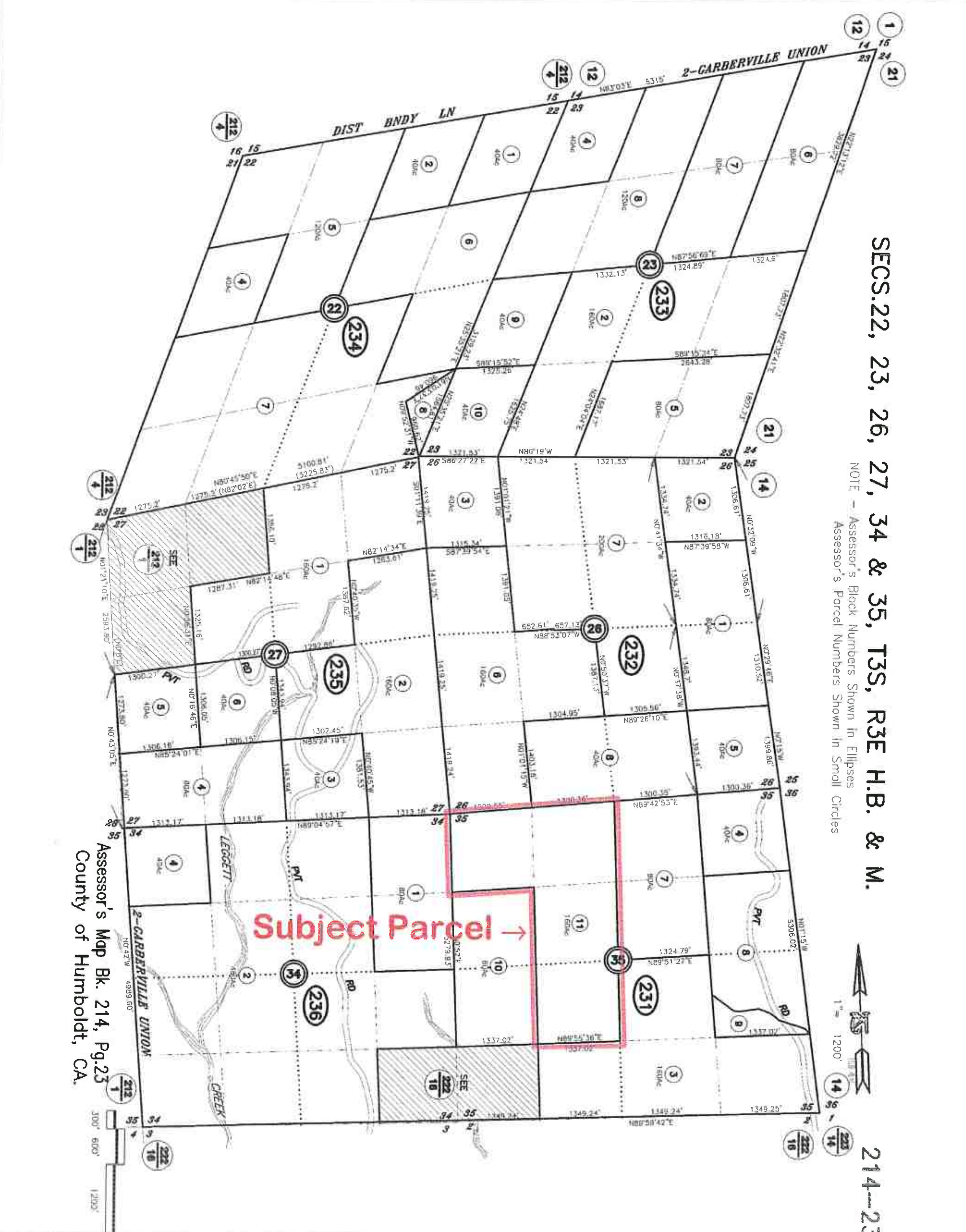
10.0 LIST OF FIGURES AND ATTACHMENTS

Lindberg Geologic Consulting	Engineering-Geologic R-2 Soils Report	Figure 1
Post Office Box 306	422 Wood Ranch Road, Redway, California	May 9, 2019
Cutten, CA 95534	APN 214-231-011, Mr. Jade Hass, Client	Project 0301.00
(707) 442-6000	Topographic Location Map (locations approximate)	1" ≅ 1800'



Modified from: USGS "Miranda, Calif.", 7.5' Quadrangle, (1970). N ≅

Lindberg Geologic Consulting	Engineering-Geologic R-2 Soils Report	Figure 2
Post Office Box 306	422 Wood Ranch Road, Redway, California	May 9, 2019
Cutten, CA 95534	APN 214-231-011, Mr. Jade Hass, Client	Project 0301.00
(707) 442-6000	Assessor's Parcel Map (locations approximate)	Scale as Shown

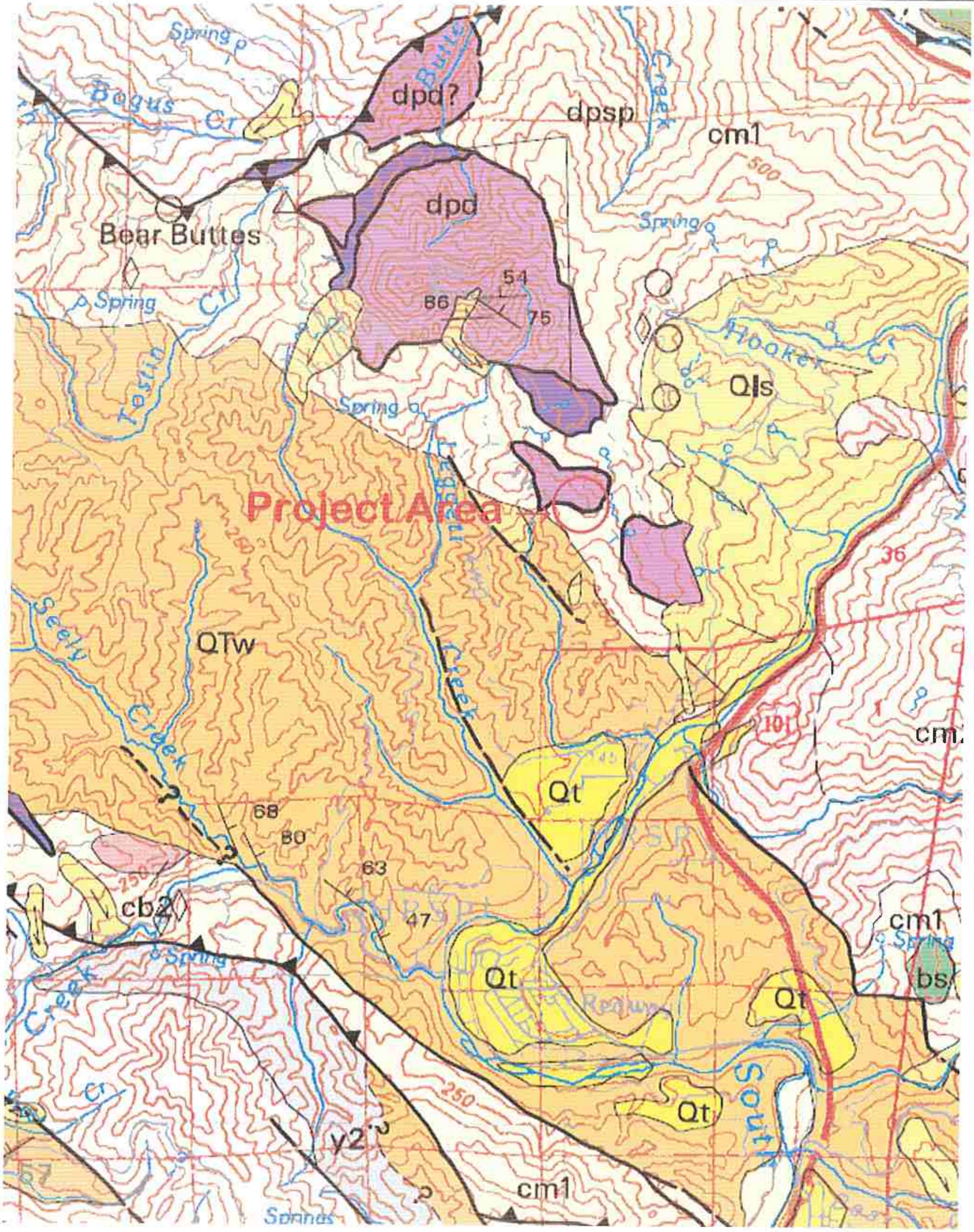


Lindberg Geologic Consulting	Engineering-Geologic R-2 Soils Report	Figure 3
Post Office Box 306	422 Wood Ranch Road, Redway, California	May 9, 2019
Cutten, CA 95534	APN 214-231-011, Mr. Jade Hass, Client	Project 0301.00
(707) 442-6000	Satellite Image of Project Site with Historic Landslides	Scale as Shown

= Approximate Extents of Graded Areas

Modified from: Humboldt County Planning and Building Department, Web GIS imagery dated November 2018.

Lindberg Geologic Consulting	Engineering-Geologic R-2 Soils Report	Figure 4
Post Office Box 306	422 Wood Ranch Road, Redway, California	May 9, 2019
Cutten, CA 95534	APN 214-231-011, Mr. Jade Hass, Client	Project 0301.00
(707) 442-6000	Geologic Map of Project Area (locations approximate)	1" ≅ 4300'



Modified from: McLaughlin and Others, 2000. N ≅

DESCRIPTION OF MAP UNITS

QUATERNARY AND TERTIARY OVERLAP DEPOSITS

- **Qal** Alluvial deposits (Holocene and late Pleistocene?)
- **Qm** Undeformed marine shoreline and aolian deposits (Holocene and late Pleistocene)
- **Qt** Undifferentiated nonmarine terrace deposits (Holocene and Pleistocene)
- **Qls** Landslide deposits (Holocene and Pleistocene)
- **QTog** Older alluvium (Pleistocene and (or) Pliocene)
- **QTw** Marine and nonmarine overlap deposits (late Pleistocene to middle Miocene)
- **fh** Volcanic rocks of Fickle Hill (Oligocene)

COAST RANGES PROVINCE

FRANCISCAN COMPLEX

— Coastal Belt —

Coastal terrane (Pliocene to Late Cretaceous)

Sedimentary, igneous, and metamorphic rocks of the Coastal terrane (Pliocene to Late Cretaceous):

- **co1** Melange
- **co2** Melange
- **co3** Broken sandstone and argillite
- **co4** Intact sandstone and argillite
- **cob** Basaltic Rocks (Late Cretaceous)
- **cols** Limestone (Late Cretaceous)
- **m** Undivided blueschist (Jurassic?)

King Range terrane (Miocene to Late Cretaceous)

- **Krp** Igneous and sedimentary rocks of Point Delgada (Late Cretaceous)
- **m** Undivided blueschist blocks (Jurassic?)

Sandstone and argillite of King Peak (middle Miocene to Paleocene(?)):

- **krk1** Melange and (or) folded argillite
- **krk2** Highly folded broken formation
- **krk3** Highly folded, largely unbroken rocks
- **krl** Limestone
- **krc** Chert
- **krb** Basalt

False Cape terrane (Miocene? to Oligocene?)

- **fc** Sedimentary rocks of the False Cape terrane (Miocene? to Oligocene?)

Yager terrane (Eocene to Paleocene?)

Sedimentary rocks of the Yager terrane (Eocene to Paleocene?):

- **y1** Sheared and highly folded mudstone
- **y2** Highly folded broken mudstone, sandstone, and conglomeratic sandstone
- **y3** Highly folded, little-broken sandstone, conglomerate, and mudstone
- **Ycgl** Conglomerate

— Central belt —

Melange of the Central belt (early Tertiary to Late Cretaceous):

Unnamed Metasandstone and meta-argillite (Late Cretaceous to Late Jurassic):

- **cm1** Melange
- **cm2** Melange
- **cb1** Broken formation
- **cb2** Broken formation
- **cwr** White Rock metasandstone of Jayko and others (1989) (Paleogene and (or) Late Cretaceous)
- **chr** Haman Ridge graywacke of Jayko and others (1989) (Cretaceous?)
- **cfs** Fort Seward metasandstone (age unknown)
- **cls** Limestone (Late to Early Cretaceous)
- **cc** Chert (Late Cretaceous to Early Jurassic)
- **bs** Basaltic rocks (Cretaceous and Jurassic)
- **m** Undivided blueschist blocks (Jurassic?)
- **gs** Greenstone
- **c** Metachert
- **yb** Metasandstone of Yolla Bolly terrane, undivided
- **b** Melange block, lithology unknown

— Eastern Belt —

Pickett Peak terrane (Early Cretaceous or older)

Metasedimentary and metavolcanic rocks of the Pickett Peak terrane (Early Cretaceous or older):

- **ppsm** South Fork Mountain Schist
- **mb** Chinquapin Metabasalt Member (Irwin and others, 1974)
- **ppv** Valentine Springs Formation
- **mv** Metabasalt and minor metachert

Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?)

Metasedimentary and metaigneous rocks of the Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?):

- **ybt** Taliaferro Metamorphic Complex of Suppe and Armstrong (1972) (Early Cretaceous to Middle Jurassic?)
- **ybc** Chicago Rock melange of Blake and Jayko (1983) (Early Cretaceous to Middle Jurassic)
- **gs** Greenstone
- **c** Metachert
- **ybh** Metagraywacke of Hammerhorn Ridge (Late Jurassic to Middle Jurassic)
- **c** Metachert
- **gs** Greenstone
- **sp** Serpentinite
- **ybd** Devils Hole Ridge broken formation of Blake and Jayko (1983) (Early Cretaceous to Middle Jurassic)
- **c** Radiolarian chert
- **ybi** Little Indian Valley argillite of McLaughlin and Ohlin (1984) (Early Cretaceous to Late Jurassic)

Yolla Bolly terrane

- **yb** Rocks of the Yolla Bolly terrane, undivided

GREAT VALLEY SEQUENCE AND COAST RANGE OPHIOLITE

Elder Creek(?) terrane

- **ecms** Mudstone (Early Cretaceous)

Coast Range ophiolite (Middle and Late Jurassic):

- **ecg** Layered gabbro
- **ecsp** Serpentinite melange

Del Puerto(?) terrane

Rocks of the Del Puerto(?) terrane:

- **dpms** Mudstone (Late Jurassic)

Coast Range ophiolite (Middle and Late Jurassic):

- **dpt** Tuffaceous chert (Late Jurassic)
- **dpb** Basaltic flows and keratophyric tuff (Jurassic?)
- **dpd** Diabase (Jurassic?)
- **dpsp** Serpentinite melange (Jurassic?)
- **sp** Undivided Serpentinized peridotite (Jurassic?)

KLAMATH MOUNTAINS PROVINCE

Undivided Great Valley Sequence:

- **Ks** Sedimentary rocks (Lower Cretaceous)

GREAT VALLEY SEQUENCE OVERLAP ASSEMBLAGE

Hayfork terrane

Eastern Hayfork subterrane:

- **eh** Melange and broken formation (early? Middle Jurassic)
- **ehls** Limestone
- **ehsp** Serpentinite

Western Hayfork subterrane:

- **whu** Hayfork Bally Meta-andesite of Irwin (1985), undivided (Middle Jurassic)
- **whwg** Wildwood (Chanchelulla Peak of Wright and Fahan, 1988) pluton (Middle Jurassic)
- **whwp** Clinopyroxenite
- **whjl** Diorite and gabbro plutons (Middle? Jurassic)

Rattlesnake Creek terrane

- **rcm** Melange (Jurassic and older)
- **rcls** Limestone
- **rcc** Radiolarian chert
- **rcls** Volcanic Rocks (Jurassic or Triassic)
- **rcic** Intrusive complex (Early Jurassic or Late Triassic)
- **rcp** Plutonic rocks (Early Jurassic or Late Triassic)
- **rcum** Ultramafic rocks (age uncertain)
- **rcpd** Blocky peridotite

Western Klamath terrane

Smith River subterrane:

- **srs** Galice? formation (Late Jurassic)
- **srv** Pyroclastic andesite
- **srgb** Glen Creek gabbro-ultramafic complex of Irwin and others (1974)
- **srpd** Serpentinized peridotite

MAP SYMBOLS

- Contact
- Fault
- Thrust fault
- Trace of the San Andreas fault associated with 1906 earthquake rupture

Strike and dip of bedding:

- 10, 20 Inclined
- Vertical
- Horizontal
- 10, 20 Overturned
- 20 Approximate
- 10 Joint
- 10 Strike and dip of cleavage

Shear foliation:

- 10 Inclined
- Vertical

Folds:

- Synclinal or synformal axis
- Anticlinal or antiformal axis
- Overturned syncline
- Qls Landslide

Melange Blocks:

- Serpentinite
- Chert
- Blueschist
- Greenstone
- Fossil locality and number

GEOLOGY OF THE CAPE MENDOCINO, EUREKA, GARBERVILLE, AND SOUTHWESTERN PART OF THE HAYFORK 30 X 60 MINUTE QUADRANGLES AND ADJACENT OFFSHORE AREA, NORTHERN CALIFORNIA (McLaughlin et al., 2000)